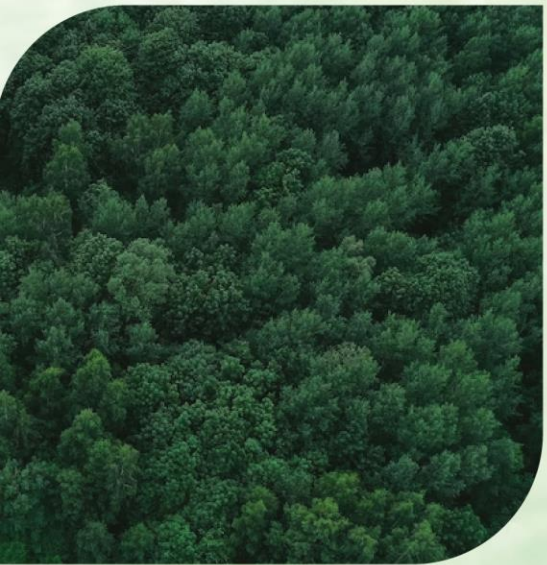
# EIGHTH NATIONAL COMMUNICATION AND FIFTH BIENNIAL REPORT OF TÜRKİYE UNDER THE UNFCCC



ANKARA
2023

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# ABBREVIATIONS

| | |
|---|---|
| *AECC* | *Air Emissions Coordination Council* |
| *AFAD* | *Disaster and Emergency Management Authority* |
| *ASDEP* | *Family Social Support Programme* |
| *BIST* | *Borsa Istanbul Inc.* |
| *CBRT* | *Central Bank of the Republic of Türkiye* |
| *CCACB* | *Climate Change and Adaptation Coordination Board* |
| *CCAMCB* | *Climate Change and Air Management Coordination Board* |
| *CCCB* | *Climate Change Coordination Board* |
| $CH_4$ | *Methane* |
| *CLRTAP* | *Convention on Long-range Transboundary Air Pollution* |
| *CO* | *Carbon Monoxide* |
| $CO_2$ | *Carbon Dioxide* |
| $CO_2$ *eq.* | *Carbon Dioxide Equivalent* |
| *CoHE* | *Council of Higher Education* |
| *CRF* | *Common Reporting Format* |
| *ÇEM* | *General Directorate of Combating Desertification and Erosion* |
| *DCC* | *Directorate of Climate Change* |
| *DSİ* | *Directorate General of State Hydraulic Works* |
| *EMRA* | *Republic of Türkiye Energy Market Regulatory Authority* |
| *EU* | *European Union* |
| *ETS* | *Emissions Trading System* |
| *F-gases* | *Fluorinated Gases* |
| *FAO* | *Food and Agriculture Organization* |
| *GDP* | *Gross Domestic Product* |
| *GWh* | *Gigawatt Hour* |
| *HadGEM* | *Hadley Centre Global Environment Model* |
| *HCFC* | *Hydrochlorofluorocarbon* |
| *İLBANK* | *İlbank Inc.* |
| *IPA* | *Instrument for Pre-Accession Assistance* |
| *IPCC* | *Intergovernmental Panel on Climate Change* |
| *IPPU* | *Industrial Processes and Product Use* |
| *ISO* | *International Organization for Standardization* |

| | |
|---|---|
| *KOSGEB* | *General Directorate for Development and Support of SMEs* |
| *KOSGEB* | *Small and Medium Enterprises Development Organization of Türkiye* |
| *KÖYDES* | *Village Infrastructure Support Project* |
| *Kt* | *Kilo tons* |
| *kWh* | *Kilowatt Hours* |
| *LULUCF* | *Land Use, Land Use Change and Forestry* |
| *MENR* | *Republic of Türkiye Ministry of Energy and Natural Resources* |
| *Mha* | *Million hectares* |
| *MNE* | *Republic of Türkiye Ministry of National Education* |
| *MoAF* | *Republic of Türkiye Ministry of Agriculture and Forestry* |
| *MoCT* | *Ministry of Culture and Tourism* |
| *MoEUCC* | *Republic of Türkiye Ministry of Environment, Urbanization and Climate Change* |
| *MoFA* | *Ministry of Foreign Affairs* |
| *MoH* | *Republic of Türkiye Ministry of Health* |
| *MoI* | *Republic of Türkiye Ministry of Interior* |
| *MoIT* | *Republic of Türkiye Ministry of Industry and Technology* |
| *MoT* | *Republic of Türkiye Ministry of Trade* |
| *MoTF* | *Republic of Türkiye Ministry of Treasury and Finance* |
| *MoTI* | *Republic of Türkiye Ministry of Transport and Infrastructure* |
| *MRV* | *Monitoring, Reporting and Verification* |
| *Mt* | *Million tons* |
| *MTA* | *Directorate General of Mineral Research and Exploration* |
| *MToe* | *Million tons of oil equivalent* |
| *MÜSİAD* | *Independent Industrialists and Businessmen's Association* |
| *MW* | *Megawatt* |
| *MWe* | *Megawatt electricity* |
| *MWt* | *Megawatt thermal* |
| $N_2O$ | *Nitrous Oxide* |
| *NC* | *National Communication* |
| *NCCS* | *National Climate Change Strategy* |
| *NE* | *Not Estimated* |
| *NIR* | *National Inventory Report* |
| *NGO* | *Non-Governmental Organization* |

| | |
|---|---|
| *NMVOC* | *Non-Methane Volatile Organic Compounds* |
| *NO* | *Not Occurred* |
| *NOx* | *Nitrogen Oxides* |
| *OECD* | *Organisation for Economic Co-operation and Development* |
| *OIZ* | *Organized Industrial Zone* |
| *OSP* | *Official Statistics Programme* |
| *PMR* | *Partnership for Market Readiness* |
| *PMI* | *Partnership for Market Implementation* |
| *PPP* | *Public-Private Partnership* |
| *PPP* | *Purchasing Power Parity* |
| *R&D* | *Research and Development* |
| *SBB* | *Presidency of Strategy and Budget* |
| *SDG* | *Sustainable Development Goals* |
| *SME* | *Small and Medium-Sized Enterprises* |
| *$SO_2$* | *Sulphur Dioxide* |
| *SOE* | *State-Owned Enterprise* |
| *SPI* | *Standardized Precipitation Index* |
| *SSI* | *Social Security Institution* |
| *STI* | *Science, Technology and Innovation* |
| *TBB* | *The Union of Municipalities of Türkiye* |
| *TEİAŞ* | *Directorate General of Turkish Electricity Transmission Corporation* |
| *TEMA* | *The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats* |
| *TOBB* | *Turkish Union of Chambers and Commodity Exchange* |
| *TOE* | *Tonne of Oil Equivalent* |
| *TOKİ* | *Housing Development Administration* |
| *TSE* | *Turkish Standards Institution* |
| *TSMS* | *Turkish State Meteorological Service* |
| *TÜBİTAK* | *The Scientific and Technological Research Council of Türkiye* |
| *TÜÇA* | *Turkish Directorate of Environment Agency* |
| *TUDES* | *Turkish National Sea Level Monitoring Network* |
| *TÜRKAK* | *Turkish Accreditation Agency* |
| *TurkStat* | *Turkish Statistical Institute* |

| | |
|---|---|
| *TURSAB* | *Association of Turkish Travel Agencies* |
| *TÜSİAD* | *Turkish Industry and Business Association* |
| *TWh* | *Terawatt Hours* |
| *UCLG* | *United Cities and Local Governments* |
| *UCLG-MEWA* | *UCLG Middle East and West Asia Section* |
| *UN* | *United Nations* |
| *UNCCD* | *United Nations Convention to Combat Desertification* |
| *UNDP* | *United Nations Development Programme* |
| *UNECE* | *United Nations Economic Commission for Europe* |
| *UNESCO* | *United Nations Educational, Scientific and Cultural Organization* |
| *UNFCCC* | *United Nations Framework Convention on Climate Change* |
| *WIGOS* | *WMO Integrated Global Observing System* |
| *WMO* | *World Meteorological Organization* |
| *WOUDC* | *World Ozone and Ultraviolet Radiation Data Centre* |
| *WRF* | *Weather Research and Forecasting* |
| *YEKA* | *Renewable Energy Resource Areas* |
| *YEKDEM* | *Renewable Energy Sources Support Mechanism* |

# 1 EXECUTIVE SUMMARY

This document contains Türkiye's Eighth National Communication required under the United Nations Framework Convention on Climate Change, as reaffirmed by UNFCCC decision 9/CP.16 and UNFCCC decision 2/CP.17. Türkiye has submitted its First National Communication in 2007. The latest submission was the Seventh National Communication in 2019. The Eighth National Communication provides information for the four-year period from 2019 to 2022, and its findings are up until the end of 2022. The Communication provides detailed information and offers a comprehensive overview of the climate chance policies and measures of Türkiye. The Communication provides a comprehensive overview of the trends and outcomes related to national circumstances, GHG emissions and sinks for the period covered. It also includes assessments of vulnerability, climate change impacts and adaptation, research findings, and systematic observations, as well as reviews of education, training, and public awareness efforts. Moreover, it also includes the Fifth Biennial Report of the Country. Significant developments have occurred since the end of 2022, which are not included in this Communication. This information will be covered in the following Ninth National Communication.

## NATIONAL CIRCUMSTANCES

Türkiye has experienced significant demographic and economic changes in the last few decades. Its population has grown from 55.1 million in 1990 to **83.4 million in 2022** and is projected to reach 104.8 million in 2050. While there has been a decline in the rural population, the urban population has increased, with 93.4% of the population living in urban areas in 2022. The Country's **surface area is 783,562 km2**, and the **population density was 111 persons per km2** in 2022. The Turkish economy has generally experienced growth from 1990 to 2022, with **GDP (current price)** increasing from 149.2 billion $ to **905.5 billion $,** and **annual foreign trade volume** reached **617.9 billion $** in **2022**. The COVID-19 pandemic has significantly impacted Türkiye after its outbreak in early 2020. Türkiye implemented various measures to curb the spread of the virus, including lockdowns, curfews, and travel restrictions. These measures had a significant impact on the economy, with the tourism sector being particularly adversely affected. However, Türkiye became one of the few countries that recorded positive growth in 2020. The economy grew strongly by 11.4 percent in 2021. Türkiye became the fastest growing country among the G20. In 2022, despite of the increasing commodity prices, the economy continued to grow by 5.6 percent.

Türkiye locates between subtropical and temperate zones, as well as its coastal location and mountainous landscape result in varying climatic conditions across different regions of the Country. The long-term annual mean temperature in Türkiye has increased to 13.9°C, and the annual mean precipitation was 573.4 mm between 1991 and 2020.

The **total primary energy supply** was 52.5 Mtoe in 1990 and since then it has increased by 203% reaching to **159.4 Mtoe in 2021.** In 2021, the industrial sector accounted for 33.7%, residential and services for 31.1%, transportation for 24.8%, non-energy consumption for 6.3%, and agriculture for 4.1% of the final energy consumption. In the same year, 15.6% (24.9 Mtoe) of Türkiye's total primary energy supply was met by renewable energy sources. Renewable energy in Türkiye is supplied through various sources. In 2021, geothermal sources accounted for the highest proportion, contributing 45%, followed by hydraulic sources at 19%, biomass sources at 16%, wind at 11%, and solar energy at 8% among renewable energy sources. Approximately 710 bcm of natural gas reserves discovered in the Black Sea recently are expected to gradually reduce foreign dependency on natural gas, with the start of natural gas production in the field as of 2023.

The **total installed power capacity** of Türkiye increased fourfold since 1990 and reached **103.8 GW in 2022**, and it is expected to reach 189.7 GW by 2035. Annual electricity production grew from 57.5 TWh to 326 TWh in the same period. **The share** of **hydropower** was **20.5%, other renewables** were **21.2%,** natural gas was 21.9%, solid fuels was 35.0% and the percentage of liquid fuels were only 1.1%.

Türkiye's **manufacturing industry** accounts for 22.1% of Türkiye's GDP. The cement, iron and steel, and glass sectors significantly contribute to GHG emissions in the Country. Türkiye has a **high rate of urbanization** with a rapid annual urban population increase. In comparison to 2002, the annual number of new buildings increased by 107.7%, the annual number of new dwelling units increased by 291.5%, and the annual floor area of new buildings increased by 300.5% by 2022. This increase also boosts the demand for cement, steel, glass, and other materials. The **transportation sector** is responsible for 23.86% (26.97 Mtoe) of the Country's final energy consumption. While there were 3.8 million road motor vehicles in 1990, this number reached approximately 26.5 million in 2022. This was reflected in the rise of **road motor vehicles per 1000** people from 68 in 1990 to **310 in 2022**. Road transport was the largest energy consumer consisting of 94.44% of the energy consumption within the transport sector. **Waste generation** has been increasing in Türkiye, but there have been improvements in waste management since 1990, with a shift from open dumps to landfill sites.

## INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINKS

According to the latest greenhouse gas inventory of Türkiye, **total GHG emissions in 2020 was 523.9 Mt $CO_2$ eq.** (excluding the LULUCF), representing a 138.4% increase with respect to the levels realized in 1990. The energy sector accounted for the largest share of emissions with 70.2%, and $CO_2$ emissions represented 78.9% of total $CO_2$ eq. emissions. Türkiye's per capita GHG emission was 3.9 ton of $CO_2$ eq. in 1990 and increased to 6.3 ton of $CO_2$ eq. in 2020. While the total and per-capita emissions were increasing, Türkiye has been able to reduce its **greenhouse gas emissions intensity of GDP** by 50% between 1990 and 2020, from 1.47 ton

$CO_2$ eq. per 1,000 $ (current prices) to **0.73 ton of $CO_2$ eq. per 1,000 $** (current prices), and still achieving economic growth. This represents a significant improvement in efficiency.

The **energy sector**'s 2020 emissions were 367.6 Mt $CO_2$ eq. Energy industries were the main contributor, accounting for 38.9% of emissions from the energy sector. It is followed by the transport sector with 20.5%, other sectors (fuel consumption at buildings and other emissions) with 21.9%, and manufacturing industries with 16.4%. The **IPPU sector**'s 2020 emission was 66.8 Mt $CO_2$ eq. The most important GHG emissions sources of IPPU in 2020 were cement production, with 8.7%, and iron and steel production 2.2% shares of the total national GHG emissions excluding LULUCF. F-gases with 6 Mt $CO_2$ eq. comprised 9% of the total IPPU emissions. The **agriculture sector**'s 2020 emission was 73.2 Mt $CO_2$ eq., consisting of enteric fermentation at 47.3%, agricultural soils at 37.4%, and manure management at 12.4%. The sector was responsible for 61% of the total $CH_4$ emissions and 80% of the total N2O emissions in 2020. The **waste sector**'s 2020 emission was 16.4 Mt $CO_2$ eq.

## POLICIES AND MEASURES

Türkiye became a party to the United Nations Framework Convention on Climate Change (UNFCCC) on 24 May 2004, ratified the Kyoto Protocol on 26 August 2009, and ratified the Paris Agreement on 7 October 2021. The Country's **first NDC** pledges to a **21% GHG emissions reduction compared to the business-as-usual level by 2030**. Türkiye revised and **increased its reduction target to 41% with its updated first NDC**. Moreover, Türkiye aims for **net-zero emissions by 2053**, and the updated NDC aims for **peak emissions by 2038**.[1]

The Eighth National Communication provides information up until the end of 2022. Significant developments have occurred since the end of 2022, which will be included in the next communication period. Türkiye has developed several cross-cutting and sectoral policies and measures to mitigate GHG emissions and to achieve these targets. The **11th Development Plan** is a multi-sectoral national policy that sets the country's vision for stronger, sustainable socioeconomic development, including key performance targets for climate change mitigation. The 12th Development Plan of Türkiye, being prepared for the 2024-2028 period, and its long-term strategy towards 2053 will accommodate the increasing climate ambition of Türkiye. Key policy documents dedicated solely to Türkiye's climate change policies include the **National Climate Change Strategy (NCCS) (2010-2023)** and the **National Climate Change Action Plan (2011-2023)**, which is based on the NCCS. The **Green Deal Action Plan of Türkiye** contains the actions for the green transformation of Türkiye's industries and adopting measures for harmonizing with the EU's Green Deal, especially in areas related to trade and industry. The **Türkiye National Energy Plan** and the **National Energy Efficiency Action Plan (NEEAP)** are

[1] Comprehensive information on the updated first NDC will be conveyed at the Ninth National Communication of Türkiye under the UNFCCC.

two key documents in terms of energy policies that impact the country's emissions in various sectors. In addition, there are several other national strategies and action plans which influence the national emissions.

Türkiye's energy policy prioritizes the use of renewable energy sources while reducing import dependency to improve supply security. Policies such as the **Renewable Energy Sources Support Mechanism (YEKDEM)** and **Renewable Energy Resource Areas (YEKA)** have significantly accelerated investments in renewable energy, especially for wind and solar power. **Nuclear power** is considered another means to improve supply security and reduce GHG emissions. Various policies and legislation also address **energy efficiency** in buildings and industry. Increasing the **energy performance of new buildings** is one of the key policies of Türkiye. The **eco-design** approach is a crucial cross-cutting policy of Türkiye for energy efficiency. Türkiye has been investing in sustainable transport projects, such as **extending the railway network** and decreasing the share of road transport in freight transport. Türkiye has been promoting **electric and hybrid vehicles** and blending **biodiesel and ethanol** into fuels. **Controlling nitrate usage**, optimizing fertilizer amount, and promoting the sustainable use of agricultural waste are some of the relevant agriculture sector policies. There has also been increasing interest in investing in power generation from sanitary landfills through capturing **landfill gas** over the last decade, which decreases the waste sector emissions while leading to higher levels of renewable power generation. Türkiye also has active policies for **expanding**, improving, and protecting its **forest areas**.

## PROJECTIONS AND TOTAL EFFECT OF POLICIES AND MEASURES

Türkiye developed its GHG emissions projections during its NDC preparation and revision. First, Türkiye submitted its INDC to the UNFCCC Secretariat in 2015. At that time, baseline and mitigation scenarios were established and shared. Türkiye later delivered the same target as the NDC to UNFCCC Secretariat without changing its target and assumptions in 2022. Finally, Türkiye announced during the COP27 that it would increase the targets of its first NDC. According to estimations of the first NDC, Türkiye forecasts that its GHG emissions will increase to **1,175 Mt $CO_2$ eq.** (including LULUCF) without measures (WoM) as its baseline. With the mitigation scenario, which includes measures (WM), Türkiye targeted a reduction of 21% of its GHG emissions compared to the WoM scenario by 2030. Thus, Türkiye targeted **929 Mt $CO_2$ eq.** (including LULUCF) by 2030. The revised NDC will increase targeted emissions to almost **695 Mt $CO_2$ eq.** (including LULUCF) by 2030. Currently, Türkiye is working on revised mitigation scenarios for the updated first NDC, which were not included in the scope of the 8th NC. These studies will be further elaborated on at 9th NC.

## VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION

Türkiye has experienced significant changes in its climate in recent decades. The **Turkish State Meteorological Service** (TSMS) has reported that temperatures have been consistently rising since the base year 1990, with 2010 seeing the highest temperature anomalies on record, at 1.6 °C above the average. In 2022, Türkiye's mean temperature was 14.5 °C; this is 0.6 °C above the 1991-2020 mean value of 13.9 °C. There have been positive temperature anomalies in Türkiye's mean temperatures since 2007, except in 2011. The hottest year was 2010, with 15.5 °C. The year 2022 was the seventh warmest year, with 14.5 °C. Türkiye's mean areal precipitation was recorded as 503.8 mm in 2022. The amount is approximately 12.1%, below 1991-2020's normal of 573.4 mm.

A large part of Türkiye is located in the subtropical Mediterranean climate zone with dry summers. Türkiye is a country with a medium to high risk of climate change and future climate risks. In this context, there is a need for studies on the issues of climate monitoring, climate change vulnerability and risk assessments as well as adaptation measures to reduce the adverse impacts of climate change. Türkiye analyzed the temperature changes in the Country from 1971-2000 reference period to 2021-2100 projection period using the MPI-MR-ESM model under the RCP4.5 and RCP8.5 scenarios. The reference period had an average temperature of 14-19°C in the coastal areas of the Aegean and Mediterranean Regions and Southeastern Anatolia, and 12°C in the Marmara Region, with decreasing temperatures towards the higher elevations of the East Anatolia Region. Both scenarios predict higher temperatures than the reference period, with the RCP8.5 scenario projecting an increase of 2.5°C until the 2060s and over 5°C by the end of the century. Precipitation levels during the reference period were lowest in Central Anatolia and southern Southeastern Anatolia and highest in the Eastern Black Sea Region. The RCP4.5 scenario projects an average increase of 50 mm in the Marmara and Black Sea Regions and a decrease of 200 mm in the Mediterranean Region during the 2061-2080 period, while the RCP8.5 scenario predicts fluctuations of precipitation between -100 to +100 mm until the 2060s, with the Black Sea Region projected to have an increase of 150 mm and the Mediterranean Region projected to have a decrease of 300 mm by the end of the century.

Changes in temperature and precipitation have had significant impacts on Türkiye, including an increase in the frequency and severity of extreme weather events such as floods and droughts. Türkiye has recognized the importance of climate adaptation and demonstrated a strong commitment to it by publishing its **Climate Change Adaptation Strategy and Action Plan (2011-2023)** in 2012. The 11th Development Plan (2019-2023) also includes specific targets on climate adaptation.

During recent years, number there has been a significant increase in the number of **extreme meteorological events**, and the year **2022** saw the highest number of disasters, with a total of

**1030 disasters**. As a response, Türkiye is updating its Climate Change Adaptation and Strategic Action Plan, which is expected to be completed by 2023 and will have further reinforced adaptation actions for ensuring the resilience of its society and economy.

### FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT

Türkiye, with an ambitious climate agenda, continues to finance many climate projects including large-scale investments from its public budget to combat climate change. Türkiye, as a developing country located in the Mediterranean Basin, which is one of the most vulnerable regions in the world to the adverse impacts of climate change, faces significant investment needs for mitigation and adaptation actions. In order to meet the increasing financial needs for Türkiye's sustainable development projects, primarily at renewable energy, energy efficiency and low carbon transport sectors receive external financing from multilateral development banks, bilateral agencies, and international climate funds.

Moreover, the Turkish private sector is undertaking concrete measures to decrease GHG emissions. In recent years, many companies operating in Türkiye disclosed their climate change targets and implementation roadmaps to accelerate progress towards Türkiye's 2053 Net Zero Target. However, Türkiye needs significant international financial support for its climate-friendly technical assistance and investment projects to implement its mitigation and adaptation actions beyond its domestic public and private sources of finance.

### RESEARCH AND SYSTEMATIC OBSERVATION

There are several research institutions in Türkiye which are actively working on climate research. TUBITAK and universities are the key institutions while the MoEUCC, MENR, and MoAF have their own strategy and research centers to develop technologies, which will enable Türkiye reach its climate targets. These ministries also provide RDI supports in their relevant technology areas.

Türkiye prioritized five topics focused on five main themes namely **"Climate Change, Environment and Biodiversity", "Clean and Circular Economy", "Clean, Accessible and Secure Energy Supply", "Green and Sustainable Agriculture", "Sustainable Smart Transportation"** for the green transition of the Türkiye in the light of Green Deal Action Plan. Projects focusing on these topics are being prioritized in the TUBITAK's R&D and Innovation Supports and co-creation models for both knowledge creation and development of human resources are being mobilized by TUBITAK.

Within the scope of the Action Plan, **"Green Growth Technology Roadmap"** studies are being carried out by the MoIT and TUBITAK. The Technology Roadmap study is being conducted for the Iron-Steel, Aluminum, Cement, Chemicals, Plastics and Fertilizer sectors; which are critically important for the Turkish economy and have high carbon emissions. Because of the Technology Roadmap studies, priority R&D and innovation themes for each sector will be detailed.

The **TSMS** is the sole authority for conducting **atmospheric measurements** in Türkiye. The organization of the TSMS is widespread and covers the entire country, with 16 regional directorates, and the observation network is connected to these regional directorates. As of 2022, the number of systems in the observation network has reached 1,715. TSMS operates a wide range of **weather observation** and **monitoring systems** including *Automatic Weather Observation Station (AWOS), "Airport Automatic Weather Observation Station (A-AWOS), Handheld Automatic Weather Stations (HAWS), Meteorological Satellite Ground Receiver Systems, Meteorological Radar Systems.* The TSMS uses global models for forecasting and ensuring a high level of accuracy and consistency in **weather forecasts** and **early warnings**. In addition to preparing and communicating meteorological warnings, the TSMS also prepares and presents short and medium-term weather forecasts to the public. The TSMS has demonstrated a high-level of consistency in precipitation and temperature forecasting, with an average of 85.4% for long-term precipitation forecasting and 91.5% in 2020 and 92.4% in 2021.

The **General Directorate of State Hydraulic Works (DSI)** is responsible for carrying out **hydrometeorological observation** activities in Türkiye. Within the scope of observation activities, DSI carries out instantaneous hydrometric, hydrometeorological, sediment, snow and water quality observations in 25 basins across the country, as well as monitoring environmental water flow released from Hydroelectric Power Plants (HEPPs). There were 8,759 active stations and 1,603 online stations in a hydrometeorological observation network as of 2022. There are also 3,618 monitoring points within the scope of the water quality monitoring program between 2019-2021. These monitoring points are spread across 25 river basins in Türkiye to collect data on various water quality parameters.

The duty of the preparation of the water quality monitoring programmes belongs to the MoAF **General Directorate of Water Management (GDWM).** The GDWM is responsible for determining policies related to the protection, improvement and usage of the water resources. In this scope, the mission of keeping up to date the digital water resources data and preparing water quality monitoring programmes for 25 river basins are being executed by GDWM. Digital water resources data and accordingly surface water types, surface water bodies and eventually water quality monitoring programmes have been lastly revised in 2021. In the recent surface water monitoring programmes, there is a total of 3905 surveillance, 4929 operational and 1793 protected area monitoring points for 25 river basins. Moreover, reference (pristine) water bodies for biological quality elements and reference monitoring points were determined by DGWM and reference monitoring studies are carried out in these bodies.

The TSMS has developed several key tools and systems to support its research and services in the field of climate and climate change. The **"Meteorological Communication and Applications Package (METCAPPLUS)"** and ***"Flash Flood Guidance System (FFGS) Model"*** *were developed by the TSMS and used by other countries.* Türkiye was recognized as the

***"Regional Training Center (RTC)"*** of the World Meteorological Organization (WMO) and the TSMS operated three RTC in Ankara, Istanbul, and Alanya in 2022, and has trained over 1900 international participants from more than 150 countries through various training events.

Moreover, the **Turkish State Meteorological Service (TSMS)**, the **General Command of Mapping** and the **Middle East Technical University, Institute of Marine Sciences** (METU-IMS) play significant roles in **ocean climate observing systems**. The **General Directorate of Geographic Information System** established a national spatial information infrastructure called the **ATLAS Application**. The aim of this application is to facilitate geographic data sharing through a technical infrastructure that enables querying metadata via the national spatial data portal. The **General Directorate of Combating Desertification and Erosion (ÇEM)** in Türkiye has been actively involved in international cooperation efforts to combat desertification and land degradation.

The **Ministry of Culture and Tourism (MoCT)** is responsible for the management, monitoring and preservation of cultural heritage and World Heritage Sites (WHS) in Türkiye. In 2019, the MoCT established a Project Coordination Office (PCO) under the Directorate-General Cultural Assets and Museums (KVMGM) to investigate cutting-edge approaches and best-practices on impact assessment, climate change mitigation and adaptation for museums and cultural heritage sites.

## EDUCATION, TRAINING AND PUBLIC AWARENESS

The **Ministry of National Education (MNE)** is responsible for administering education in Türkiye. As part of efforts to improve education, MNE provides in-service trainings for teachers and administrators. Between 2017 and 2022, MNE organized seminars and courses on various topics related to climate change, energy efficiency, and zero waste, and trained a total of 339,639 teachers and administrators. To further promote environmental education, MNE updated the curriculum of the Environmental Education elective course, which has been renamed Environmental Education and Climate Change. Starting in the 2022-2023 academic year, this course is being taught in secondary schools (6th, 7th, and 8th grades) twice a week, for a total of 72 hours. The updated curriculum consists of six units: human and nature, circular nature, environmental problems, global climate change, climate change and Türkiye, and sustainable development and environmentally friendly technologies.

Overall, MNE's efforts to improve environmental education in Türkiye have been extensive and impactful, with significant investments in training for teachers and administrators, as well as curriculum updates that reflect the importance of climate change and sustainability.

Through a collaborative interdisciplinary effort, The MNE has developed a strategic Climate Change Action Plan tailored specifically to educational institutions. This plan encompasses

awareness-raising, adaptation, and knowledge-empowering activities, and is currently being implemented across all types and levels of educational institutions.

**Turkish State Meteorological Service (TSMS)** provides information on scientific findings of climate and climate change and projections. TSMS also has a vital role of providing an early warning system to the public informing about expected climatic events through the website and smart phone application.

The **Zero Waste Project** of Türkiye was launched in 2017 by the MoEUCC, aiming to increase public awareness about the importance of reducing waste and promoting recycling, and encouraging municipalities, businesses, and individuals to adopt zero waste practices. The project focused on four main areas: waste reduction, waste separation, composting, and recycling. Global waste generation is expected to increase by 70% by 2050, with the highest rates of waste growth occurring in developing countries. The "Zero Waste" Project, was carried to the global scale through the United Nations General Assembly Resolution entitled **"Promoting Zero Waste Approaches to Advance 2030 Agenda for Sustainable Development"**. As a result of this Resolution, which was presented by Türkiye and adopted later in the UN 77th General Assembly with the valuable support of 105 co-sponsor countries, Türkiye will contribute to the global efforts to combat climate change to achieve the Sustainable Development Goals promoting circularity, and to the implementation of the Paris Agreement.

The **"Young Climate Envoys Movement Project"** was initiated by the MoEUCC to increase youth participation in the fight against climate change in line with Türkiye's net-zero emissions and green development goals. The project involves young climate envoys from universities across Türkiye who work to increase social awareness of climate change and encourage green and climate-friendly studies. The project aims to provide training to strengthen institutional capacities, expand climate communities in universities, and increase climate change awareness.

Private institutions have a complementary role to the state institution's efforts by reaching many other stakeholder groups in many areas and sectors. Also, climate change has been pulling the attention of the media over the recent years which resulted with several TV documentaries, regular TV programmes and several writers in newspapers and magazines.

# 2 NATIONAL CIRCUMSTANCES

This chapter elaborates Türkiye's national circumstances relevant to greenhouse gas emissions and removals.

## 2.1 GOVERNMENT STRUCTURE

Türkiye is a presidential representative democracy and a constitutional republic. The legislative branch is the Grand National Assembly of Türkiye (GNAT), which is responsible for enacting laws and overseeing the government's actions. GNAT is consisting of 600 elected members who serve five-year terms. The public elects the President for a maximum of two five-year terms. The President wields executive power, overseeing the appointment of vice presidents and ministers, as well as leading the central administration. There are 17 ministries[2] and several other administrative units. The judicial branch, composed of independent courts and judges, responsible for enforcing the laws.

Türkiye's local administration structure is organized into 81 provinces. There are two main administrative structures at the provincial level; governorates and municipalities. Governorates serve as the central government and its structures' representation. Governorates are headed by a governor, who the central government appoints, and is responsible for coordinating policy and regulation implementation. The governor is supported by district governors responsible for ensuring that policies and regulations are implemented effectively at the district level. Municipalities have a range of responsibilities, including infrastructure development, public transportation, waste management, water supply and sewerage, and land use planning. Municipalities are headed by a mayor, who is elected by the public for a five-year term. 30 of 81 provinces of Türkiye are metropolitan areas, each managed by a metropolitan municipality mayor. District municipality mayors manage the district municipalities and collaborate with the metropolitan municipality to ensure adequate public service conditions within the metropolitan area.

In order to promote an effective climate action in the Country, the Ministry of Environment and Urbanization (MoEU) was amended and converted to the Ministry of Environment, Urbanization

[2] Ministry of Justice, Ministry of Foreign Affairs, Ministry of the Interior, Ministry of National Defense, Ministry of Treasury and Finance (Former Ministry of Finance), Ministry of Energy and Natural Resources, Ministry of Industry and Technology (former Ministry of Science, Industry and Technology), Ministry of Trade (former Ministry of Customs and Trade and former Ministry of Economy), Ministry of Environment, Urbanization and Climate Change (former Ministry of Environment and Urbanization), Ministry of National Education, Ministry of Health, Ministry of Transport and Infrastructure (former Ministry of Transport, Maritime Affairs and Communication), Ministry of Culture and Tourism, Ministry of Labor and Social Security (former Ministry of Family, Labor and Social Services, Ministry of Family and Social Services, Ministry of Agriculture and Forestry (former Ministry of Food, Agriculture and Livestock and Ministry of Forestry and Water Affairs), Ministry of Youth and Sports.

and Climate Change (MoEUCC).[3] The MoEUCC is structured to prepare legislation on settlement, environment and construction, to carry out urban transformation works, to supervise implementation, to ensure the development of professional services, to prevent environmental pollution and to protect our environment and nature, and to combat the effects of climate change. The Directorate of Climate Change (DCC) was also established as an affiliated institution of the MoEUCC with the specified Presidential Decree. Türkiye's governmental structure on formulation, implementation and evaluation of climate change policies is elaborated at the Section 4.1.2.

## 2.2 POPULATION PROFILE

While the population of Türkiye was 56.47 million in 1990, it reached to 83.61 million in 2020. (See Table 1) Despite the increase in population experienced since 1990, a significant decrease was observed in the population growth rate for the 1990-2020 period. It is anticipated that the population will reach to 88.43 million by the year 2030 and 104.75 million by 2050 with an approximate annual increase rate of 1% during the period between 2020 and 2030 and with a decreasing annual growth rate in 2025-2050.[4]

In to 2020, 88.8% of the population lived in urban areas, and 11.2% of the population inhabited in rural areas. The average age was 32.7, with an average age for men and women 32.1 and 33.4 respectively. The working age population was between 15 and 64, comprised 67.7% of the whole population. 22.8% of the population was 0-14 years and 9.5% was over 65 or older. Population density in 2020 was 109 person/km2.[5]

Increasing population especially in urban areas has a significant effect on the increased demand for housing, energy, and transportation in urban areas of Türkiye. An increase in greenhouse gas emissions is expected alongside the increase in population. Furthermore, since most of the population resides in urban areas, the policies and actions of local authorities are particularly important in influencing emission increase.

*Table 1 - Population of Türkiye[6]*

| Data | 1990 | 2000 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Population (millions) | 56.47 | 67.80 | 73.72 | 78.74 | 83.61 |
| *Female (millions)* | *27.87* | *33.46* | *36.68* | *39.23* | *41.70* |
| *Male (millions)* | *28.61* | *34.35* | *37.04* | *39.51* | *41.92* |

[3] The Presidential Decree No. 85 published in the Official Gazette dated 29 October 2021 and numbered 31643

[4] TurkStat, 2016.

[5] TurkStat, 2021_a.

[6] TurkStat, 2021_a; Ministry of Health, 2022.

| | | | | | |
|---|---|---|---|---|---|
| Annual growth rate of population (‰) | 21.7 | 18.3 | 15.9 | 13.4 | 5.5 |
| Population density (person/km²) | 73 | 88 | 96 | 102 | 109 |
| Urban population (% of total)(1) | 51.3 | 59.2 | 71 | 87.6 | 88.8 |
| Rural Population (% of total)(2) | 48.7 | 40.8 | 29.0 | 12.4 | 11.2 |

*(1) "Urban population" is defined as population of the localities which has population 20.001 and over*

*(2) "Rural population" is defined as population of the localities which has population 20.000 and below.*

## 2.3 GEOGRAPHICAL PROFILE

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

The surface area of Türkiye is 785,264 km2 and approximately 29% is forest land, 34.3% is cropland, 30.6% is grassland, 2.3% is wetlands and 3.7% is settlements and other land. Türkiye has a diversity of freshwater systems including a 1,263 km length of the Euphrates River and 523 km length of the Tigris River. There are many natural lakes and artificial lakes of various sizes. Türkiye is a mountainous country with an average altitude of 1,141 meters.[7]

Türkiye's rich biodiversity is in part due to hosting a wide range of ecosystems including forests, mountains, steppe, wetlands, coastlines and seas, as well as its location at the intersection of the three bio-geographical regions: the European- Siberian (Paleo-boreal European Forest); Mediterranean; and Iran-Turan. This impressive diversity of ecosystems and habitat is home to a significant diversity of species. For example, Türkiye contains approximately 19,000 invertebrate species, of which approximately 4,000 are endemic. Approximately 1,500 vertebrate species have been identified to- date, including more than 100 endemic species. In terms of plant diversity, while there are only 12,500 gymnosperm and angiosperm plant species in the whole of the European continent, Türkiye accommodates approximately 11,000 species. Approximately one-third of these are endemic to Türkiye (IUCN, 2018). Climate change has the potential to pose a significant threat to the biological diversity of Türkiye.

Türkiye has seven geographical regions based on its terrain, climate, and physical features. These seven regions are the Marmara Region, Black Sea Region, Aegean Region, Mediterranean Region, Central Anatolia Region, Eastern Anatolia Region, and Southeastern Anatolia Region. Each region has its own distinct climate, landscape, and flora and fauna. The results of the

[7] 7th NC, 2019.

various climate change impact, extreme hazards and vulnerability and risk assessments are explained in these seven regions.

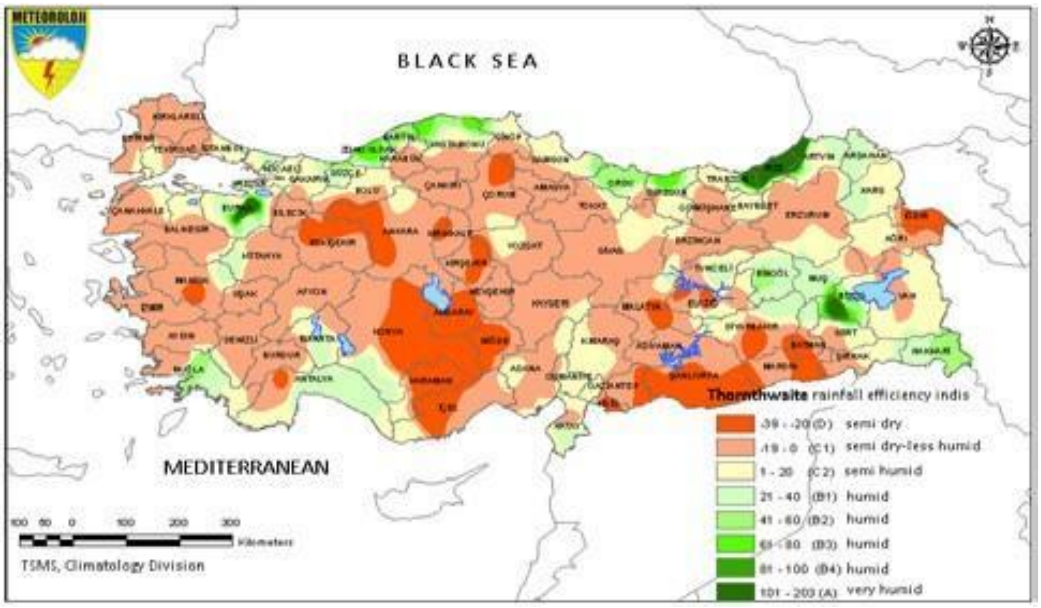
*Figure 1 - Geographical regions of Türkiye*


## 2.4 CLIMATE PROFILE

### 2.4.1 Climate Zones

Türkiye lies between the subtropical and temperate zones and is surrounded by sea on three sides. Its unique landscape, characterized by mountains and diverse terrain, results in significant variations in climatic conditions across different regions. The coastal areas of Türkiye experience milder climates influenced by the sea, while the North Anatolian Mountains and the Taurus Mountains prevent these effects from penetrating the country's interior, leading to continental climate characteristics in those regions. Figure 2 shows the climate zones of Türkiye as per the Thornthwaite climate classification.

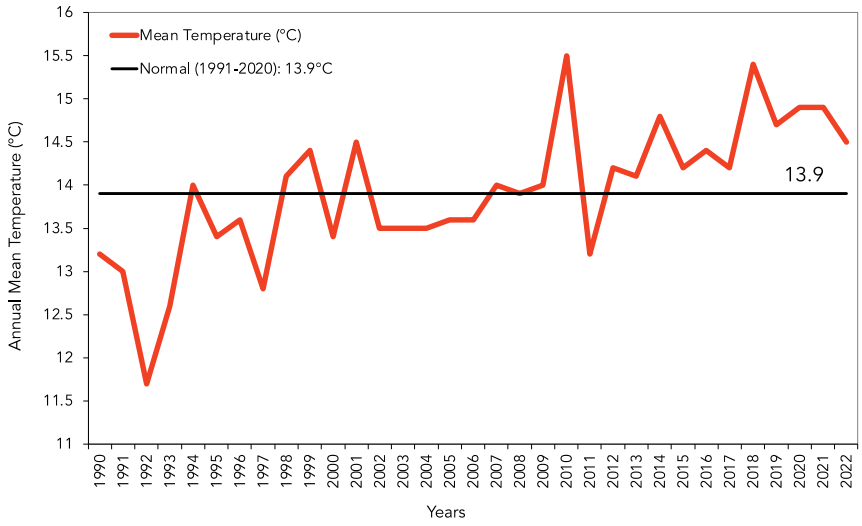
*Figure 2 - Climate zones of Türkiye (TSMS, 2018)*




### 2.4.2 Temperature

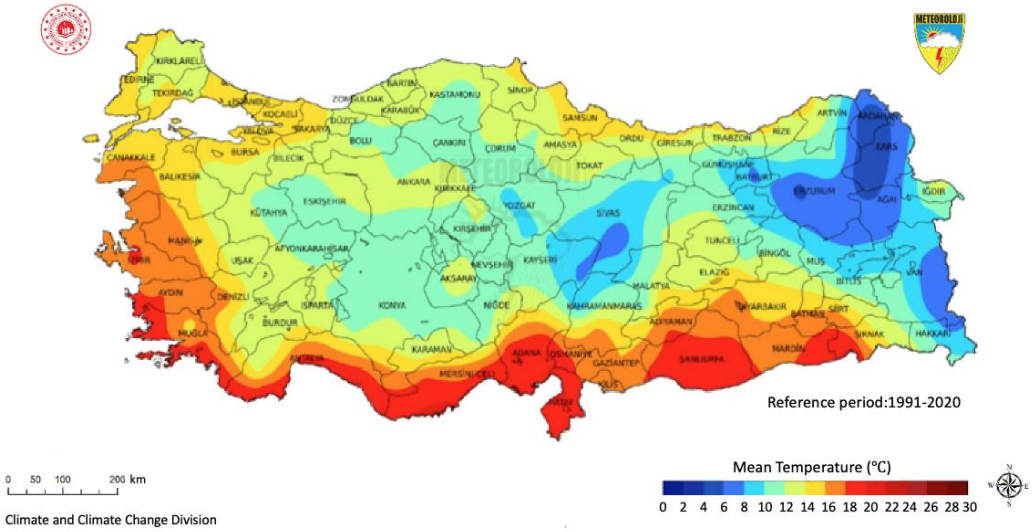
The Turkish State Meteorological Service (TSMS) has reported that the long-term annual mean temperature in Türkiye has increased to 13.9°C during the new normal period of 1991-2020 (TSMS a, 2022). Observed temperature data from TSMS shows the year 2010 had the highest recorded temperature anomalies, with temperatures 1.6°C above average, while 1992 had the lowest, with temperatures 2.0°C below average as shown in Figure 3 (TSMS, 2022). Further elaboration on observed temperature changes can be found in Chapter 6.2.1.

*Figure 3 - Annual Mean Temperature in Türkiye*




During the 1991-2020 period, the highest long-term average temperature in Türkiye were recorded in the Mediterranean, Southeast Anatolia, and Aegean regions as given in Figure 4. Specifically, average temperature values in cities such as Adana, Hatay, and Antalya in the Mediterranean region, Muğla and Aydın in the Aegean region, and Şanlıurfa and Mardin in Southeast Anatolia reach 18-20°C. In the Marmara region, the average temperature values range between 12-14°C, and as you move eastward towards Central Anatolia, the average temperature values decrease to 8-12°C. The Eastern Anatolia region, particularly the Northeastern Anatolia, experiences the lowest temperatures, approaching 0°C.

*Figure 4 - Long-term Mean Temperature Distribution in Türkiye (TSMS, 2022)*

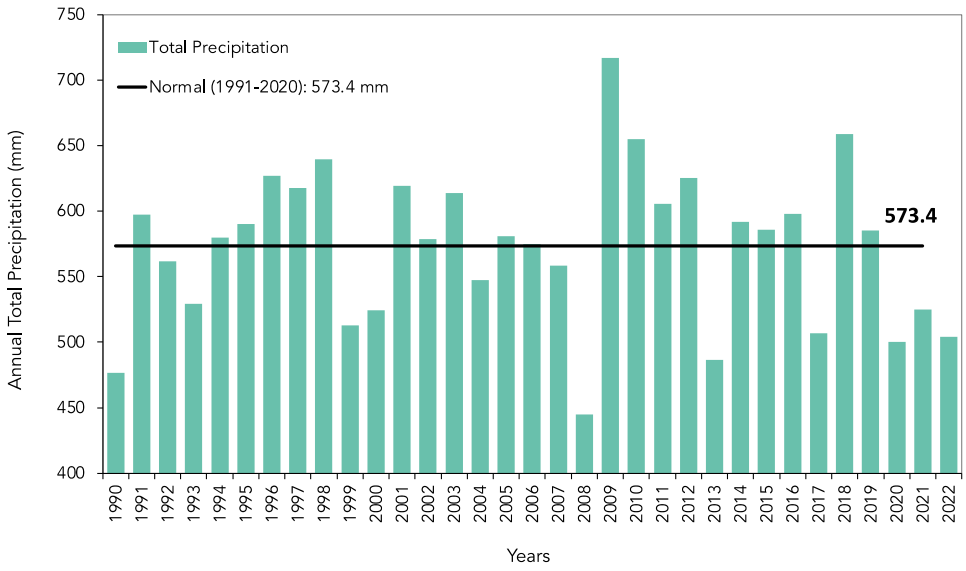


In 2022, the lowest temperature was -34.4°C in Özalp/ Van in January, and the highest temperature was 47.9 °C in Silopi/Şırnak in August. In 2022, while the mean temperatures in Türkiye are below the long-term mean in 19 centers; at 201 stations, it was above the long-term mean.[8]

### 2.4.3 Precipitation

According to the TSMS, the long-term annual mean precipitation in Türkiye between 1991 and 2020 was 573.4 mm (TSMS, 2022). Analysis of the observed data indicates that the year 2009 had the highest recorded precipitation at 717 mm, which is 143 mm above the long-term average, while 2008 had the lowest recorded at 445 mm, which is 129 mm below the long-term average as shown in Figure 5 (TSMS, 2022). Türkiye's mean areal precipitation was recorded as 503.8 mm in 2022. The amount is approximately 12.1%, below from the period of 1991-2020's normal (573.4 mm).

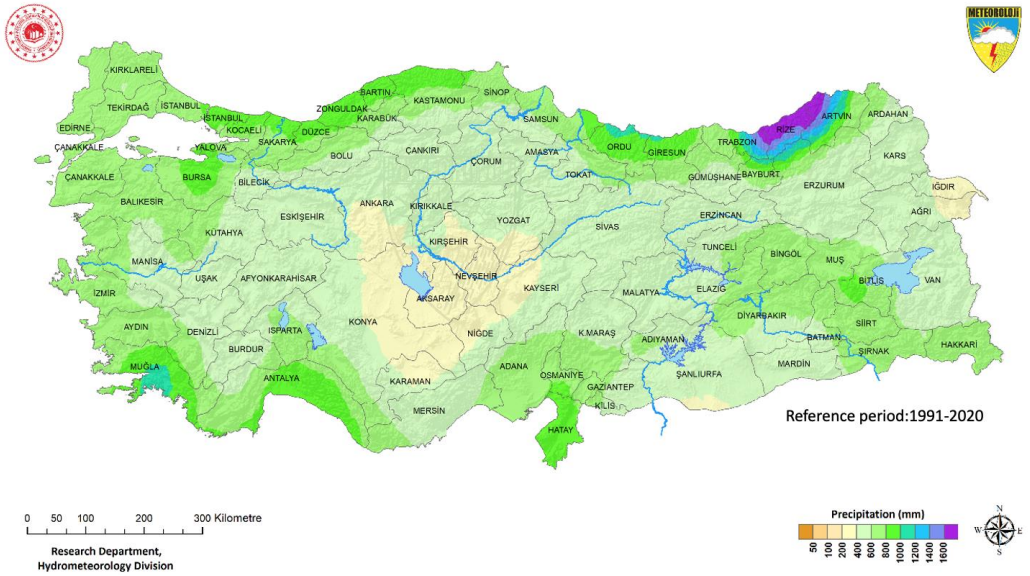
*Figure 5 - Annual Total Precipitation in Türkiye*




During the period of 1991-2020, the Eastern Black Sea Region had the highest total precipitation, while the lowest values were observed in the Central Anatolia and Eastern Anatolia Regions as presented in Figure 6. Specifically, the total precipitation amount exceeding 1600 mm was observed over Artvin, Rize, and Trabzon in the Eastern Black Sea Region, while it was around 800-1000 mm following the Western and Central Black Sea and the Taurus Mountains. The Aegean Region had the highest precipitation amount reaching around 1000 mm over Muğla province. The lowest total precipitation in Türkiye was observed around 300 mm over Konya, Aksaray, Karaman, Iğdır, and Şanlıurfa provinces.

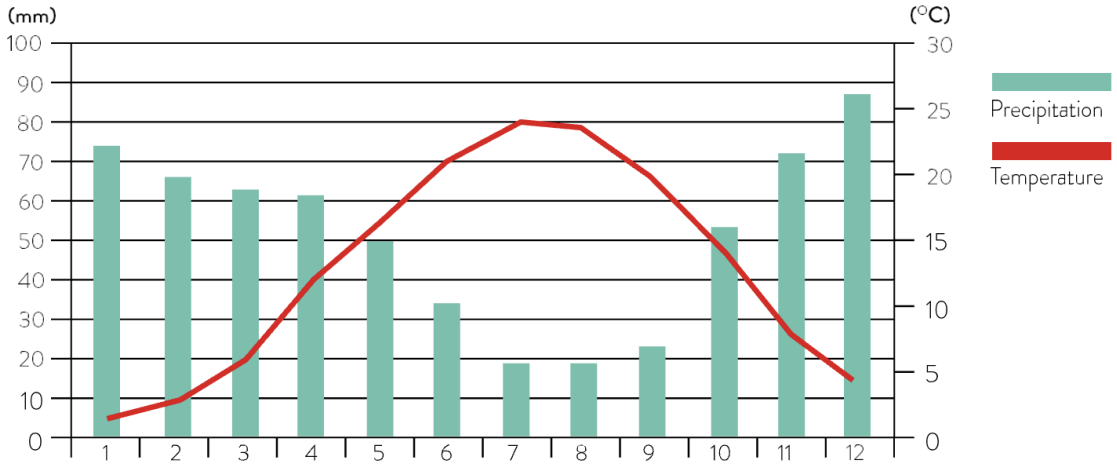
[8] TSMS, 2023. https://www.mgm.gov.tr/eng/Yearly-Climate/State_of_the_Climate_in_Turkey_in_2022.pdf

*Figure 6 - Long-term Mean Total Precipitation Distribution in Türkiye (TSMS, 2022)*




In Türkiye, the highest temperatures are generally observed in the summer season with the countrywide average reaching up to 25°C, while the lowest temperatures are typically experienced in the winter season, falling below 5°C (Figure 7). Türkiye receives the majority of its precipitation during the winter and spring seasons. During the summer, the amount of precipitation decreases, while the temperature and evaporation rates increase. This phenomenon results in the presence of water shortages in most parts of the country during the summer months, except for the Eastern Black Sea Region.

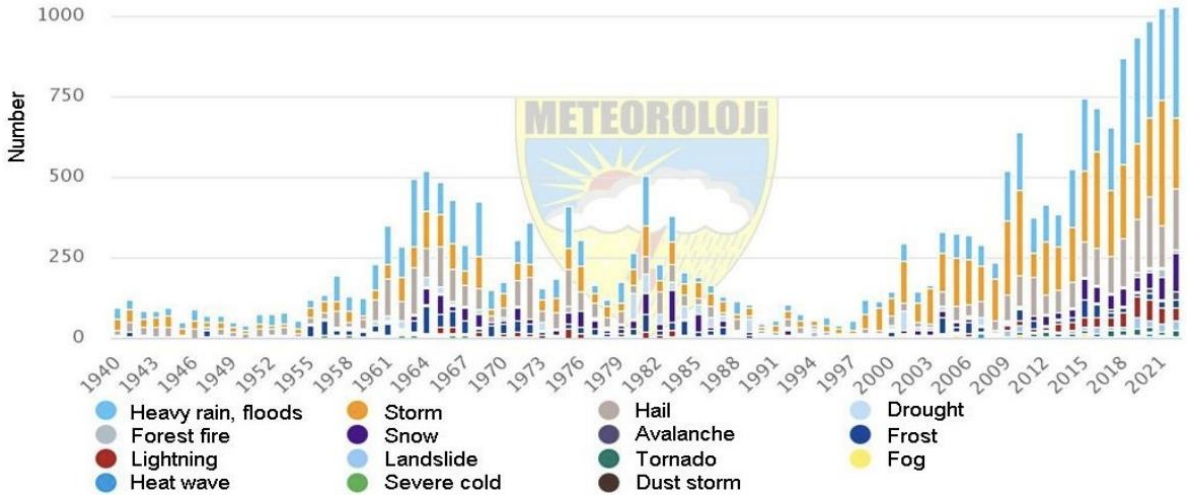
*Figure 7 - Climate diagram of Türkiye (TSMS, 2018)*




### 2.4.4 Extreme Weather Events

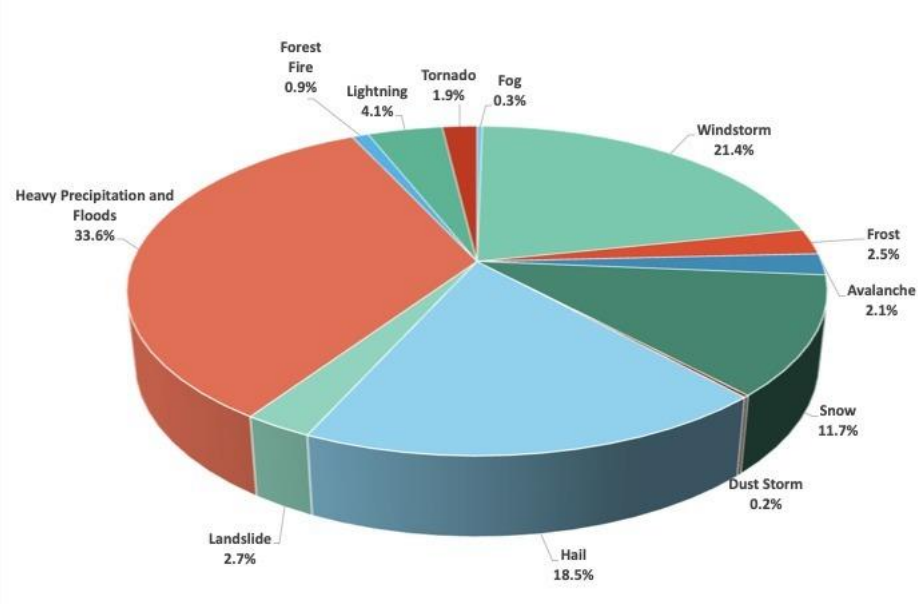
There has been a significant increase in the number of meteorological extreme events in Türkiye, particularly since 2000. A total of 1024 and 1030 meteorological natural disasters were reported in 2021 and 2022, respectively (Figure 8; TSMS, 2023). The year 2022 saw the highest number of disasters since 1971 with a total of 1030 disasters. (Figure 8; TSMS, 2023).

*Figure 8 - Total numbers of annual extreme weather events in Türkiye (1940-2022)*




The percentage of extreme events recorded in 2022 were heavy precipitation and floods (33.6%), windstorms (21.4%), hail (18.5%), snow (11.7%), lightning (4.1%), forest fire (0.9%), frost (2.5%), landslide (2.7%), avalanche (2.1%), dust storm (0.2%) and fog (0.3%)

*Figure 9 - Extreme weather events in 2022 (TMSM, 2023)*

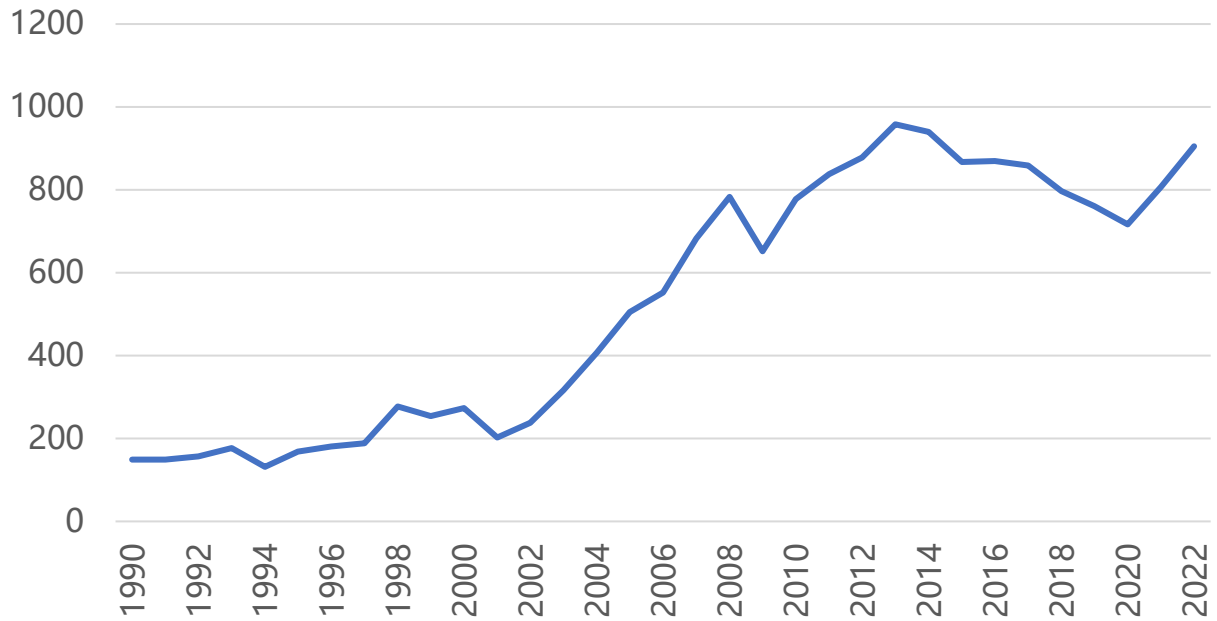


## 2.5 ECONOMIC PROFILE

Since 1990, Türkiye's macroeconomic outlook has been fluctuant based on regional and global conditions. Turkish economy demonstrated growth in the 1990-2013 period accepting economic crisis years of 1994, 2001, and 2008. Decreasing trend was observed in GDP during 2014-2020 period (see Figure 10) and it started to increase again in 2021 and 2022.

Türkiye's Gross Domestic Product (GDP) was 905.5 billion US Dollars in 2022. The per capita GDP in 2022 was USD 10,655. Industry's share and manufacturing industry's share in GDP became 27.1% and 22.1% in 2022, respectively. The share of agriculture, forestry and fishing in the GDP was 6.5%, and construction's was 4.8%.[9]

*Figure 10 – GDP, Billion USD, 1990 – 2020*[10]




According to the targets of the Medium-Term Programme (MTP) 2023-2025, Türkiye aims to grow 5.0%, 5.5% and 5.5% for successive three years.[11] With regard to the estimates of OECD, in the period of 2023-2024 Türkiye will have annual growth rates of 2.8% and 3.8%.[12] Economic growth is the main driver of Turkish anthropogenic GHG emissions. GHG emissions are expected to increase in parallel to the GDP growth in the next decade.

[9] Data source: TurkStat, 2023_b.

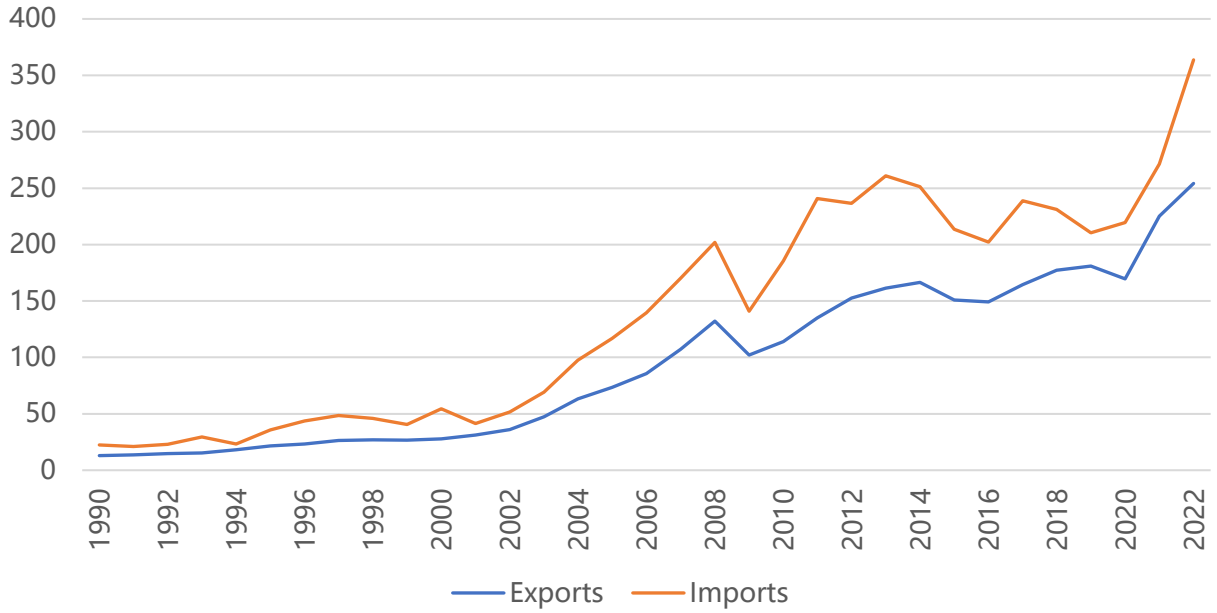
[10] Data source: TurkStat, 2023_b.

[11] MTP, 2021.

[12] OECD, 2022.

Türkiye had an overall trade value of 617.9 billion USD in 2022, 254.2 billion USD coming from exports and 363.7 billion USD from imports. Turkish foreign trade value has grown in the periods between 1990-2013 except economic crisis years of 1994, 2001 2009. Both the imports and exports values of Türkiye increased. The value of trade decreased in the period between 2014-2020. Foreign trade deficit increased from 9.3 billion USD in 1990 to 109.5 billion USD in 2022. The highest 3 value of export in 2022 was vehicles[13] and their parts, confection, boilers, machinery and mechanical appliances. The highest 3 volumes of import in 2022 was mineral fuels, minerals oils and products, boilers, machinery and mechanical appliances and iron and steel.[14]

*Figure 11 - Foreign trade, Billion USD, 1990-2022[15]*




## 2.6 ENERGY INDUSTRIES

In the last 5 years (2016-2021), total electricity demand has increased by 19%. The installed power capacity of Türkiye increased more than threefold in the last two decade and reached 103,809 MW as the end of 2022. In the period between 2016-2021, the installed power of renewable energy sources increased by 55%, while there was an increase of 5% in fossil fuel sources. Total additional renewable energy installed capacity was 4,817 MW in 2020, it became

[13] Other than railway or tramway rolling-stock

[14] Data source: TurkStat, 2022_b.

[15] Data source: for 1990 to 2012 data: TurkStat, 2016 and 1985 – 2015 for 2013 to 2020 data: TurkStat, 2023_c.

4,018 MW in 2021. The share of solar and wind electricity generation in total production has exceeded 15% in 2022.[16]

Türkiye's Energy Policy gives top priority to decreasing import dependency by improving security of supply and utilizing renewable energy sources to the maximum extent in an environmentally sound manner. Therefore, the priority of Türkiye in the forthcoming period will be reducing dependency on imports by realizing its domestic and renewable energy potential along with providing energy supply security. In this context, Türkiye's main strategies and policies based on the energy supply security are outlined as:

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

### 2.6.1 Primary Energy

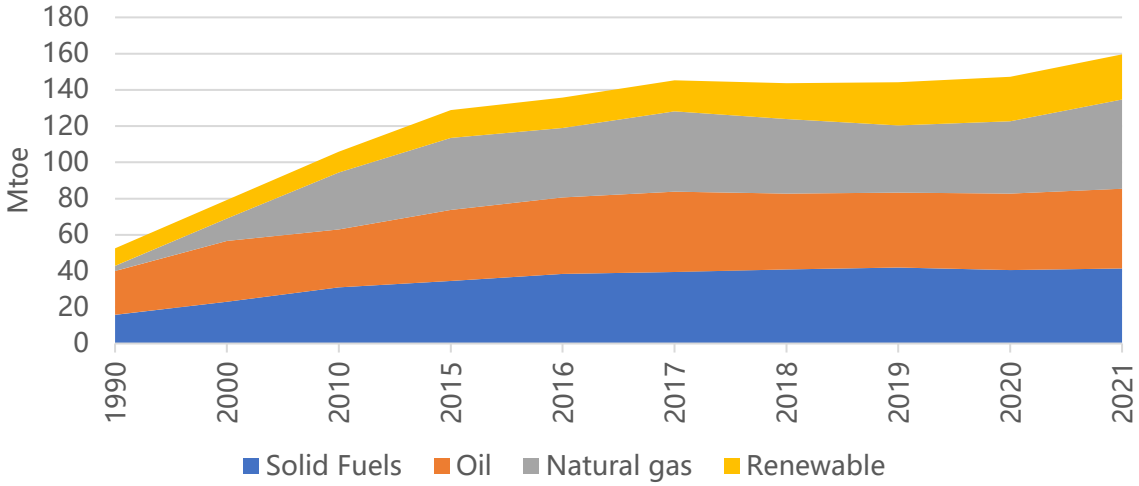
#### *2.6.1.1 Production from Primary Energy Resources*

Türkiye has the highest rate of energy demand growth among OECD countries over the last 15 years. Growing economy, population increase, urbanization has led to an increased demand of energy. The domestic energy resources of Türkiye, especially in terms of oil and natural gas reserves are quite limited and are not adequate to meet the national demands. Türkiye was able to meet only around 30% of its total energy demand from its own domestic resources in 2020. Türkiye is dependent on imported fuels, and 91.8% of the oil supply and 99.4% of the natural gas supply is imported. Energy import dependency is increasing due to the growing energy demand.

[16] TEİAŞ, 2022.

Total primary energy supply was 52.5 Mtoe in 1990 and increased to 159.4 Mtoe in 2021 (with 203% increase). The share of fossil fuels in total primary energy supply was 82% in 1990, and 84.5% in 2021.The share of renewables, on the other hand, was 15.6% in 2021 (See Figure 12).

*Figure 12 - Primary Energy Supply 1990-2021*[17]




Total installed power capacity of Türkiye increased sixfold since 1990 and reached to 99.82 GW in 2021 and it is expected to reach 189.7 GW by 2035. The share of domestic resources in total installed power capacity was 65.1% in 2021.[18]

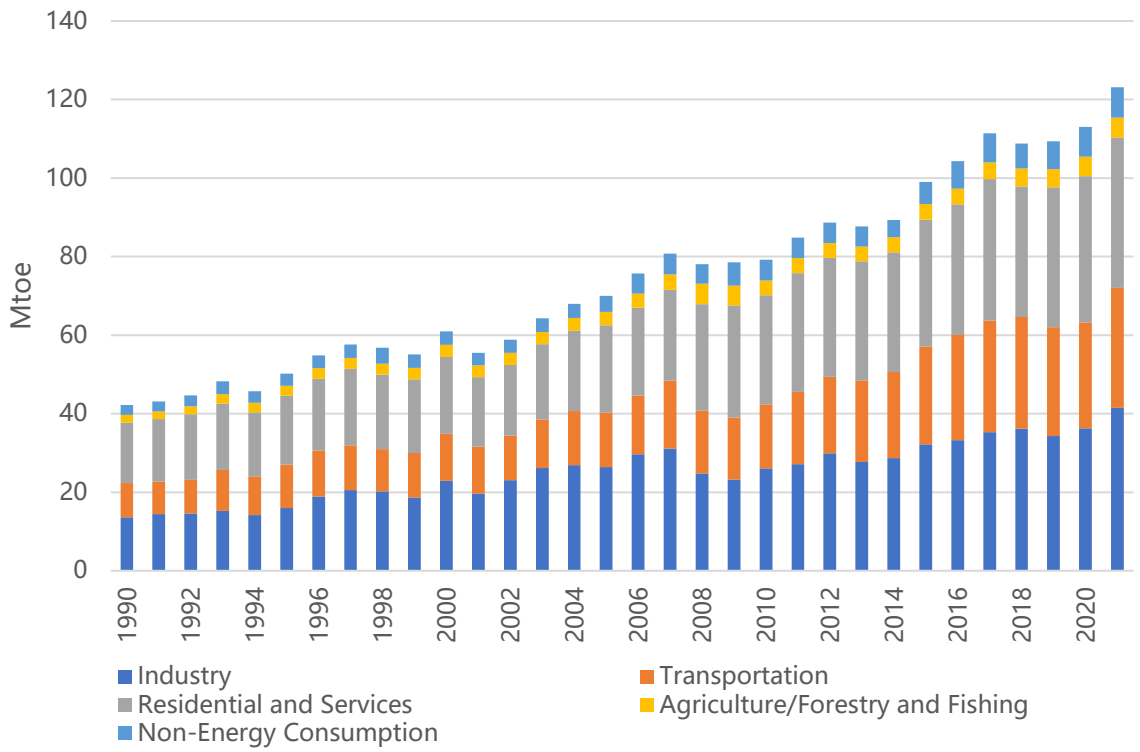
### *2.6.1.2 Consumption of Primary Energy Sources*

Final energy consumption of Türkiye increased from 42.2 Mtoe in 1990 to 123.9 Mtoe in 2021. Although energy consumption has risen from 1990 to 2021, in periods of economic crisis (i.e. 1994, 2001 and 2008) clear decreases were observed especially for industrial sector (see Figure 13).

[17] Data source: MENR, 2022.

[18] TUEP, 2022.

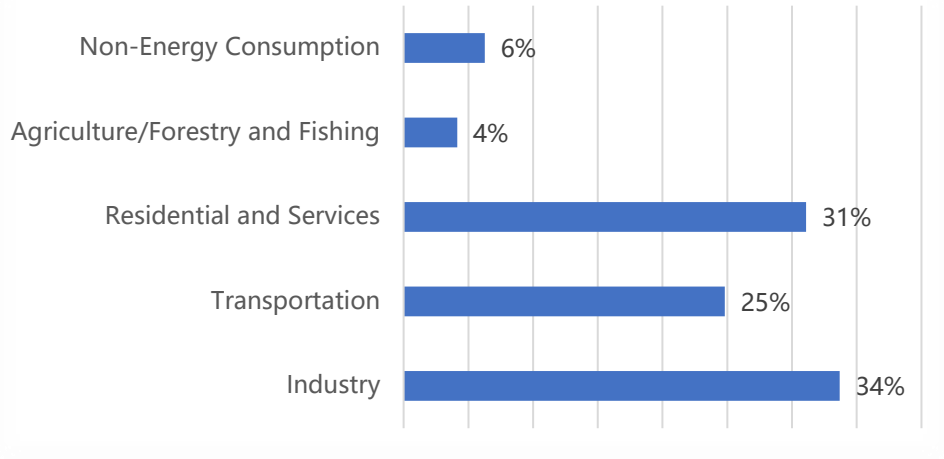
*Figure 13 - Final energy consumption by sector, 1990-2021*[19]




Industrial sector and construction sector are the highest energy consuming sectors and accounts for around 65% to 70% of final energy consumption. In 2021, the industrial sector accounted for 33.7%, residential and services for 31.1%, transportation for 24.8%, non-energy consumption for 6.3%, and agriculture for 4.1% of the final energy consumption. (see Figure 14)

[19] Data source: MENR, 2022.

*Figure 14 - Distribution of final energy consumption by sectors (%), 2021*[20]



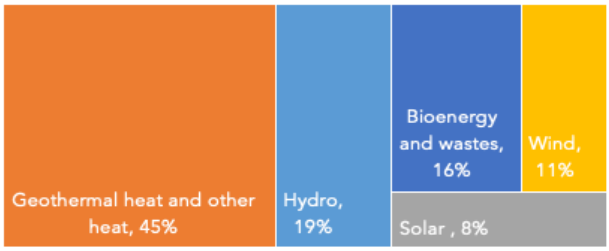

### 2.6.2 Renewable Energy Sources

As the demand for energy grows in Türkiye, utilization of renewables for electricity generation appears to be one of the most efficient alternatives in meeting the growing demand for electricity. The share of renewable energy in the total electricity installed capacity has reached 55% in Türkiye as of the end of 2022. With this ratio, Türkiye ranks 5th in Europe and 12th in the world. Having 11% of the global geothermal power, Türkiye is the 1st in Europe and the 4th in the world. In hydraulics, it is the 2nd in Europe and the 8th in the world. 97% of the 9,000 MW power commissioned in 2020 and 2021 were renewable, the rest is cogeneration, which is a best practice of efficiency.

In 2021, 15.6% (24.9 Mtoe) of Türkiye's total primary energy supply was met by renewable energy sources. As of the end of 2021, 16% of the renewable energy supply in Türkiye was from biomass sources, 19% from hydraulic sources, 45% from geothermal sources, 11% from wind, and 8% from solar energy (See Figure 15).

[20] Data source: MENR, 2023

*Figure 15 - The share of Renewable energy by energy resources, 2021*[21]




### *2.6.2.1 Wind Energy*

According to the **Wind Energy Potential Atlas,** the potential of Türkiye is nearly 140,000 to 150,000 MW; 20,788 MW of which is offshore[22]. Wind power-based electricity generation facilities in Türkiye have been increased. The wind power plant capacity which used to be 18.9 MW in 2002 reached to 11,396.16 MW in 2022.[23]

EMRA licensed projects with a total capacity of 9,940.25 MW until the end of 2017. As of May 2018, the total of 239 licensed projects correspond to 10,536.41 MW.

Following the enforcement of the By-Law on Renewable Energy Resource Areas (YEKA), the REZ Wind Power Plant (WPP)-1 Competition held in 2017 with a connection capacity of 1,000 MWe was allocated for the projects located in Edirne-Tekirdağ-Kırklareli, Sivas and Eskişehir provinces. Within the scope of the contract, the installation of the wind turbine factory in İzmir-Aliağa by the winner of the competition was completed in December 2019 and it was made ready for 65% domestic wind turbine production. An R&D Center was established in İzmir by the winner of the competition and more than 50 qualified researchers from different universities/research centers were employed. EMRA granted pre-licenses on 24 September 2020 to 6 WPP projects in the announced REZ's. Wind measurements and project development studies continue for the projects. A contract was signed on 26 February 2018 in the General Directorate of Renewable Energy (GDRE) in order to establish a 1,000 MWe Electricity Generation Plant, to maintain R&D activities for the next 10 years and to establish a wind turbine plant. Administrative and technical activities have been initiated for Candidate YEKAs submitted to the GDRE by the Investor as required by the Specifications.

In 2019, 4 YEKA WPP-2 Competitions, each with a capacity of 250 MW, were held in Aydın, Çanakkale, Muğla and Balıkesir provinces for the allocation of a total capacity of 1,000 MW. 19

[21] MENR, 2022.
[22] MENR, 2022.
[23] TEİAŞ, 2023.

regions proposed by winners were announced as YEKA in the Official Gazette on 21 March 2021. 13 projects corresponding to 1,000 MW are in pre-license period since 30 April 2022. YEKA WPP-3 competitions were announced in the Official Gazette on 29 May 2021 to include 20 tenders for the allocation of a total connection capacity of 850 MWe in 20 to 80 MWe capacities. The competition model is Allocation for Use of Domestic Goods (AUDG) method. Within the scope of tender, the winner companies undertake to use domestic parts in their power plants. Applications for the competitions were received on 31 May 2022 and the tenders were held on 14 June 2022. Contracts were signed with the 9 winner companies on 20 July 2022. The evaluation process for some candidate REZ's were completed and these were announced as REZ's in the Official Gazette on 26 November 2022. In order to make maximum use of Türkiye's wind power potential, to ensure integration of more wind farms to electricity system and to predict the electricity power to be generated from wind, a By-Law published in 2013 introduced the condition of connecting all wind power plants to Wind Power Monitoring and Forecasting System (RITM). In this framework, 243 wind power plants with a capacity of over 10 MW have been connected to the RITM (83% of the installed power, total installed power 10,976 MW). Power generation of operational WPPs can be simultaneously monitored and power generation for 48 hours can be forecasted. Moreover, the activities with the aim of reducing forecast error ratio for the electricity generated from wind are in progress within the scope of the RITM Project.[24]

#### *2.6.2.2 Solar Energy*

Türkiye, judging by its geographical location on the globe, is situated in one of the most advantageous regions in terms of benefiting from solar energy, which is called the solar belt. According to **Türkiye's Solar Energy Potential Atlas (GEPA)** prepared by the MENR, total annual insolation time is 2,737 hours (total of 7.5 hours per day) and total annual solar energy derived is 1,527 kWh/m2 (total of 4.2 kWh/m2 per day).[25] The installed capacity of solar energy is 9,425 MW at the end of 2022 and expected to increase to 52,900 MW according to TUEP.[26]

Within the framework of **YEKA** initiative, the first tender was awarded in May 2017 for the construction of a 1 GWe solar power plant (SPP) with an estimated USD 1.3 billion total investment. The solar plant will be operational for 30 years meeting the electricity demand of over 600,000 households. The tender also included a commitment to conduct R&D activities in Türkiye for a minimum of 10 years, employment of at least 80% local staff, and construction of an integrated factory for production from ingot to photovoltaic module. The country's first solar module manufacturing facility, based on investment of USD 400 million and with an annual

[24] http://www.ritm.gov.tr/root/index_eng.php

[25] MENR, 2022.

[26] TUEP, 2022.

capacity of 500 MWe, opened in August 2020 in Ankara's Başkent Organized Industrial Zone, employing around 1400 people. The project is expected to be completed in the first quarter of 2023. In addition to Karapınar YEKA SPP-1, In 2021, by the 74 YEKA SPP-3 Competitions covering 36 provinces, 1000 MW of connection capacity were allocated as 10, 15 and 20 MW. The competition model is Allocation for Use of Domestic Goods (AUDG) method. Contracts with all winners were signed as of 11 August 2021. After the evaluation process for candidate YEKA proposals, they were announced as YEKA's in the Official Gazettes. As of 17 November 2022, pre-licenses are obtained for 52 projects of 670 MWe. YEKA SPP-4 Competitions were announced in the Official Gazette on 14 July 2021 for the allocation of 1000 MWe. Like YEKA SPP-3 Competitions, YEKA SPP-4 Competition model is Allocation for Use of Domestic Goods (AUDG) method. Applications for 300 MWe capacity in Niğde (Bor-1, Bor-2 and Bor-3 Competitions, 100 MWe each), were received on 30 March 2022 and the tenders were held on 8 April 2022. The winner companies were invited to sign contracts. Remaining 700 MWe capacity were allocated by 2 Erzin (Hatay) and 10 Viranşehir (Şanlıurfa) Competitions as 50 and 100 MWe capacities. Applications for 12 competitions were received on 21 June 2022 and tenders were held on 28 June 2022. As of 8 September 2022, pre-licenses are obtained for 5 projects of 500 MWe. Besides, REZ SPP-5 Competitions were planned to include 66 tenders in 18 connection regions for 1200 MWe connection capacity in total. As a result of the detailed studies, 59 areas in 18 provinces were declared as REZ in the Official Gazette on 11 November 2022.

#### *2.6.2.3 Geothermal Energy*

Türkiye has a high potential in terms of geothermal energy resources. Geothermal energy is a significant domestic and renewable energy source for the Country due to its intensive tectonic movements. Theoretically speaking, the geothermal potential of Türkiye is 35,500 MWt and 12.6% of this potential is again theoretically expected to be suitable for electricity generation. Even though the technical potential for generating electricity from geothermal sources is estimated to be 4,000 MW, the total installed power in Türkiye reaches to 1,691 MW as of the end of 2022.[27] Geothermal utilization in Türkiye can be represented by a remarkable increase especially in electricity production. As of December 2022, there are 63 operating geothermal power plants at 26 geothermal fields in Türkiye consisting of this installed capacity. By the amendment on Electricity Market Law No. 6446 on 1 July 2022, technical evaluation has been obligatory for geothermal power plants.

Judging by the temperature of current springs and falls in Türkiye, 14% of geothermal energy is used for heating purposes (greenhouse, residential areas, plants, etc), 4% for thermal tourism, and 82% for electricity generation. The share of the capacity is located as 79% in Western

[27] MENR, 2022.

Anatolia, 8.5% in Central Anatolia, 7.5% in Marmara Region, 4.5% in Eastern Anatolia and 0.5% in other regions.

The heat potential in Türkiye is estimated to be 16,098 MWt, out of which 3,800 MWt is used for heating purposes. However, the utilization of available resources is observed to be around 10%, given the total potential. In Türkiye, there are 18 settlement units which use geothermal energy in the heating systems, which corresponds to approximately an equivalent of central heating for 140,000 houses.

#### *2.6.2.4 Hydraulic Energy*

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

As of the end of 2022, there were 751 hydropower plants, with the total capacity of 31,571MW. This is the equivalent of 30.44% of the total capacity. In 2022, hydroelectricity production has been increased to 66.7 billion kWh which means 20.4% of the Country's electricity production was obtained from hydropower. Additional hydropower plants are currently under construction, further helping Türkiye to meet the potential for enhanced hydropower development. The installed capacity of hydro is expected to increase 35,100 MW according to TUEP.[28]

#### *2.6.2.5 Biomass Energy*

The **Biomass Energy Potential Atlas (BEPA)** prepared by MENR for identifying biomass potential of Türkiye. According to the Atlas, the biomass potential is identified, in theory, as 34 Mtoe. The amount of usable biomass energy potential is approximately 3.9 Mtoe. The amendment on Electricity Market Law No. 6446 on 1 July 2022 gets technical evaluation for biomass power plants. Until 2011 there were only a few biomass plants, producing energy from wastewater, the number of plants generating energy from various biomass sources reached 384 with the total capacity of 1,921 MWe as of the end of 2022.[29]

In order to decrease import dependency, to increase diversity of supply and to progress the approximation process to EU Acquis, the rules and procedures on blending ethanol produced from local agricultural products into gasoline and diesel have been regulated. According to the data of Energy Market Regulatory Authority (EMRA), the installed bioethanol capacity in Türkiye is 152.0 million liters with three active facilities. The total amount of bioethanol

[28] TUEP, 2022.

[29] (MENR, 2022.

production in the year of 2022 was 87,570.37 tons. The installed biodiesel capacity in Türkiye is 239,715 tons and the total amount of biodiesel production in the year of 2022 was 119,061.43 tons according to the data of EMRA.

The biogas production (collected gas) on landfills and wastewater treatment was increased in the recent years. In total, 333.9 kt methane was collected in 2020 from solid waste sites and wastewater facilities. (see Section 2.10)

### 2.6.3 Waste Heat

Within the scope of the National Energy Efficiency Action Plan objectives, the **"Turkey Waste Heat Potential Evaluation Project"** have been conducted in cooperation with the World Bank in order to determine the waste heat potential of Türkiye and to prepare the necessary arguments for converting this potential into an enterprise-based investment. Studies have been carried out to assess the waste heat market in Türkiye, identify technically and financially viable waste heat recovery investments and existing barriers against implementation of waste heat recovery investments and develop sample/templates for energy audit within the scope of the project.

A total of 18 energy audit focusing waste heat have been done in industrial enterprises, buildings and thermal power plants, the final energy consumption information of the sectors from the database of our MENR and the chimney temperature and flow rate information of 340 industrial enterprises from the database of the MoEUCC have been used in order to determine the waste heat areas. In addition, information was gathered by holding consultation meetings with sector representatives and institutions. After the waste heat potential was determined with the top-down methodology in the light of the collected data, it was analyzed by comparing it with the potential that emerged with the bottom-up methodology as a result of the studies carried out in the enterprises.

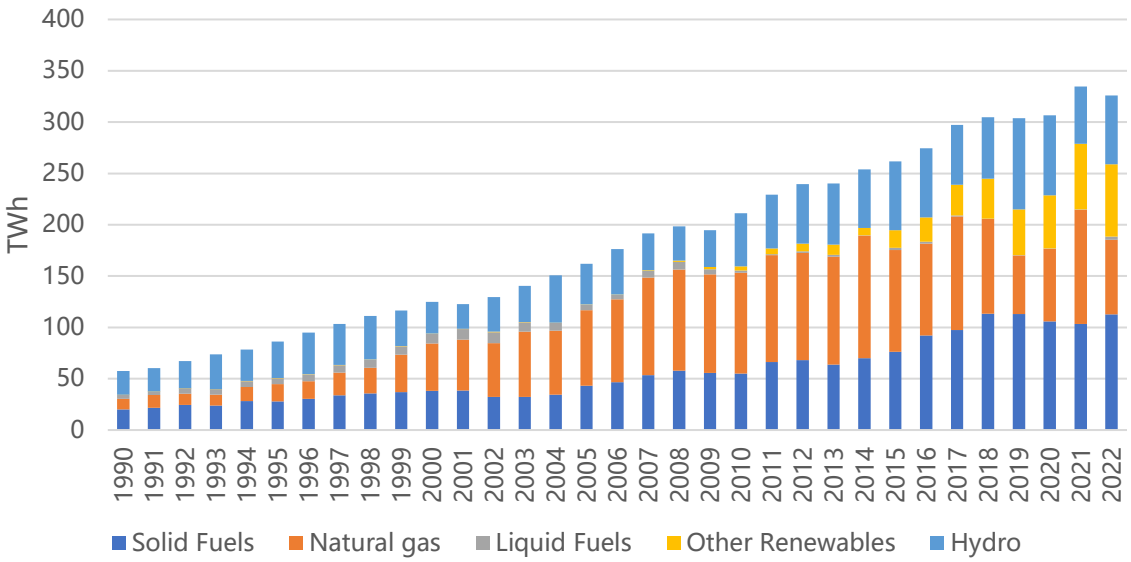
As a result of the studies, 66,000 TJ/year at the rate of 11% of the final consumption of the industrial sector, 29,000 TJ/year at the rate of 5% of the final consumption of the building sector, and 65,000 TJ/year at the rate of 5% of the final consumption of the thermal power plants. In total, a theoretical waste heat potential of 160,000 TJ/year has been determined. It has been calculated that an investment of 2.4 billion dollars will be needed in order to bring the identified potential to the economy. With the acquisition of the potential, 10 $MtCO_2$/year emissions corresponding to 4 million vehicles can be prevented.

### 2.6.4 Electricity Sector

According to the latest national GHG inventory, the total $CO_2$ emission released by the energy sector in 2020 was 367.6 million tons of $CO_2$ eq. and 142.93 million tons of this was attributable to the electricity sector. Installed power capacity increased from 16,318 MW in 1990 to 103,809 GW at the end of the 2022. Annual electricity production grew from 57.5 TWh to 326 TWh during

the same period. The share of hydropower was 20.5%, other renewables were 21.2%, natural gas was 21.9%, liquid fuels were 1.1%, and the percentage of solid fuels was 35.0% in the electricity production in 2022.

*Figure 16 - Electricity generation by primary energy resources, 1990-2022*[30]




The **National Renewable Energy Resource Guarantee System**, i.e. YEK-G System, and Organized YEK-G Market was opened on June 2021 under the operation of Energy Exchange Istanbul (EXIST/EPİAŞ). The By-Law on Renewable Energy Resource Guarantee System (YEK-G System) has been prepared by EMRA and entered into force on June 1, 2021. Moreover, procedures and principles for the operation of the YEK-G system and organized YEK-G market was also published in the Official Gazette on May 8, 2021. The YEK-G system and organized YEK-G market started operation on June 21, 2021 under the operation of EXIST (market operator of Türkiye). The system enables the trade of YEK-G certificates issued for each 1 MWh green energy generation from renewable power plants. YEK-G certificates are tradeable within licenced market players by bilateral agreements and also on the organized YEK-G market. The system framework and certificate properties were designed similar to the EU's Guarantees of Origin system. The YEK-G system also complements the ongoing green tariff (YETA) in the matter of proofing the green electricity generation.

### 2.6.5 Energy Efficiency

Energy efficiency is a crucially important component of the **National Energy and Mining Policy** in terms of security of supply. An overall target to reduce the energy intensity by 20% until 2023 compared to the 2011 levels is formulated. Accordingly, in the National Energy Efficiency Action Plan (2017-2023) the importance of sustainable development along with competitive and green growth has been a topic of interest. Thereby, Turkish primary energy consumption will be

[30] Data source: MENR, 2022.

reduced by 14% (23.9 Mtoe) and a cumulative saving of 66.6 million tons $CO_2$ emission is expected by 2023 through an investment of 10.9 billion USD.

As a result of energy efficiency activities conducted in 2017-2021 period, a total of 6,447 million USD was invested in energy efficiency and, 4.47 Mtoe of cumulative energy savings have been achieved with a monetary value of 1,562 million US $. In 2021, a total of 1,325 million USD was invested in energy efficiency, yielding a 1.06 Mtoe primary energy savings which are correspond to 372 million USD. According to calculations, $CO_2$ emissions were reduced by 43 million tons and approximately 12,000 green employments were created in the period of 2017-2021.The work for updating NEEAP and Energy Efficiency Strategy had been started by beginning of the 2022. The papers will be updated in late 2023.

With the efforts in energy efficiency between 2000 and 2021, primary and final energy intensities of Türkiye improved by an average of 1.5% per year and decreased by about a quarter in total.

As per the Presidential Circular dated in 2019, energy saving target is set by 15% in public buildings until 2023 in order to use public resources efficiently and to reduce the burden of energy costs on the public sector. Public buildings which have total construction area over 10,000 m2 or total annual energy consumption over 250 toe, are in scope. In the period of 2019-2022 more than 31,000 toe energy saved which has a monetary return of 3.1 billion TL.

Also, an article related to EPCs, which allow EE implementations in public buildings and facilities through ESCOs, added into the EE Law in 2019. Relevant templates, guidelines and secondary legislation documents were made by the Ministry and published at the institutional website (www.enerji.gov.tr).

## 2.7 BUILDING STOCKS AND URBANIZATION

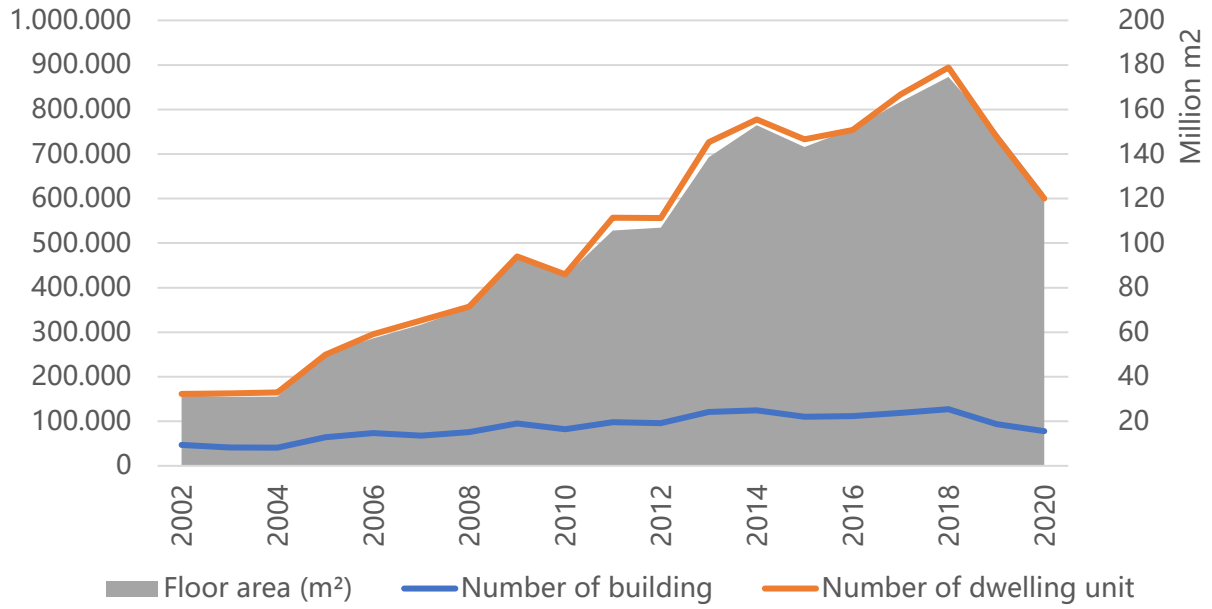
Türkiye has a high rate of urbanization with a rapid annual urban population increase. The urban population increased from 29 million to 74.2 million during the 1990-2020 period. A high rate of urbanization leads to a fast-growing building stock and an intensive need for transportation in cities. The buildings sector in Türkiye, which contains residential, commercial and public buildings, was responsible for 33% (36.9 Mtoe) of the country's total energy consumption in 2020.[31]

According to the building census results, the number of buildings in Türkiye grew from 4.3 million in 1984 to 7.8 million in 2000, and the number of dwelling units in the same period reached 16.2 million, reflecting an increase of 129%. The construction sector has been growing rapidly. According to building permit statistics, the majority of new buildings were constructed after 2002. In total, 47 thousand new buildings with a total floor area of 31.7 million m2 were constructed in 2002. In 2020, 77,849 thousand new buildings with a floor area of 122.2 million

[31] Data source: MENR, 2022.

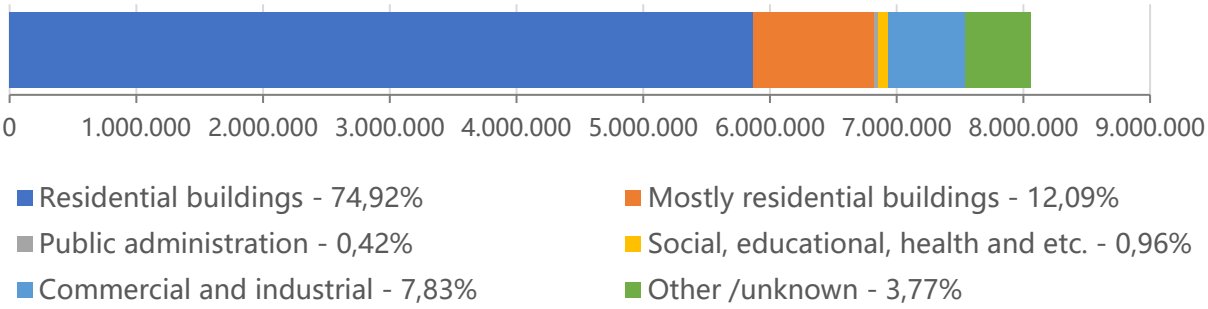
m2 were constructed (See Figure 17). During the 2002-2020 period, while the annual number of new buildings increased by 65%, the annual number of new dwelling units increased by 272% and the annual floor area of new buildings increased by 286%.

*Figure 17 - Number of new buildings' occupancy permit by year*[32]




The share of residential buildings is 86% of the total building stock, followed by commercial buildings. Public buildings are the smallest category of the stock (Figure 2.17).[33]

*Figure 18 - Number of buildings by building type in 2000*[34]



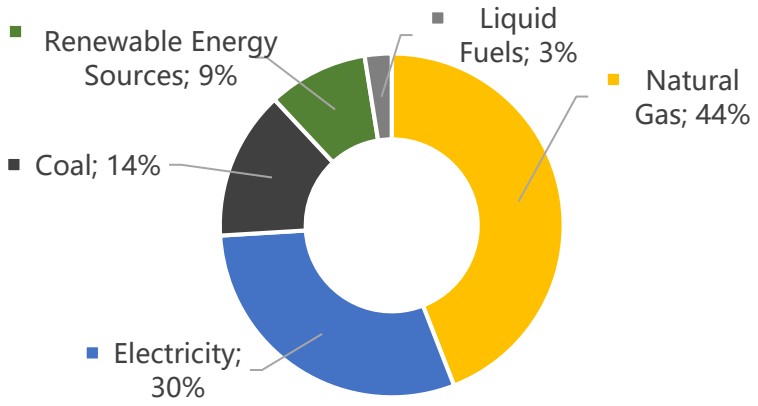

In 2020, energy consumption in buildings was met by natural gas (44%), electricity (30%), coal (14%), renewable energy sources (9%) including solar, geothermal, wood and plant/animal residues, and liquid fuels (3%) (See Figure 19).

[32] Data source: TurkStat, 2022_b.

[33] Data source: MoEUCC, 2021.

[34] Data source: 7th NC, 2019.

*Figure 19 - Energy consumption in buildings by energy resource (2020)*[35]




Building sector is responsible for 12% of total GHG emissions in 2020. Energy consumption of buildings has been increasing by 4% per year since 1990. Although energy efficiency activities lower the rate of increase in energy consumption of buildings, growing building stocks is expected, with a continued increase in GHG emissions in Türkiye. GHG intensity of the buildings decreased 34% between 1990 and 2020.

## 2.8 MANUFACTURING INDUSTRIES AND CONSTRUCTION

**Turkish industry** is composed of many different sub-sectors with different characteristics that represent approx. 20% to 30% in GDP. Among the sectors of industry, manufacturing industry greatly affects national economic growth. Turkish manufacturing industry[36] had 4.7 million jobs with a turnover of 5,118 billion TRL in 2021. Its share in the GDP was 22.2. The food, basic metal, manufacture of motor vehicles, trailers and semi-trailers, and textile industry represent the largest contributors to manufacturing industry turnover with an 15.6%, 9.7%, 8.7% 8.4% share respectively. Those sectors are followed by fabricated metal products except machinery and equipment, wearing apparel, manufacture of the Non-metallic mineral products, rubber and plastic products, and electrical equipment.[37] The automotive industry has the highest share of Turkish exports, representing 10.5% of exports.[38]

*Table 2 - Main indicators of industry sector, 2021*[39]

| Sub-sector | Turnover | Contribution to GDP |
|---|---|---|

[35] Data source: MENR, 2022.

[36] Activities classified under C at the Statistical Classification of Economic Activities in the European Community ( NACE) Rev. 2.

[37] Data source: TurkStat, 2021_c.

[38] Data source: TurkStat, 2022_b.

[39] Data sources: 7th NC, 2019 and TurkStat, 2023_b.

| | number of enterprises | number of persons employed | (Billion TRY) | (Billion TRY) | % |
|---|---|---|---|---|---|
| C- Manufacturing industry | 444,101 | 4,713,664 | 5,118.3 | 1.609.78 | 22.2 |

The construction sector was one of the most important drivers of the Turkish economy, contributing 4.8% of gross domestic product (GDP) in 2022.[40]

Primary energy consumption of industry in 2020 was 36.26 Mtoe, responsible for 32% of the total energy consumption.[41] The largest two single industries, in terms of primary energy consumption, have been the non-metallic mineral industry with 26% (9.26 Mtoe) and the iron and steel industry with 24% (8.55 Mtoe).[42]

Although energy consumption of the industrial sector increased from 13.6 Mtoe to 36.3 Mtoe during the 1990-2020 period, emission intensity of the sector decreased considerably from 2.4ton CO2eq./toe to 1.8ton CO2eq./toe in the same period. Energy efficiency activities, increasing share of renewables and using waste as an alternative fuel is expected to lead to lower the rate of increase in GHG emissions from the industrial sector.

## 2.9 TRANSPORTATION

Türkiye's transportation sector has shown rapid development in recent years. Road and railway networks have expanded, and new airports and seaports have been opened. Tunnels and bridges have been built, which will contribute to the reduction of the sector's emissions from road transportation. Between 2002 and 2022, the number of tunnels increased by 465%, and bridges and viaducts increased by 62% in 20 years. The total railway network grew by 20%. (See Table 3)

*Table 3 –Selected Key Indicators for Transportation Sector*[43]

| Indicator | 2002 | 2022 | Change |
|---|---|---|---|
| Highway (km) | 1,714 | 3,633 | 112% |
| Road Tunnel Number - (Km) | 83 | 469 | 465% |
| Number of Road Bridges and Viaducts - (Km) | 5,967 | 9,639 | 62% |
| Railway Network (km) | 10,948 | 13,128 | 20% |

[40] Data source: TurkStat, 2022_a.

[41] Data source: MENR, 2022.

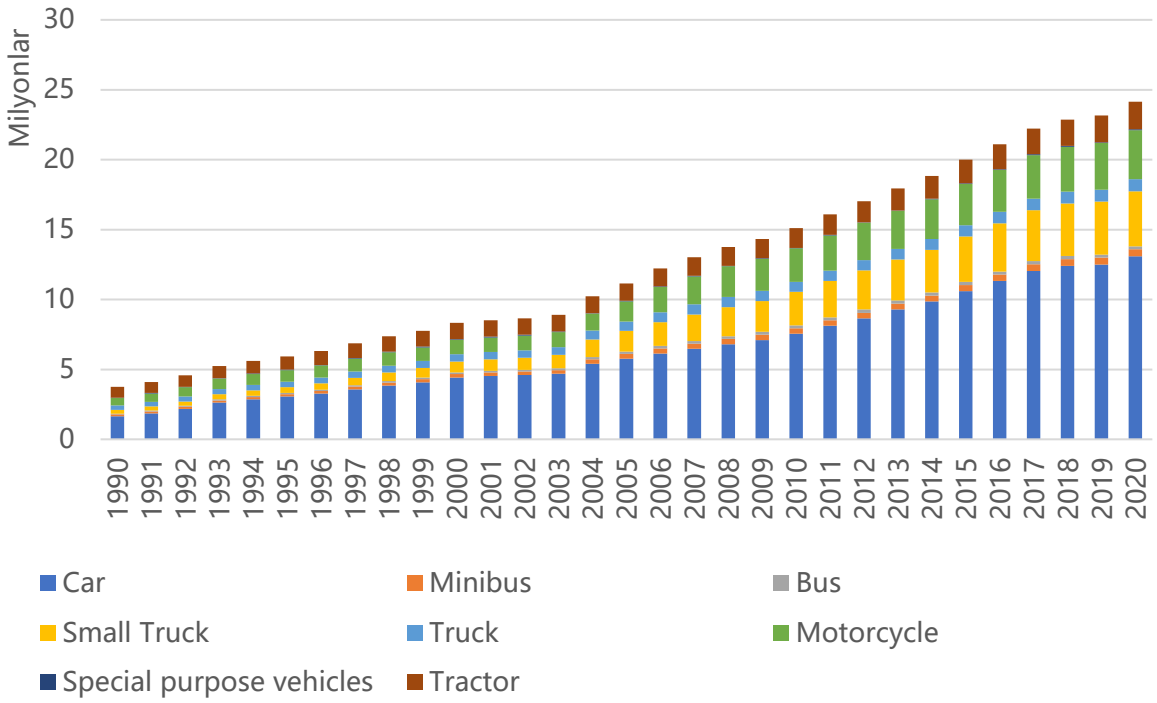
[42] Data source: MENR 2022.

[43] MoTI, 2022.

| | | | |
|---|---|---|---|
| Electric Railway Line Length (km) | 2,082 | 6,165 | 196% |
| High Speed Train Line Length (km) | 0 | 1,460 | - |
| Number of Active Airports | 26 | 57 | 119% |
| Port Facility | 149 | 217 | 46% |

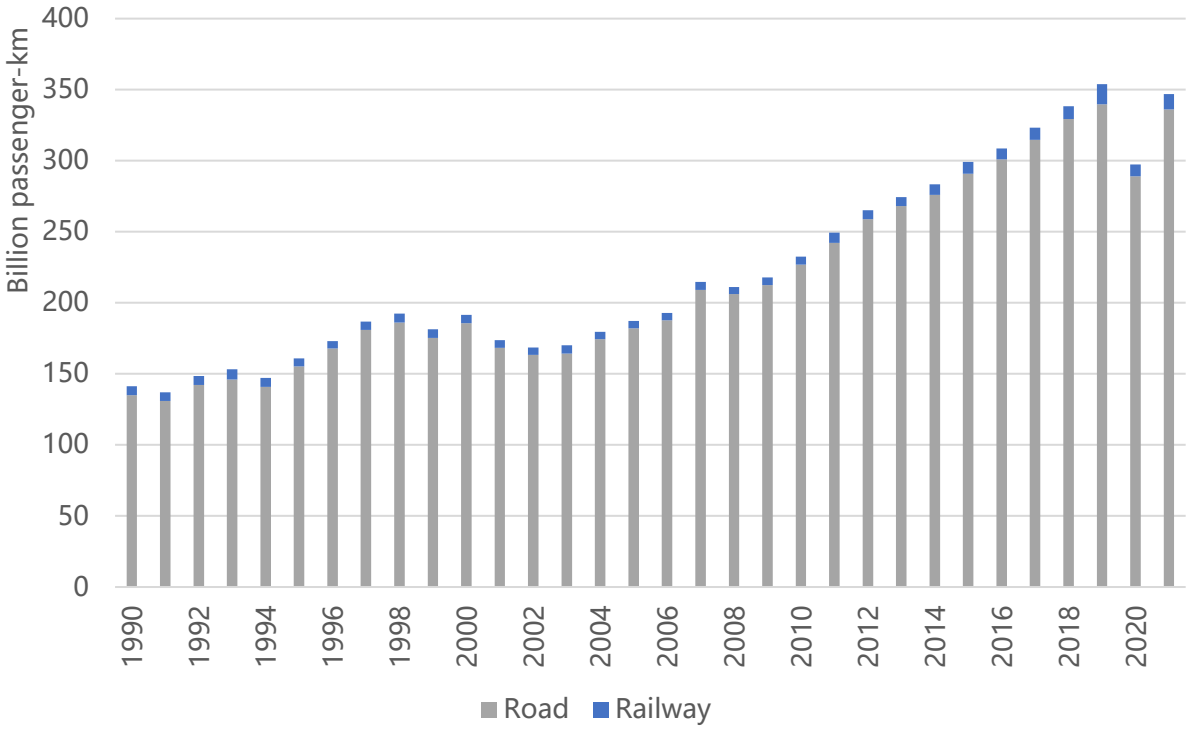
The transport sector was responsible for 23.86% (26.97 Mtoe) of Türkiye's final energy consumption in 2020. Road transport was responsible for 94.44% of energy consumption in the transportation sector and air transport was responsible for 2.68%. The number of road motor vehicles have been increasing since 1990. While there were 3.8 million road motor vehicles in 1990, this number reached approximately 25.1 million in 2020 (See Figure 20). This was reflected in the rise of road motor vehicles per 1000 people from 68 in 1990 to 290 in 2020. In parallel, the total movement of passengers (passenger-km) using inland transport increased 145% between 1990 to 2021 with (See Figure 21).

*Figure 20 - Road motor vehicles, 1990-2020*[44]




[44] Data source: TurkStat, 2023_f.

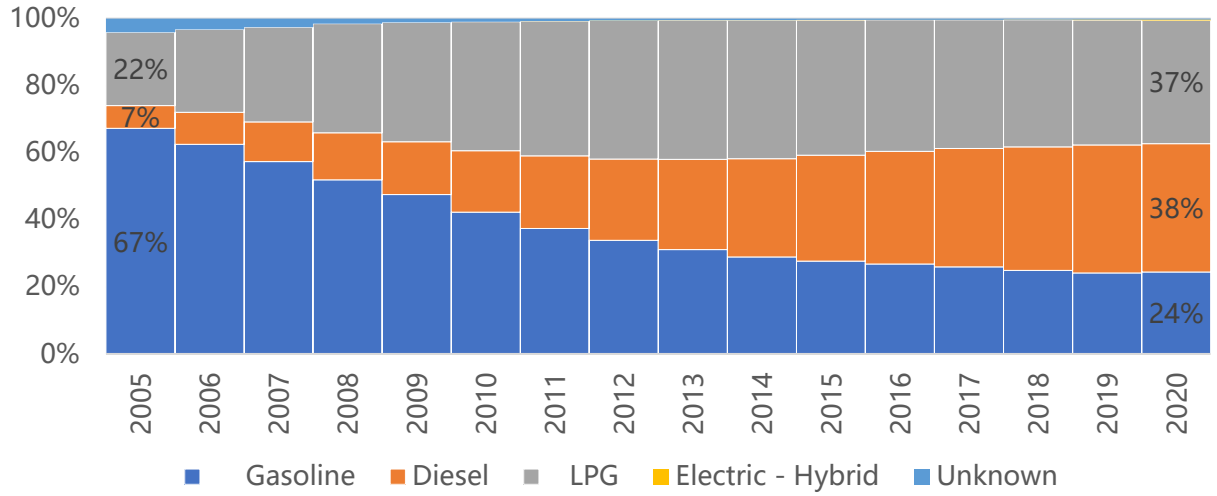
*Figure 21 – Change in passenger transport in Türkiye (1990-2021)*[45]




As a result of recent motor vehicle technology and an increase in alternative fuel use after 2003, the transport efficiency has increased. LPG was introduced in road transportation after 1997 and fuel used shifted from gasoline to diesel and LPG in road transportation. The share of gasoline in total energy consumption of road transport decreased from 67% in 1990 to 24% in 2020. The share of LPG was 37% in 2020 which was much higher than gasoline's 24% share for the same year. (See Figure 22) Since the carbon intensity of LPG is the lowest among other liquid fuels, a decrease in GHG emissions from road transportation was seen.

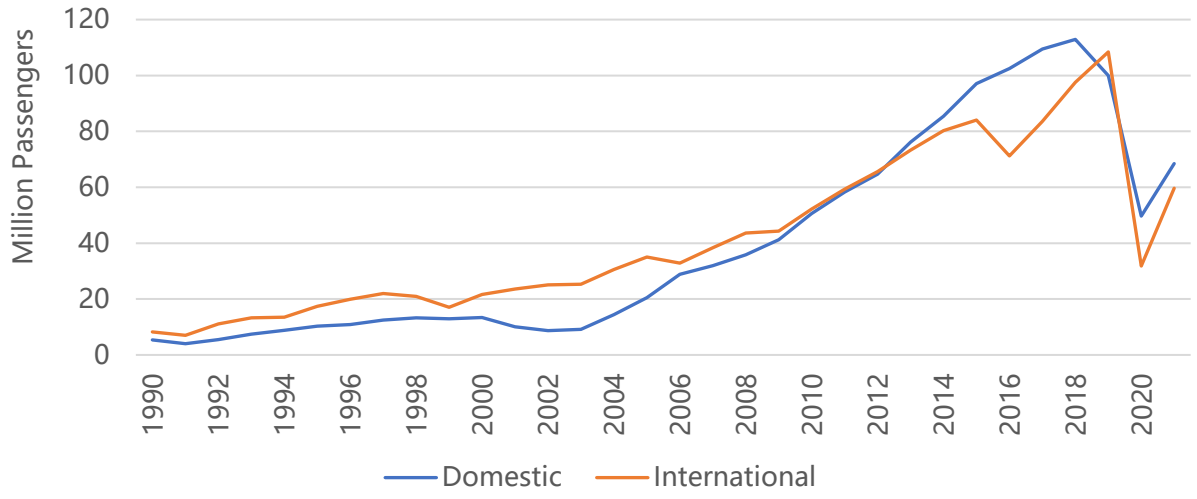
[45] Data source: OECD, 2023.

*Figure 22 - Distribution of cars registered to the traffic according to fuel type, 2004 - 2021*[46]




Besides road and railway transport, airline sector also rapidly expended. Number of domestic and international passengers using airways fourteenfold in the last 30 years, from 301,403 in 1990 to 4,090,168 in 2019 (see Figure 23). Türkiye's plane inventory increased from 138 to 558 and number of airports increased from 26 to 57 from 2002 to 2021.

*Figure 23 - Total domestic and international travel passengers at the airports*[47]




## 2.10 WASTE

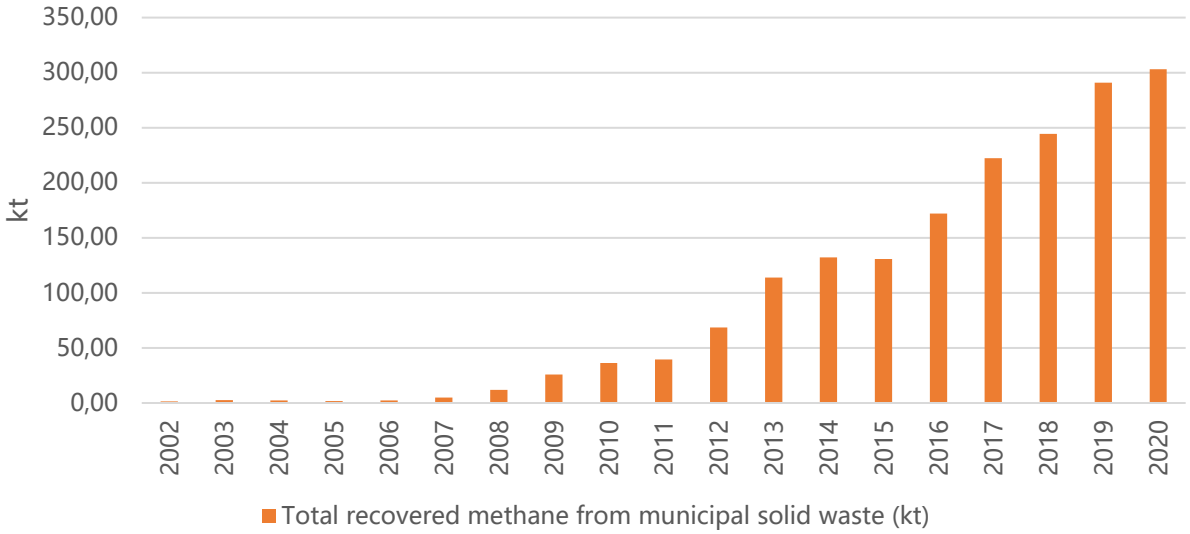
Greenhouse gas emissions originating from the waste sector in Türkiye are predominantly related to solid waste disposal and wastewater treatment. Waste generation has been growing

[46] Data source: TurkStat, 2023_f.

[47] Data source: TurkStat, 2023_g.

continuously in Türkiye; for instance, according to Turkstat data, annual municipal solid waste generation increased from 21.96 million tons in 1990 to 34.76 million tons in 2020. In the meantime, significant improvement was achieved in waste management. In 1994, by far the main disposal method for municipal waste was the open dumping of waste, nearly without the existence of any composting of waste or other biological waste recovery methods and only 2 landfills were available. With the developments in the sector, 93 landfills were in operation by 2022, with these facilities, 89% of the population is served[48]. The recovery of methane from waste disposal sites and wastewater treatment plants increased significantly from the year 2002 onwards resulting in reduction of GHG emissions from the waste sector. Number of landfill sites with landfill gas recovery increased from 1 in 2002 to 84 in 2022. Moreover, Türkiye also has methane recovery at one of its unmanaged solid waste sites, where 2.2 kt methane was recovered, which increased the total to 303 kt in 2020.[49] The landfill gas production (collected gas) on landfills and wastewater treatment has reached to a capacity of more than 200 MWe.

*Figure 24 – Recovered methane at the solid waste disposal sites (2002-2020)*



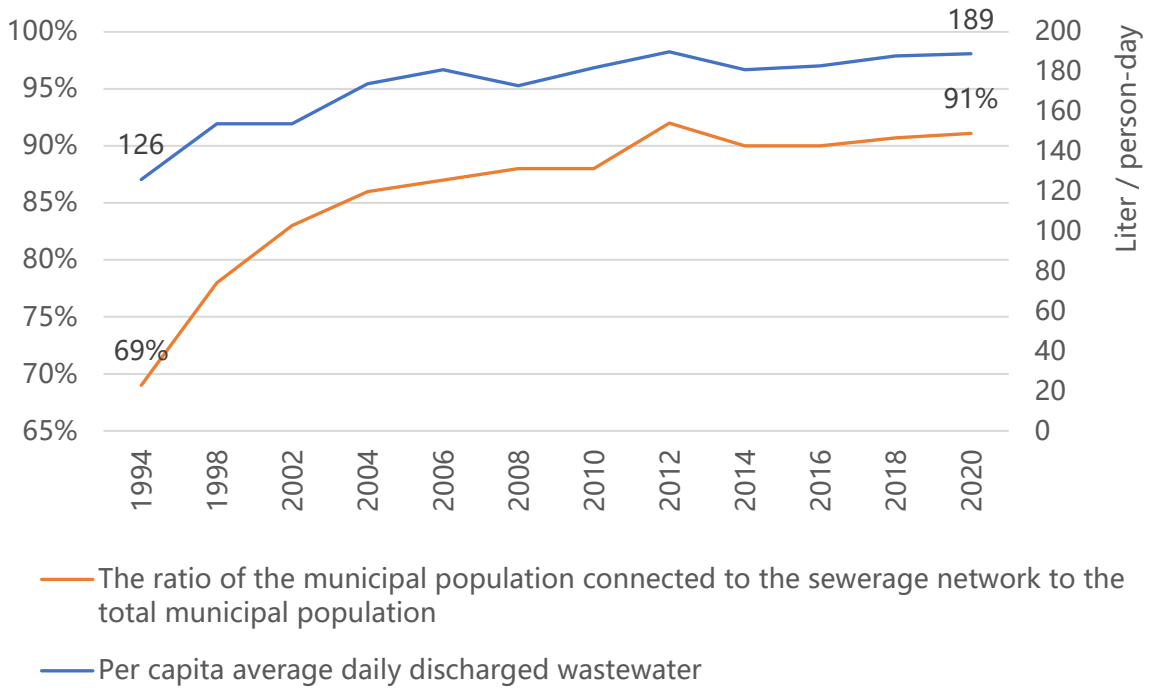

Biological treatment of waste is also on the verge of development. According to National Waste Management and Action Plan, biowaste rate is 50,41% in the municipal waste. Biological treatment of waste is also in developing trend; however annual capacity is currently not satisfactory at a too low level of 1.5 Mt. There exist 28 biological waste recovery facilities (9 composting, 19 bio-methanation) for municipal waste; 24 mechanical treatment facilities, 1 bio-

[48] MoEUCC, 2023_a.

[49] NIR, 2022 p. 412.

drying facility for mixed municipal waste and 3 incineration plants for municipal waste.[50] Private sector has been involved in solid waste management investments supported by incentives such as the YEKDEM mechanism. The private sector generally focuses on the rehabilitation of dump sites in the form of long-term (up to 49 years) build-operate-transfer (BOT) contracts with the Municipalities. These public-private partnership (PPP) projects are popular on integrated waste management for a city or a region including landfill gas capturing, biological recovery, and waste to energy facilities. (see Section 3.2.5)

*Figure 25 – Wastewater amount and services[51]*




Türkiye is in the process of transition to a circular economy. Within this process, Türkiye's priority is to continue our work on the basis of the Zero Waste project that the Country started in 2017.

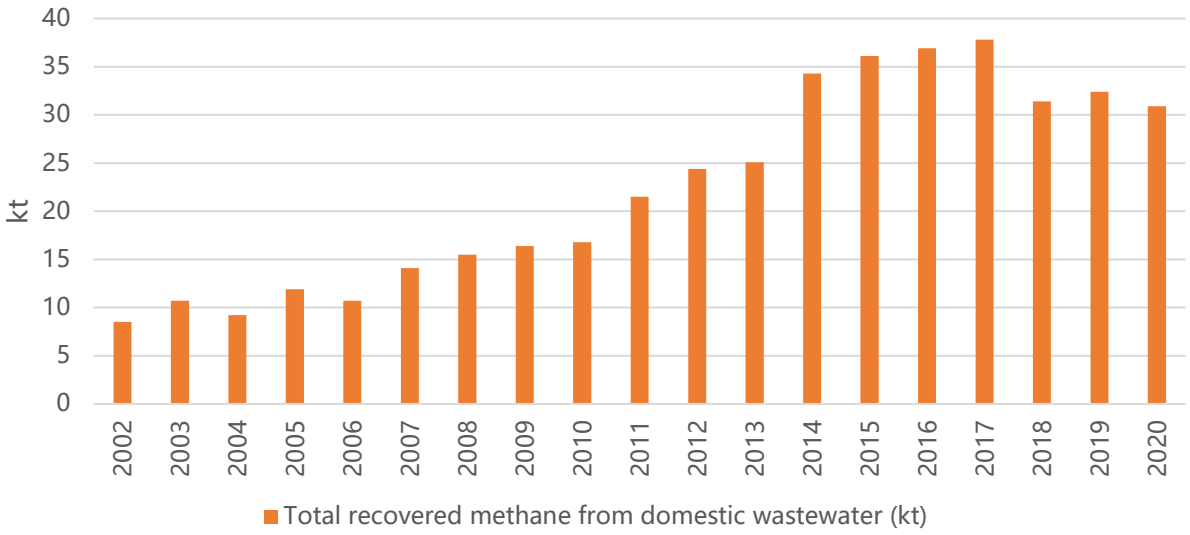
Between 1994 and 2020, both the ratio of the population connected to the municipal sewerage network and their per capita wastewater discharge increased. The percentage of the municipal population connected to sewerage rose from 69% to 91.1%. Per capita average daily wastewater discharged by the municipal population increased from 126 liters in 1994 to 189 liters in 2020. While increasing the treated wastewater, Türkiye also increased its capacities to utilize wastewater. Between 2002 to 2020, number of wastewater biogas facilities with methane

[50] MoEUCC, 2022

[51] MoEUCC, 2023_b.

recovery increased from 2 to 25 and the amount of methane recovery increased from 8.5 kt to 30.9 kt during same period.[52]

*Figure 26 – Recovered methane at the wastewater treatment facilities (2002-2020)[53]*




GHG emissions from waste disposal sites increased by 73.6% during 1990-2020 periods (from 6.7 Mt to 11.7 Mt), while waste disposal was increased by 83% in the same period. Wastewater discharge increased by 200% while GHG emissions from the same sector increased by 6%. The sector's most important greenhouse gasses are methane ($CH_4$) and nitrous oxide ($N_2O$) and the waste sector alone is responsible for 22% of total $CH_4$ emissions and 6% of total $N_2O$ emissions in the year 2020.[54] Thus, methane recovery supports the decrease of waste sector's emissions.

## 2.11 AGRICULTURE

The agriculture sector is among the sectors which provide a major contribution to the country's GDP, exports, and rural development. Türkiye is an important producer and exporter of agricultural commodities on world markets and is estimated to be the world's 7th largest agricultural producer.[55] Türkiye's agricultural vision for the year 2023 is that being a country which provides its population with sufficient, best quality and safe food; improves its net exporter position in agricultural products and; increases its competitiveness in the global market aiming to be among the top five overall producers globally. Türkiye's vision for its centenary in 2023 includes other ambitious goals; i) agricultural GDP reaching to 150 billion dollars; ii)

[52] NIR, 2022 p. 443.

[53] NIR, 2022.

[54] Data source: NIR, 2022.

[55] OECD, 2016.

agricultural exports over 40 billion dollars; iii) sustainable agricultural growth iv) achievement and land consolidation on 14 million ha; and v) modern irrigation systems for all irrigable land.[56]

Türkiye's agricultural sector accounted for 6.46% of the country's GDP in the year 2022. The main sources of agriculture sector GHG emissions are enteric fermentations, agricultural soils and manure management. Agricultural activities were the primary contributors of $CH_4$ and $N_2O$, 60.96% of $CH_4$ emissions and 80.29% of $N_2O$ emissions originate from agricultural activities in 2020.[57]

*Figure 27 - Agriculture Basins of Türkiye*[58]

Türkiye identified 30 agriculture basins defined by climate, soil characteristics, topography, and land class criteria in 2009 (See Figure 27). Basin-based agricultural support policy was implemented for 17 products. In order for more rational planning, district level agricultural basins were then defined in 2016 and the number of agricultural basins reached to 941 basins. 21 products have been under the scope of basin-based supporting systems. By adding newly established restricts, the number of basins increased to 944 in 2018.

### 2.11.1 Agricultural Lands

There has been a significant decline of agricultural lands in Türkiye since 1990. Türkiye had 23.7 million hectares arable land in 2016 while it was 27.9 million hectares in 1990 (Figure 28). There are 921 different agricultural basins based on rainfall, temperature, and topographical properties. In those agricultural basins above 250 agricultural products are produced and sold.

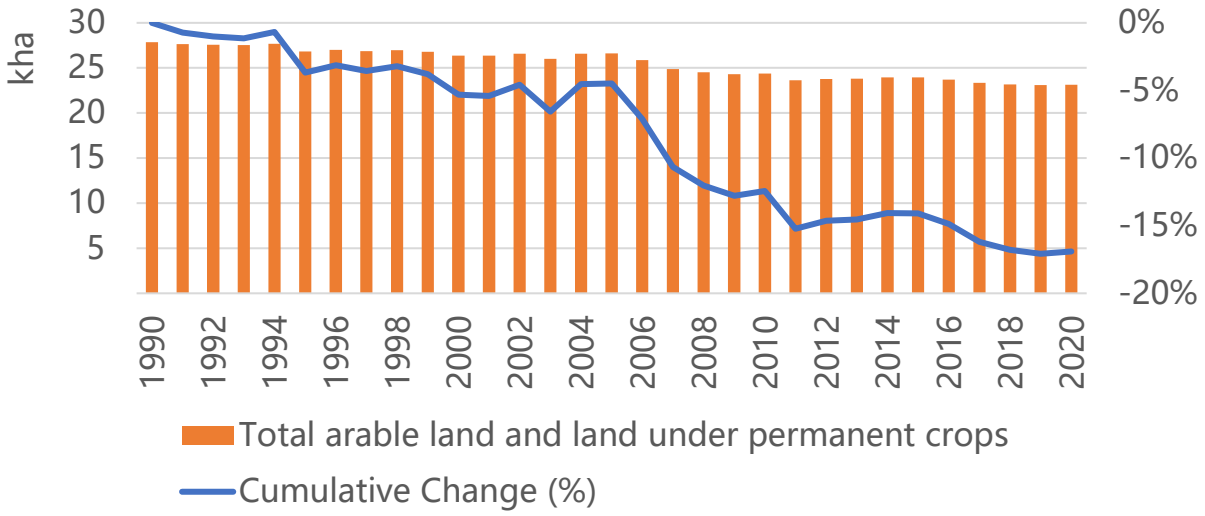
[56] MoAF, 2017.

[57] Data source: NIR, 2022.

[58] MoAF, 2023_b.

Of the total arable land, 67% is cropland, 17% is fallow land and the rest of them are cultivated as horticulture, vegetable, vineyards and olive gardens.

*Figure 28 - Total arable land and land under permanent crops*[59]

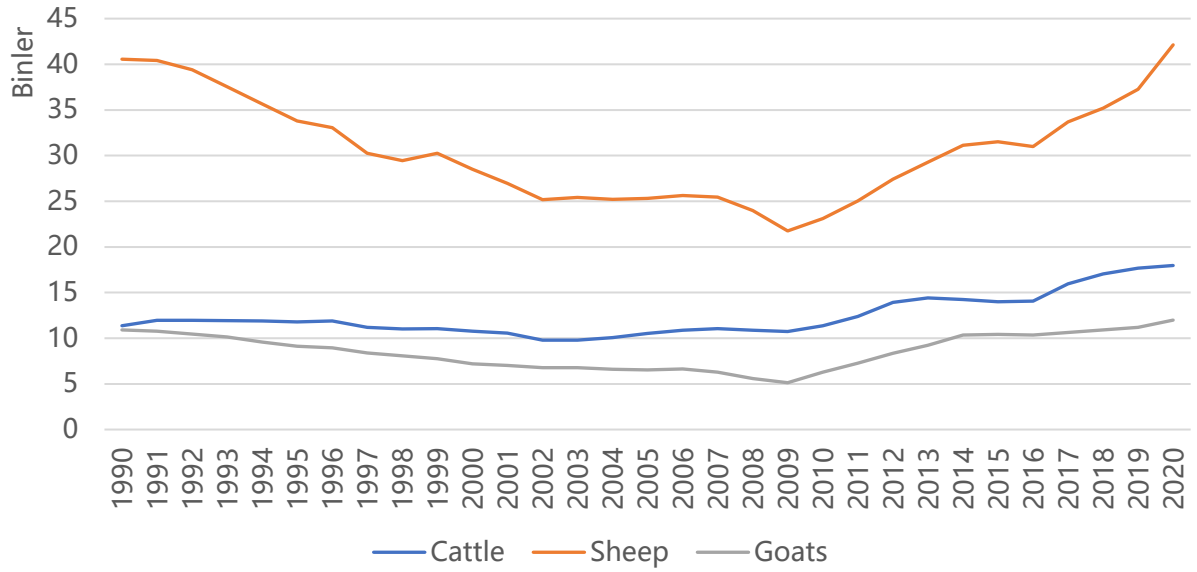



### 2.11.2 Livestock

Livestock has the biggest share of the agricultural GHG emissions and is an important part of Türkiye's agricultural sector. In 2016 the total number of cattle was approximately 14 million, and for sheep and goats, it was around 31.0 and 10.4 million, respectively while those numbers were 11.4 million, 40.6 million and 10.9 million respectively in 1990. Türkiye has experienced a decline in the number of sheep and goats since 1990. Based on recent agricultural policy to increase livestock for sustainable food supply from domestic sources, GHG emissions are expected to increase from enteric fermentation and manure management.

[59] TurkStat, 2023_d.

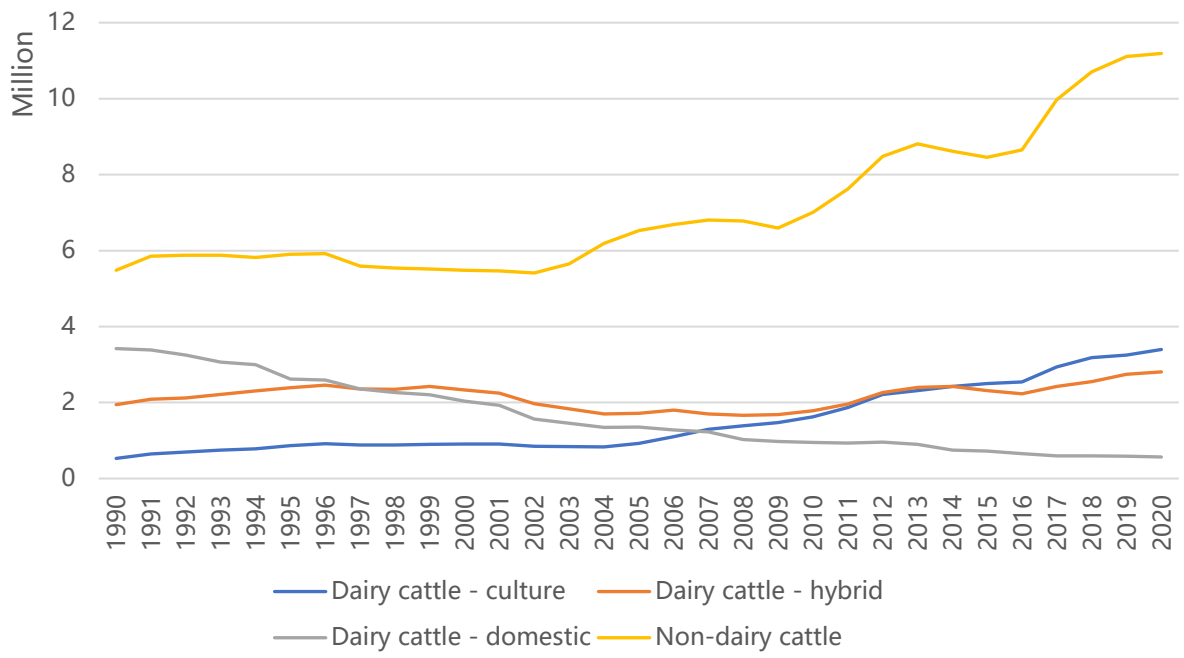
*Figure 29 - Livestock population, 1990-2020*[60]




In Türkiye there are three dairy cattle types categorized as culture cattle, hybrid cattle and domestic cattle. Culture dairy cattle is a dairy cattle type having higher milk yields compared to domestic dairy cattle whereas milk yields values of hybrid cattle are between them. Hybrid cattle are breeds of culture and domestic dairy cattle. As it is seen in the table, culture dairy cattle population is increasing by years except for the years 1997, 1998 and 2002-2004. But, in general, the culture dairy cattle population has a positive trend in the period 1990-2020, which has a percentage increase of 41.2% from 9% in 1990 to 50.2% in 2020 within dairy cattle population. For hybrid cattle population, which was around 2.8 million in 2020 despite being 1.9 million in 1990, a big increase or decrease cannot be observed throughout the same period, though the final three reporting years identified a total increase of around 0.4 million. The share of domestic cattle among dairy cattle was 58.1% in 1990 but this ratio reduced to 8.4% in 2020. As seen in Figure 30, non-dairy cattle number increased by approximately 5.7 million from around 5.5 million in 1990 to more than 11.2 million in 2020 and its share in total number of cattle increased from 48.2% to 62.3% between 1990 and 2020.

[60] NIR, 2022.

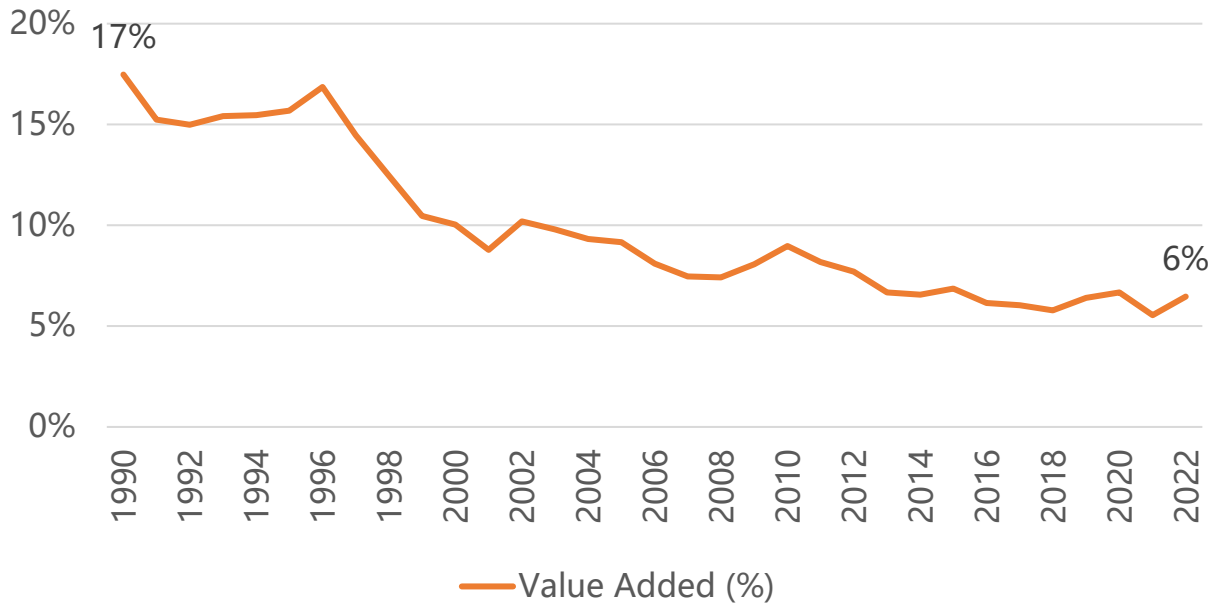
*Figure 30 - Population numbers for cattle categories, 1990–2020*




### 2.11.3 Value Added

The share of the agriculture sector in GDP in 1960 was 54% in Türkiye and Türkiye was considered to be an agricultural country in those years. However, the contribution of the agricultural sector to the economy gradually decreased and the share in GDP fell below 30% by the end of 1970, below 20% in the mid-1980s and below 10% by the 2000s. By the year 2022 the share of agriculture in GDP was dropped to 6.46% (See Figure 31), and the course of the ratio is expected to continue declining in the coming years.

*Figure 31 - Value added of Agriculture sector as % of GDP, 1960-2022*[61]




### 2.11.4 Organic Farming Practices

Organic farming in Türkiye began practice in the mid-1980s. In order to create an improvement in the legal framework for organic farming, the By-Law on Production of Plant and Animal Products through Ecological Methods entered into force by 1994. The Organic Farming Act No. 5252 was prepared within the framework of the EU laws and was enacted in 2004. On the basis of this law, the By-Law on the Principles and Implementation of Organic Farming was passed in 2010. By 2002, 310 125 tonnes of organic products were produced on an agricultural area of 89 827 ha, those figures were 351.919 ha agricultural land under organic farming with a crop production of 1.6 million tonnes in 2021.[62]

Agricultural soils was one of the main drivers of the agricultural sector's GHG emissions. In Türkiye around 19.6 million hectares of agricultural land is fertilized annually, 113 kg of fertilizers per hectare is used on the average. Total N-fertilizer consumption increased from 1.2 Mt to 1.9 Mt during 1990-2016.[63] The Increase in fertilizer consumption has foreseen a continuous increase in N2O emissions from agricultural soils.

[61] Data source: World bank, 2023
[62] 7th NC, 2019
[63] 7th NC, 2019

## 2.12 FORESTRY

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

A large portion of Türkiye's forests are natural forests with high biodiversity values. Many of the plant species have additional values in raw material production, including wood, and the use of roots, bark and resin for medicinal and aromatic purposes. Many of the harvested fauna species are used for the production of herbal products of animal origin.[64]

According to forest inventory results, forest area was 20.2 Mha in 1973 and increased to 22.93 Mha in 2020. Forest lands increased nearly 2.3 M hectares in the last 46 years. According to 2020 forest inventory results, approximately 9.7 Mha of this forest estate can be classified as degraded forests. The inventory estimates that growing stocks increased from 1.1 billion m3 to 1.7 billion m3 during 1973-2020 periods. The annual increment of the forests in Türkiye changed to 28.1 million m3, which is 1.4 m3 in 1 ha in 1973, to 47.0 million m3 which 2.1 m3 in 1 ha in 2020. The main reason for this increment is the increase of growing stock due to the silvicultural tending activities species.[65]

Pinus brutia, Pinus nigra and Pinus sylvestris are the dominant coniferous species among the other coniferous such as four kinds of Abies spp., Picea orientalis, Cedrus libani etc. In proportion these three-pine species is more than 52 % as in total volume of growing stock. Fagus orientalis and 22 Quercus spp. have a 68% ratio in total volume of the deciduous trees such as Tilia, Ulmus, Alnus, Castanea species.[66]

[64] 7th NC, 2019
[65] 7th NC, 2019
[66] 7th NC, 2019

99% of the forests in Türkiye belong to the state. 3.64 million hectares of the total forest area (15%) are found in protected areas and the rest of the 19.3 million hectares of forest area are in managed forests.

*Table 4 - Forest inventory results of Türkiye, Area 2020.*[67]

| Forest Type | Total (ha) | Coniferous (ha) | Deciduous (ha) | Coniferous+ deciduous Mixed (ha) |
|---|---|---|---|---|
| **Total** | **22 933 000** | **10 969 246** | **7 405 972** | **4 557 782** |
| Productive | 13 264 429 | 7 311 005 | 3 878 112 | 2 075 312 |
| Degraded | 9 668 571 | 3 658 241 | 3 527 860 | 2 482 470 |

*Table 5 - Forest inventory results of Türkiye, Growing Stock, 2020.*[68]

| Forest Type | Total (ha) | Coniferous (ha) | Deciduous (ha) |
|---|---|---|---|
| **Total** | **1697 055 000** | **1156 449 376** | **540 605 624** |
| Productive | **1628 295 394** | 1114 195 394 | 514 100 000 |
| Degraded | **68 759 606** | 42 253 982 | 26 505 624 |

*Table 6 - Forest inventory results of Türkiye, Annual Increment, 2020.*[69]

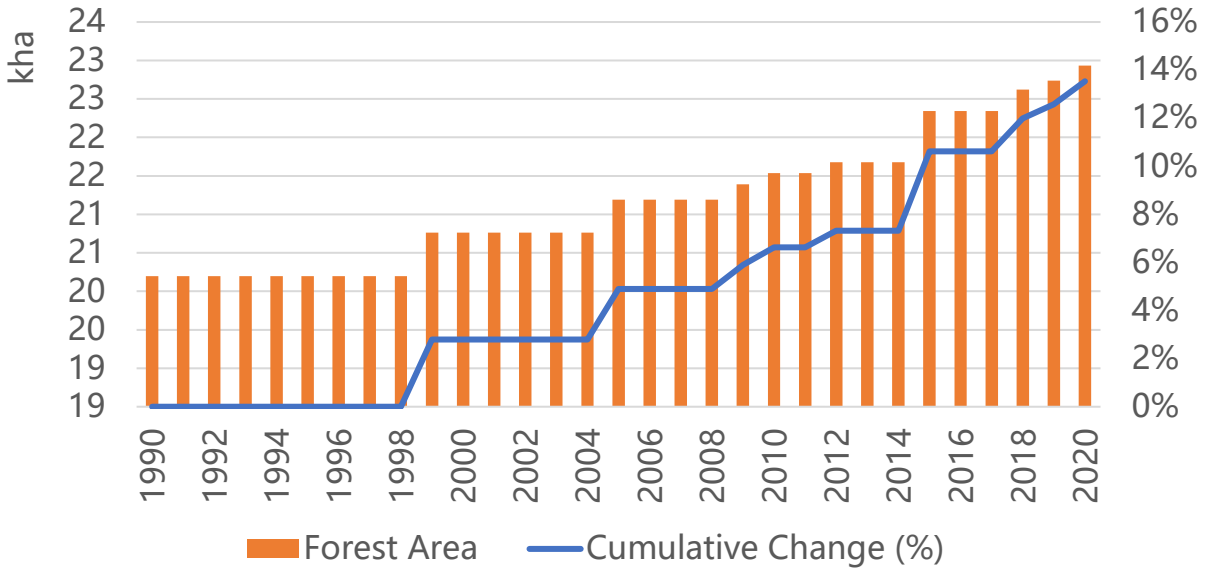
| Forest Type | Total (ha) | Coniferous (ha) | Deciduous (ha) |
|---|---|---|---|
| **Total** | **47 400 000** | **31 585 762** | **15 814 238** |
| Productive | **45 410 077** | **30 602 836** | **14 807 241** |
| Degraded | **1 989 923** | **982 926** | **1 006 997** |

[67] Data source: MoAF, 2023_a.

[68] Data source: MoAF, 2023_a.

[69] Data source: MoAF, 2023_a.

*Figure 32 – Change in forest areas of Türkiye (1990-2020)*[70]




### 2.12.1 Forest Restoration

Almost half of Türkiye's forests are considered to be degraded, with less than 10% canopy cover. In addition, 13.3 million hectares of forest has a canopy cover more than 11%. The ability of forests to regenerate declines based on human-induced pressures, including industrialization and urbanization. However, in areas where threats have been reduced, forests have regenerated. The General Directorate of Forestry has been conducting activities on the restoration of degraded forests and reforestation since 1995. The main goal of these efforts is to develop forest structure through the sink capacity and increase the yield ratio of forests. This process also covers the maintenance of naturally regenerating forest species. Reforestation and rehabilitation have been carried out in Türkiye. In 2020 9,320 ha was reforested and 56,576 ha was rehabilitated.[71]

[70] TurkStat, 2023_d.

[71] Data source: MoAF, 2023_a.

*Figure 33 - Reforestation Activities, 1992-2020.*[72]

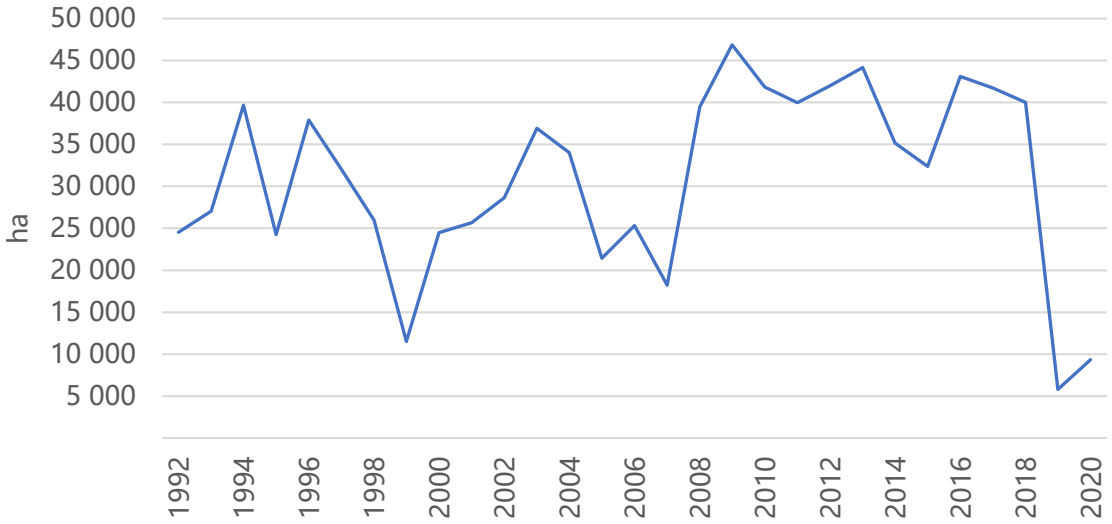
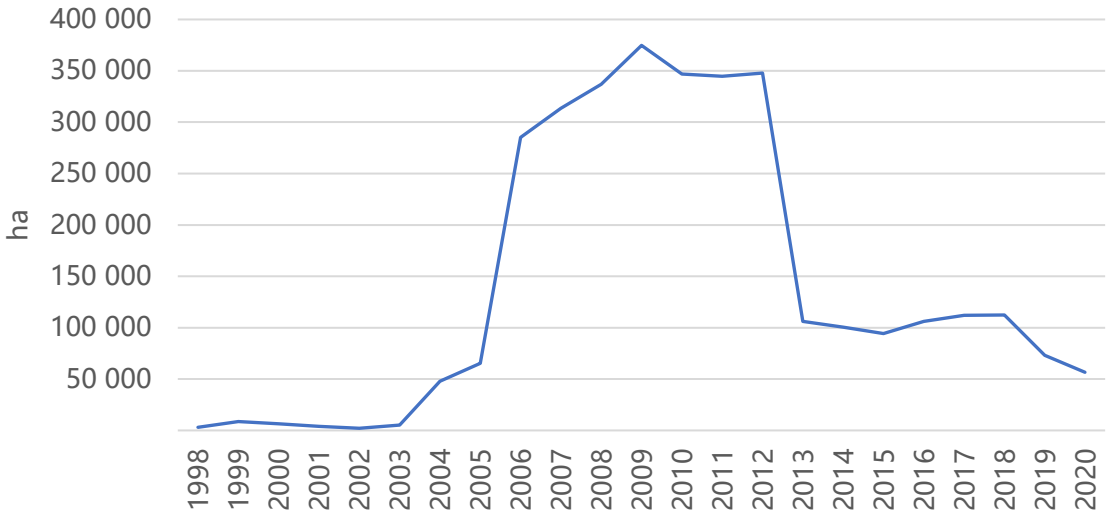



*Figure 34 - Forest Rehabilitation Activities, 1998-2020.*[73]




Sustainable forest management activities aim to increase forest area and growing stocks in Türkiye through reforestation, rehabilitation and Carbon removal rate is expected to increase in the next decade. GDF has a target for increase the growing stocks per hectare and forest area in the Strategic Plan of GDF (2019-2023).

## 2.13 TOURISM

Surrounded by seas on three sides, acting as a natural bridge between Asia and Europe, and with unique geopolitical importance, Türkiye has been a cradle of great civilizations throughout

[72] Data source: MoAF, 2023_a.

[73] Data source: MoAF, 2023_a.

history. There are nine World Heritage Sites in Türkiye and an additional 19 temporarily listed values on the World Heritage List. With its 8,333 km long coastline, Türkiye is a major tourist attraction. Tourism is also the country's main source of foreign exchange.

Türkiye is the 4th most popular tourist destination in the world, attracted approximately 30 million touristsin 2021. Türkiye had 531 blue-flag beaches in 2022. There are also 24 blue-flag marinas in Türkiye.[74] Bed capacity documented by the Ministry of Culture and Tourism was 568,960 in 2000 and reached 1.2 million in 2021. Bed capacity documented by the municipalities grew from 350,000 in 2000 to approximately 620,349,315 in 2021.[75]

There has been a rapid increase in the number of tourists coming to Türkiye (See Figure 35). The annual number of tourists has grown from approximately 5.4 million in 1990 to 51.4 million in 2022. It was low in 2020 and 2021 due to the COVID19 pandemic. Tourism revenue worth 46.3 billion USD was generated in 2022.[76]

*Figure 35 - Number of tourists, 1990-2022*[77]


Turkish tourism sector is targeting to be among the top 5 countries in the world in terms of attracting the highest number of tourists and receiving the highest amount of tourism revenue by 2023. The tourism sector has set a target of 60 million tourist arrivals and 56billion USD tourism revenue by 2023.

[74] TURÇEV, 2023.

[75] TURSAB, 2023.

[76] TurkStat, 2023_h.

[77] Data source: For 1990-2003, TURSAB, 2023 and for 2004-2022, TurkStat, 2023_h.

## 2.14 WATER RESOURCES

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

River hydrological regimes in Türkiye depend heavily on the variability of precipitation and these rivers regimes are thus quite irregular. According to General Directorate of State Hydraulic Works (DSİ), Türkiye has 25 hydrological basins. Türkiye has a hydro-meteorological observation network of 8,759 observation stations, of which are 260 snow monitoring stations, 1,340 flow monitoring stations, 2,812 groundwater monitoring stations and 531 lake-dam observation stations, all of which are operated by the DSİ.

Türkiye's consumable surface and ground water potential is 112 billion m3 per year. Based on the projects developed by the public institutions responsible from soil and water resources in Türkiye annual water consumption for various purposes reached to 57 billion m3 as of the end of 2022

Utilization rate of the current 112 billion m3 of available water resources is still around 51%. 44 billion m3 of the available water is used for irrigation (77%), 13 billion m3 is used for domestic and industrial use (23%).

Water consumption in Türkiye is increasing due to population growth and industrialization. However, Türkiye is a country that is not rich in freshwater resources. According to the annual per capita water consumption figures, Türkiye is a country that experiences water stress. The amount of annual water available per capita is calculated as 1,313 $m^3$ for 2022. Türkiye's hydroelectric potential was evaluated at Section 2.6.2.

## 2.15 TÜRKİYE'S SPECIAL CIRCUMSTANCES

UNFCCC established a system of annexes that divided countries into Annex I and II countries and Non-Annex countries. The Annex I countries included the industrialized countries that were members of the OECD and the former countries of the USSR as "Economies in Transition" [EIT]. Annex II included the developed and industrialized countries. Türkiye, albeit being a developing country, was included in both Annexes I and II because of its OECD membership. However, the UNFCCC does not provide a definition of "developed" or "developing" countries. Türkiye did not

sign the UNFCCC when adopted in 1992 and in 1997 initiated the process to be deleted from Annexes I and II.

In 2001, at the Seventh Conference of the Parties held in Marrakesh, Decision 26/CP.7 was adopted, and Türkiye was removed from the list in Annex II. Parties were also invited to recognize the "special circumstances of Türkiye, which placed Türkiye after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention." The decision took note of FCCC/CP/1997/MISC.3, submitted by Türkiye outlining its socio-economic status as a developing country. It was explained that GNP of Türkiye was $2,700 and human-induced carbon dioxide emission was 2.3 tons per capita in 1993 and total of 153 million tons was 1/10 of the Annex II countries in the submitted document. The decision further underlined the need for all Parties to protect the climate system for present and future generations, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Türkiye's position regarding its "special circumstances" is based on the principles of equity, common but differentiated responsibilities and respective capabilities, and the right to promote sustainable development in accordance with article 3 of the Convention. Further, different from other Parties included in Annex I, Türkiye does not bear historical responsibility for climate change.

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

The World Bank lists Türkiye as an upper middle-income developing country. According to World Bank's data in 2020, Türkiye's gross national income was 8,600 $ per capita.. Because of this condition, Türkiye is also eligible for official development aid under the OECD Development Assistance Committee list. (FCCC/TP/2013/3). Moreover, according to World Bank data, Türkiye's per capita and total carbon emissions are lower than many developing countries that are outside Annex I list.

The Conference of the Parties has taken other decisions concerning Türkiye in the coming years. 16. The decision 1/CP.16 adopted by the Conference of the Parties has officially recognized that Türkiye's national circumstances are different from Annex-I countries and has clearly approved that Türkiye is in a different position from the developed countries and countries in transition to a market economy. This decision also requested from the Long-Term Cooperative Action Ad

Hoc Working Group (AWG-LCA) established under the Convention to dwell upon Türkiye to have better access to the financing, technology and capacity-building opportunities to develop its ability to apply the provisions of the Convention more effectively.

In Durban, decision No. 2/CP.17 was taken to continue to further develop the Cancun the decisions on Türkiye

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

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

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

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

> *Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties,*
>
> *Reaffirming decisions 26/CP.7, 1/CP.16 and 2/CP.17, which recognized that Türkiye is in a situation different from that of other Parties included in Annex I to the Convention; Recalling that deep cuts in global greenhouse gas emissions are required and that closing the ambition gap is a matter of urgency; Recognizing that various actions to address climate change can be justified economically in their own right and can also help in solving other environmental problems in accordance with the objectives of sustainable development;*
>
> *Reaffirming the importance of financial, technological, and capacity-building support to Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties in order to assist these Parties in implementing the Convention,*

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

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

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

In the decision of the Conference of the Parties, UNFCCC is requested to prepare a technical report identifying the opportunities that Türkiye (Annex I Parties whose special circumstances are recognized by the Conference of the Parties) can benefit, at least until 2020, from support from relevant bodies established under the Convention and other relevant bodies and institutions to enhance mitigation, adaptation, technology, capacity-building and access to finance, to be evaluated by the Subsidiary Body for Implementation (SBI) at the next conference. The technical report with No. FCCC/ TP/2013/3 prepared by the secretariat states clearly that Türkiye is an upper middle class rapidly growing country and that is appropriate for the official development assistance under the OECD Development Assistance Committee. According to the technical report prepared by the Secretariat, 20th Lima Conference of the Parties adopted the decisions similar to the decisions adopted in Doha at the 20th Conference of the Parties on the basis of the recommendations offered by the Subsidiary Body for Implementation (FCCC/TP/2013/3) (21/CP.20). According to this decision, the supports that can be received by Türkiye at least until 2020 from the bodies established under the Convention, other relevant bodies and institutions in order to ensure progress in areas such as mitigation, adaptation, technology, capacity building and finance. The Annex-II countries have been invited to help

Türkiye with the implementation of national climate change strategies and actions plans and development of low-emission development plans and strategies in line with the decision No. 1/CP.16 by providing financial, technological, technical and capacity- building support through multinational agencies including the GEF, relevant intergovernmental organizations, international financial institutions, other partnerships and initiatives, bilateral agencies and the private sector, or through any further arrangements, as appropriate.

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

> *Reaffirming decisions 26/CP.7, 1/CP.16, 2/CP.17 and 1/ CP.18, which recognized that Türkiye is in a situation different from that of other Parties included in Annex I to the Convention,*
>
> *Also reaffirming the importance of financial, technological and capacity-building support to Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties in order to assist these Parties in implementing the Convention,*
>
> *1. Recognizes the opportunities for Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties to benefit, at least until 2020, from support from relevant bodies established under the Convention and other relevant bodies and institutions to enhance mitigation, adaptation, technology, capacity-building and access to finance; Encourages Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties to fully utilize those opportunities; Urges Parties included in Annex II to the Convention which are in a position to do so, through multilateral agencies, including the Global Environment Facility within its mandate, relevant intergovernmental organizations, international financial institutions, other partnerships and initiatives, bilateral agencies and the private sector, or through any further arrangements, as appropriate, to provide financial, technological, technical and capacity-building support to Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties in order to assist them in implementing their national strategies, actions and plans on climate change mitigation and adaptation, and in developing their low-emission development strategies or plans in accordance with decision1/CP.16.*

The Conference of the Parties having recognized Türkiye's special circumstances acknowledge that Türkiye is an upper middle-income developing country still undergoing rapid development in need of financial support to enable it to shift to a low emission and climate-resilient development pathways paradigm. Türkiye's access to financial support available to other upper middle-income developing Parties to the Convention fulfills the principles of equity, common

but differentiated responsibilities, and the right and duty to promote sustainable development as stipulated by the decision 26/CP.7 dated 2001.

To allow countries to determine their own situation in accordance with the "self-differentiation" principle, here is no definition and classification of developed/developing country in the Paris Agreement. Although Türkiye is among the Annex-1 list countries within the scope of the UNFCCC, there is no clear provision in the Paris Agreement that legally connects the countries in the Annex lists. Therefore, Türkiye signed the Paris Agreement as a developing country on April 22, 2016 during the signatory ceremony held in New York. Later on, Türkiye ratified on October 7, 2021 and become a party to the Agreement on November 10, 2021. The Republic of Türkiye declared its statement, on the basis of "equity, common but differentiated responsibilities and respective capabilities" as clearly and accurately recognized under the United Nations Framework Convention on Climate Change of 9 May 1992 and the Paris Agreement, and by recalling decisions 26/CP.7, 1/CP.16, 2/CP.17, 1/CP.18 and 21/CP.20 adopted by Conference of the Parties to the Convention, declares that it will implement the Paris Agreement as a developing country and within the scope of its nationally determined contribution statements, provided that the Agreement and its mechanisms do not prejudice its right to economic and social development.

Although this National Communication is a part of Türkiye's reporting obligation under the Convention, the fact that this communication was prepared and submitted will not prejudice Türkiye's ratification status of the Paris Agreement with the declaration and the understanding of a developing country. It will not cause it to be referred to as a developed country in the global-scale exercises to be carried out within the scope of the Paris Agreement.

# 3 INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINKS

## 3.1 GREENHOUSE GAS EMISSION TRENDS

Türkiye, as an Annex I party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories. The latest GHG inventory submission contains national GHG emission/removal estimates for the period of 1990-2020.[78] The emissions presented in this document are those communicated in the 2022 submission to the UNFCCC Secretariat. A complete description of the factors underlying the Turkish emission trends, the rationale for the choice of methodologies, the emission factors and parameters used to estimate emissions for the relevant sectors is provided in the National Inventory Report, and CRF tables.[79]

Türkiye's total GHG emissions were 523.9 Mt $CO_2$ eq. excluding the LULUCF, and 466.9 Mt $CO_2$ eq., including the LULUCF in 2020. The energy sector was the highest contributor with 367.6 Mt $CO_2$ eq. followed by agriculture with 73.2 Mt $CO_2$ eq., industrial processes and other product use (IPPU) with 66.8 Mt $CO_2$ eq., and waste with 16.4 Mt $CO_2$ equivalent. Regarding their shares, the energy sector has the highest percentage with 70.2%, agriculture has 14.0%, industrial processes and other product use (IPPU) has 12.7%, and waste has 3.1%. (Figure 36, Table 7)

There were increasing trends in the annual change almost for each sector from 2019 to 2020. Sectors' increasing trends were 0.6% for energy, 14% for IPPU, 7.5% for agriculture, and 2.1% for waste. On the contrary, LULUCF decreased by 32.2%. In the long term, all sectors have an increasing trend from 1990 to 2020. Energy sector emissions increased by 163% compared to 1990. During the same period, IPPU sector emissions increased by 190%, agricultural sector emissions increased by 59%, and waste sector emissions increased by 48%.[80] (Figure 37) The main reasons for the increase for all sectors were population growth, a growing economy and an increase in energy demand.

[78] NIR, 2022.

[79] NIR, 2022 and CRF, 2022.

[80] NIR, 2022.

*Figure 36 - Greenhouse gas emissions/removals, Mt $CO_2$ eq., 1990-2020*[81]

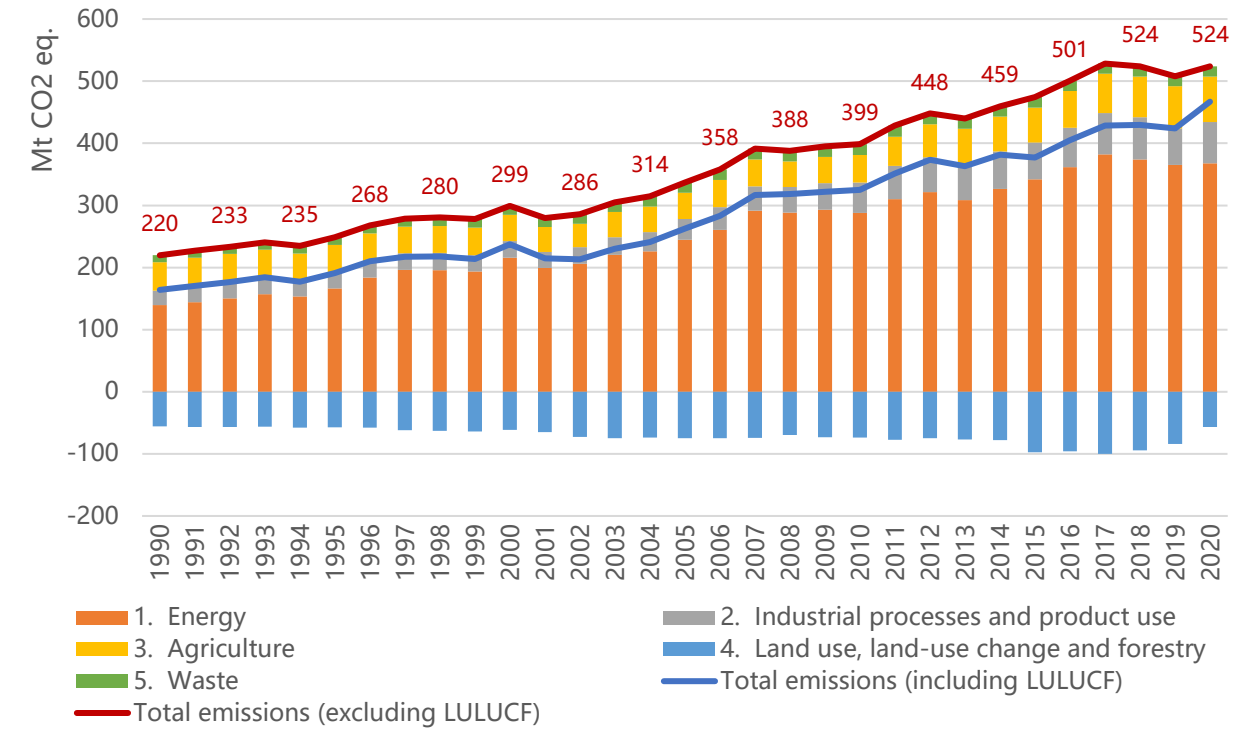
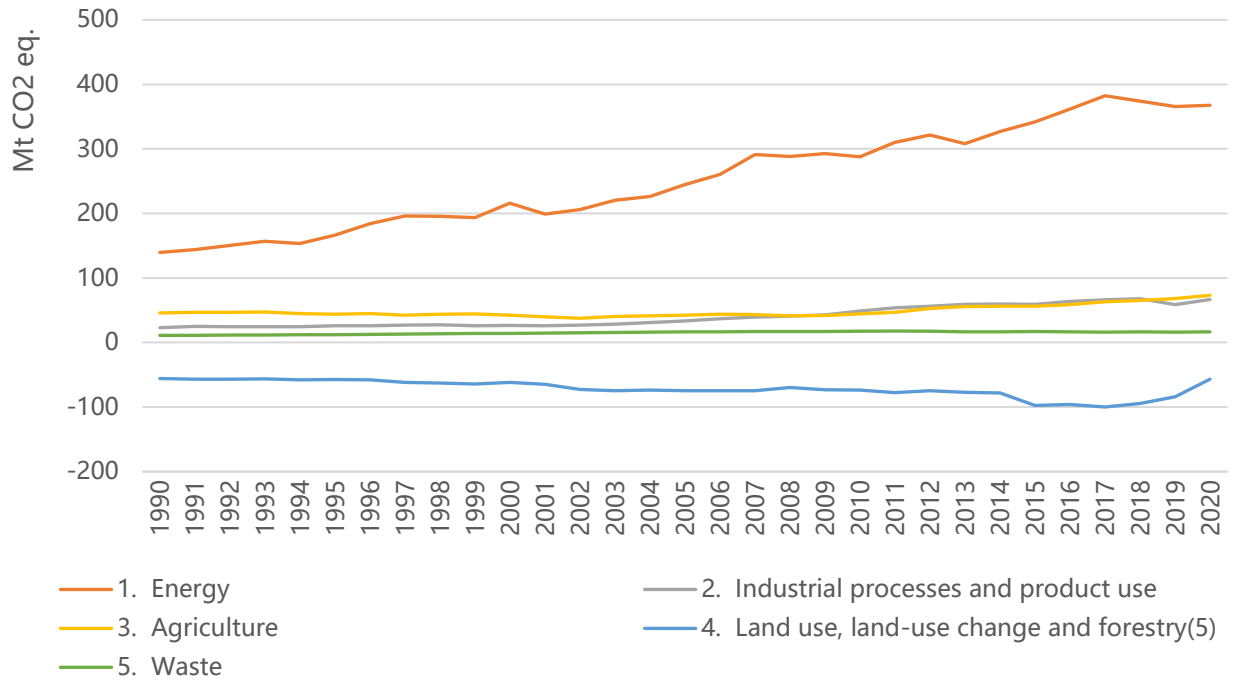



*Figure 37 - GHG emission trend by sectors, Mt $CO_2$ eq., 1990-2020*[82]




[81] Data source: CRF, 2022.

[82] Data source: CRF, 2022.

*Table 7 - Greenhouse gas emissions/removals, Mt $CO_2$ eq., 1990-2020*

| Year | Energy | IPPU | Agriculture | LULUCF | Waste | Total (without LULUCF) | Total (with LULUCF) |
|---|---|---|---|---|---|---|---|
| 1990 | 139.6 | 23.0 | 46.1 | -55.7 | 11.1 | 219.7 | 164.0 |
| 1995 | 166.3 | 25.9 | 44.1 | -57.4 | 12.3 | 248.6 | 191.2 |
| 2000 | 216.0 | 26.3 | 42.3 | -61.6 | 14.3 | 299.0 | 237.4 |
| 2005 | 244.4 | 33.7 | 42.4 | -74.5 | 16.4 | 337.0 | 262.5 |
| 2010 | 287.8 | 49.0 | 44.4 | -73.6 | 117.4 | 398.7 | 325.1 |
| 2015 | 342.0 | 59.2 | 56.1 | -97.5 | 17.1 | 474.5 | 376.9 |
| 2016 | 361.7 | 63.5 | 58.9 | -96.0 | 16.7 | 500.8 | 404.8 |
| 2017 | 382.4 | 66.4 | 63.3 | -99.8 | 16.3 | 528.3 | 428.5 |
| 2018 | 374.1 | 68.0 | 65.3 | -94.4 | 16.6 | 524.0 | 429.6 |
| 2019 | 365.4 | 58.6 | 68.0 | -84.0 | 16.1 | 508.1 | 424.0 |
| 2020 | 367.6 | 66.8 | 73.2 | -56.9 | 16.4 | 523.9 | 466.9 |
| Change (%) from base to latest reported year | 163.3% | 190.5% | 58.8% | 2.2% | 48.0% | 138.4% | 184.8% |

### 3.1.1 GENERAL FACTORS UNDERLYING EMISSION TRENDS

Türkiye's GHG emission trends are highly correlated with GDP growth rate. The total and net GHG emissions trends are similar to the trend in GDP for 1990-2020 periods. There is an increasing trend in the total emissions over the period of 1990-2020. However, for year 1994, 1999, 2001 and 2008 the GHG emissions decreased due to economic slowdown in those years. The GHG emissions decreased by 2.7%, 0.4%, 6.3% and 0.8% respectively as compared to the previous years.

In the energy sector; manufacturing industries and construction and other sectors show 10.3% and 8.6% increase respectively while the transport sector 2.12% and energy industries show 4.4% decrease in 2020.[83]

[83] NIR, 2022

*Table 8 - Selected indicators of Türkiye, 1990-2020*[84]

| Indicators | 1990 | 2000 | 2010 | 2020 | Change (%) as compared to 1990 |
|---|---|---|---|---|---|
| GDP (current, Billion US$) | 149.19 | 273.08 | 777.46 | 717.09 | 380% |
| GDP per capita (current US$) | 2,774 | 4,249 | 10,629 | 8,600 | 209% |
| Population (million people) | 55.1 | 64.3 | 73.1 | 83.4 | 48% |
| Urban Population (million people) | 28.98 | 40.17 | 52.34 | 77.73 | 156% |
| Rural Population (million people) | 27.49 | 27.63 | 21.38 | 5.88 | -66% |
| Total Primary Energy Supply (Mtoe) | 52.5 | 79.4 | 105.9 | 147.17 | 180% |
| Primary Energy Supply Per Capita (toe/person) | 0.93 | 1.17 | 1.44 | 1.75 | 88% |
| Electricity consumption per capita (kWh/capita) | 829 | 1,450 | 2,334 | 3,910 | 372% |
| Total GHG emissions (Excluding LULUCF) (Mt $CO_2$ eq.) | 219.72 | 299,01 | 398,68 | 523.9 | 138% |
| Greenhouse Emissions Per Capita (ton $CO_2$ eq. per capita) | 3.9 | 4.6 | 5.4 | 6.3 | 58% |

The fluctuations in the emission trends are mainly due to the trends in economic activities. Therefore, GDP can be thought as the main driver of the GHG emissions in Türkiye. It has nearly the same pattern as total GHG emissions for the period 1990-2020. It reached 719 billion USD in 2020 from 149 billion USD in 1990.

Population data is another driver of the emission trends in national inventories. The mid-year population of Türkiye increased about 48% for the period 1990-2020. While it was 55 million in 1990, it reached 83 million in 2020. Türkiye's per capita GHG emission was 4.0 t $CO_2$ eq. in 1990 and increased to 6.3 t $CO_2$ eq. in 2020.[85]

[84] Data sources: Worldbank, GDP, TurkStat_a, 2020 for population, MENR, 2020 for energy, UNFCCC, 2020 for G HG emissions/removals data.

[85] NIR, 2022

*Figure 38 - Trends in emissions per capita and dollar of GDP relative to 1990*[86]

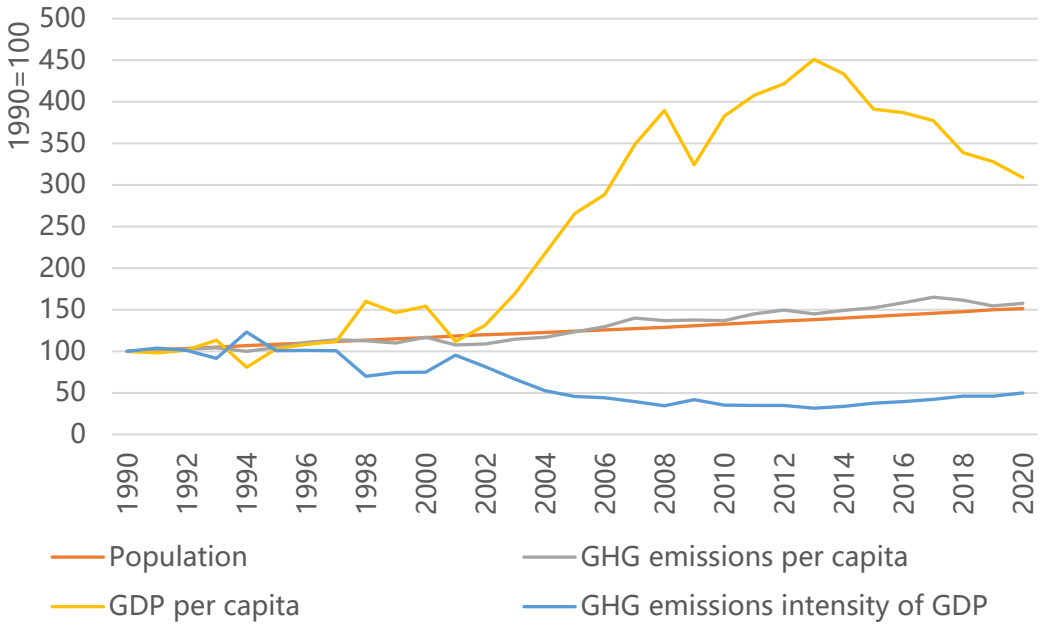
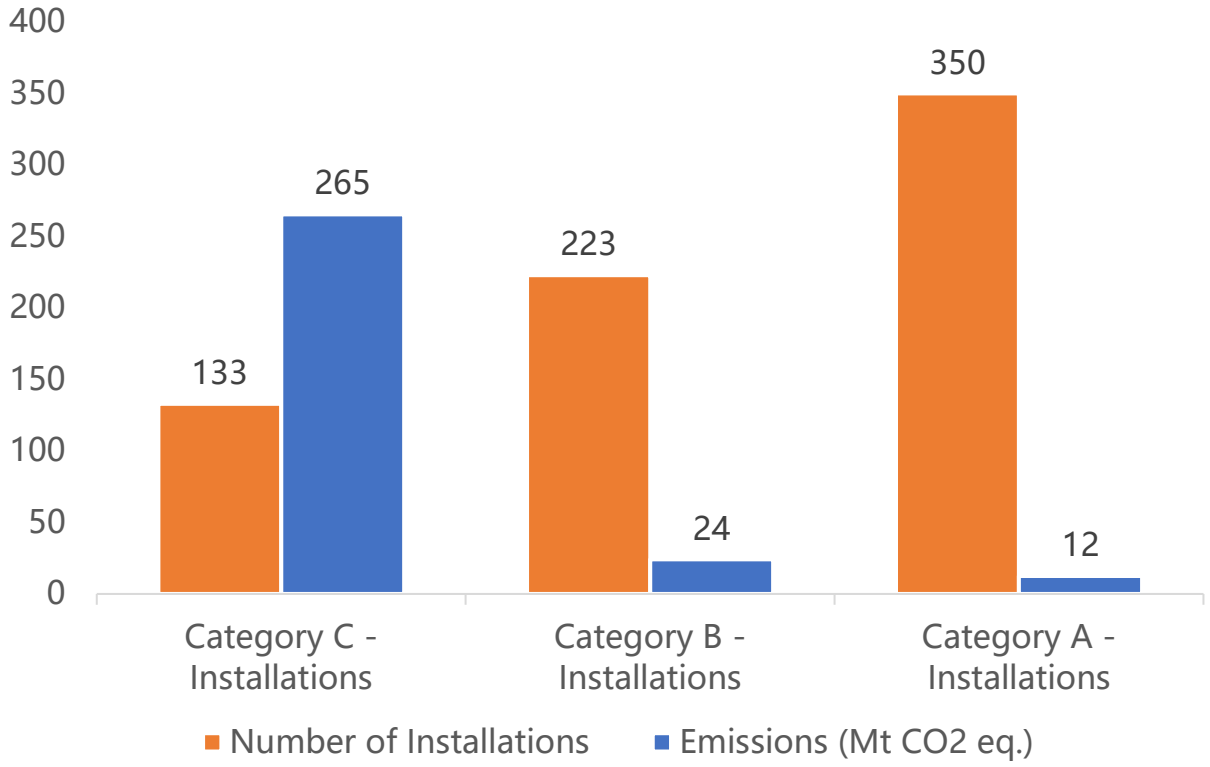



Figure 38 shows trends on various statistics related to Turkish greenhouse gas emissions normalized to 1990 as a baseline year. The direction of the emission intensity trend started to change after 2002. GDP (in current price) peak in 2013 and began to decline while population and emissions per capita continued to increase slightly.

In Türkiye, within the scope of the Regulation on the Monitoring of Greenhouse Gas Emissions and related communiqués, greenhouse gases originating from thermal power plants and industrial sectors have been monitored at the operation/facility level since 2015. Figure 39 shows the total GHG emissions from 715 facilities registered to the MRV system in 2021. Total emissions were 302 Mt $CO_2$ eq., this data constitute approximately half of the country's total greenhouse gas emissions. (Figure 39)

[86] Data sources: CRF, 2022; TurkStat, 2021_a

*Figure 39 –GHG emissions from installations under the scope of MRV system*




### 3.1.2 GHG EMISSION TRENDS BY GAS

According to 2020 GHG inventory, out of the total greenhouse gas emissions, carbon dioxide ($CO_2$) contributed the highest share of 78.9%, followed by methane ($CH_4$) with 12.2%, nitrous oxide ($N_2O$) with 7.7%, and fluorinated gases (F-gases) with 1.1%. Total $CO_2$ emissions (excluding LULUCF) increased by 172.6% from 1990 to 2020. $CH_4$ emissions (excluding LULUCF) increased by 50.6% and $N_2O$ emissions (excluding LULUCF) increased by 62.2%. Total $CO_2$ emissions (including LULUCF) increased by 271.8% from 1990 to 2020. There were no significant changes in other GHGs by taking into account the LULUCF sector. $CH_4$ emissions (including LULUCF) increased by 50.6% and $N_2O$ emissions (including LULUCF) increased by 62.6%.

In terms of evaluation of each main GHG gases, $CO_2$ emissions show a general increasing trend, while $N_2O$ and $CH_4$ emissions were not changing considerably. (Figure 40)[87]

[87] NIR, 2022

*Figure 40 - Emission trend of main GHGs, 1990-2020*[88]

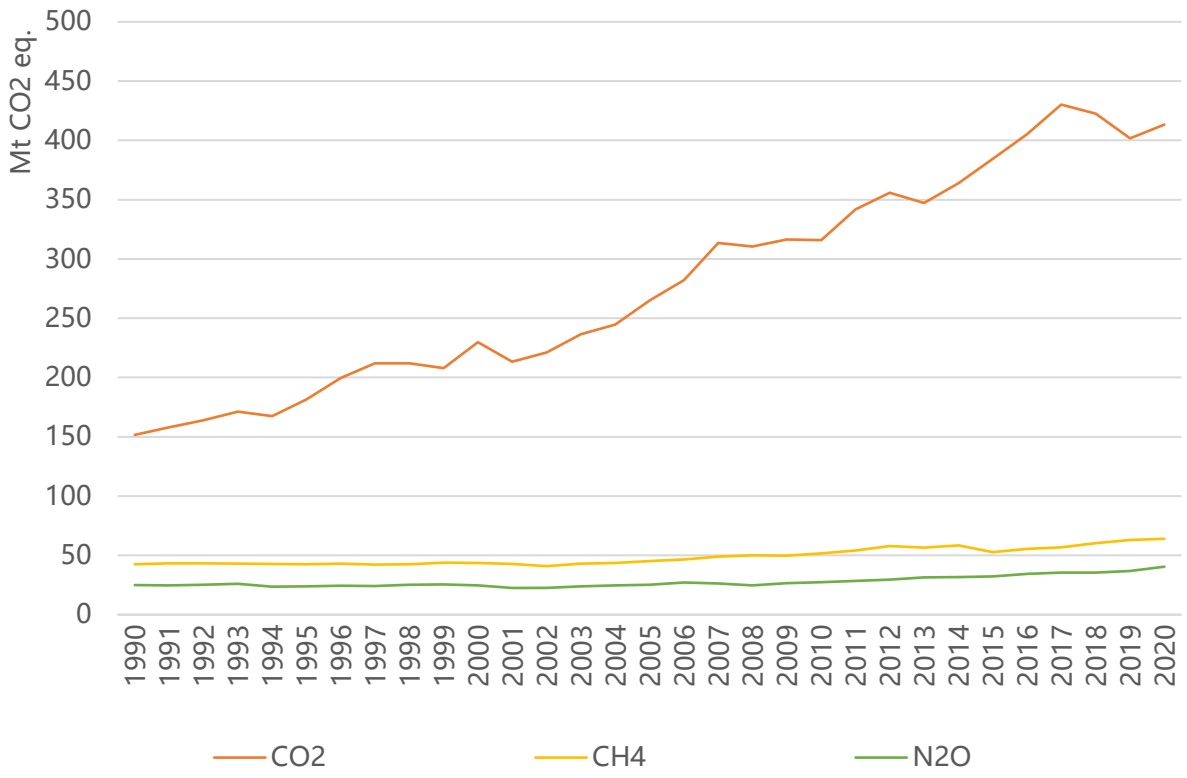



*Table 9 - Aggregated GHG emissions excluding LULUCF, Mt $CO_2$ eq., 1990-2020*[89]

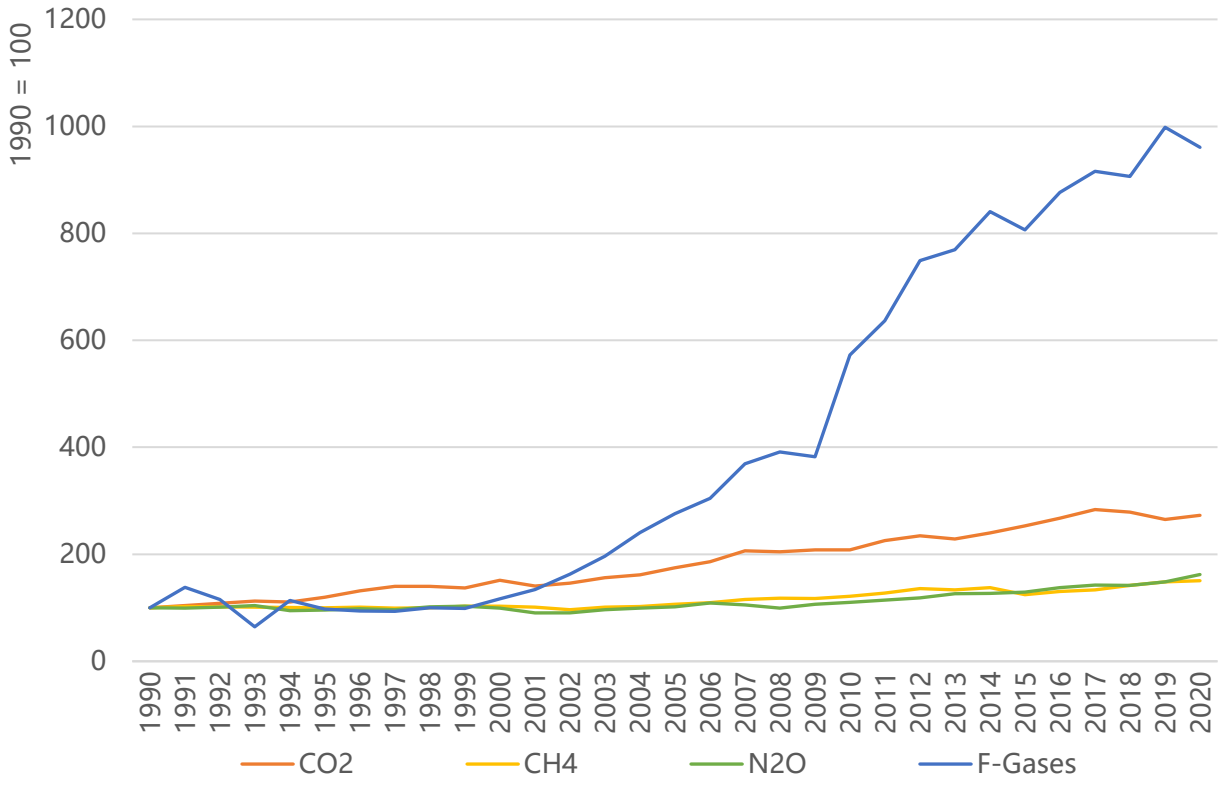
| Gas | 1990 | 2000 | 2005 | 2010 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 219.72 | 299.01 | 336.99 | 398.68 | 474.47 | 500.75 | 528.31 | 524.04 | 508.08 | 523.90 |
| $CO_2$ | 151.66 | 229.86 | 264.77 | 316.04 | 384.33 | 405.30 | 430.22 | 422.57 | 401.72 | 413.43 |
| $CH_4$ | 42.48 | 43.66 | 45.15 | 51.61 | 52.78 | 55.56 | 56.78 | 60.35 | 63.14 | 63.99 |
| $N_2O$ | 24.95 | 24.77 | 25.34 | 27.45 | 32.32 | 34.41 | 35.59 | 35.46 | 36.98 | 40.47 |
| HFCs | NO | 0.12 | 1.15 | 3.05 | 4.80 | 5.26 | 5.53 | 5.50 | 6.06 | 5.85 |
| PFCs | 0.63 | 0.60 | 0.56 | 0.46 | 0.16 | 0.14 | 0.07 | 0.04 | 0.06 | 0.04 |
| SF6 | NO | 0.01 | 0.02 | 0.07 | 0.08 | 0.08 | 0.12 | 0.13 | 0.12 | 0.12 |

[88] Data source: CRF, 2022.

[89] NIR, 2022.

Figure 41 shows trends in the index for each year compared to previous year by gas for the 1990-2020 period. 1990 is assumed as "100" for indexing. All gases were showing an increasing trend compared to 1990 and also to previous years in general. The sharpest trend belongs to F-gases since they increased by 861% in proportion to 1990. However total share of F-gases in whole GHG emissions was 1.1% in 2020.[90]

*Figure 41 - Trends in emissions by gas relative to 1990*[91]




### 3.1.3 INDIRECT GHG EMISSIONS

Emission trends of NOX, CO, NMVOC, $NH_3$ and $SO_2$ from 1990 to 2020 are given in below Table 10. While three indirect gases have an increasing trend from 1990 to 2020 including NOX (242.7%), $SO_2$ (28.7%) and NMVOC (29.5%), two gases have a decreasing trend including CO (5.4%) and $NH_3$ (45.5%).[92]

[90] NIR, 2022.

[91] Data source: CRF, 2022.

[92] NIR, 2022.

*Table 10 - Total emissions for indirect greenhouse gases, kt, 1990-2020*[93]

| Gas | 1990 | 2000 | 2005 | 2010 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| NOX | 253 | 1490 | 1297 | 998 | 857 | 870 | 855 | 860 | 888 | 866 |
| CO | 2040 | 8762 | 3745 | 3454 | 2522 | 2332 | 2164 | 1643 | 1762 | 1930 |
| NMVOC | 896 | 1607 | 1110 | 1104 | 1110 | 1087 | 1114 | 1092 | 1118 | 1161 |
| SO2 | 1683 | 2237 | 2000 | 2554 | 1939 | 2244 | 2351 | 2515 | 2521 | 2166 |
| NH3 | 85 | 97 | 84 | 62 | 59 | 45 | 46 | 41 | 43 | 46 |

In terms of annual change for each gas from 2019 to 2020. There is not a specific pattern. The gases having increasing trends are CO (9.5%), NMVOC (3.8%) and NH3 (9.1%). The gases that have decreasing trends are SO2 (14.1%) and NOX (2.5%).[94]

## 3.2 GREENHOUSE GAS EMISSIONS BY SECTOR

### 3.2.1 ENERGY

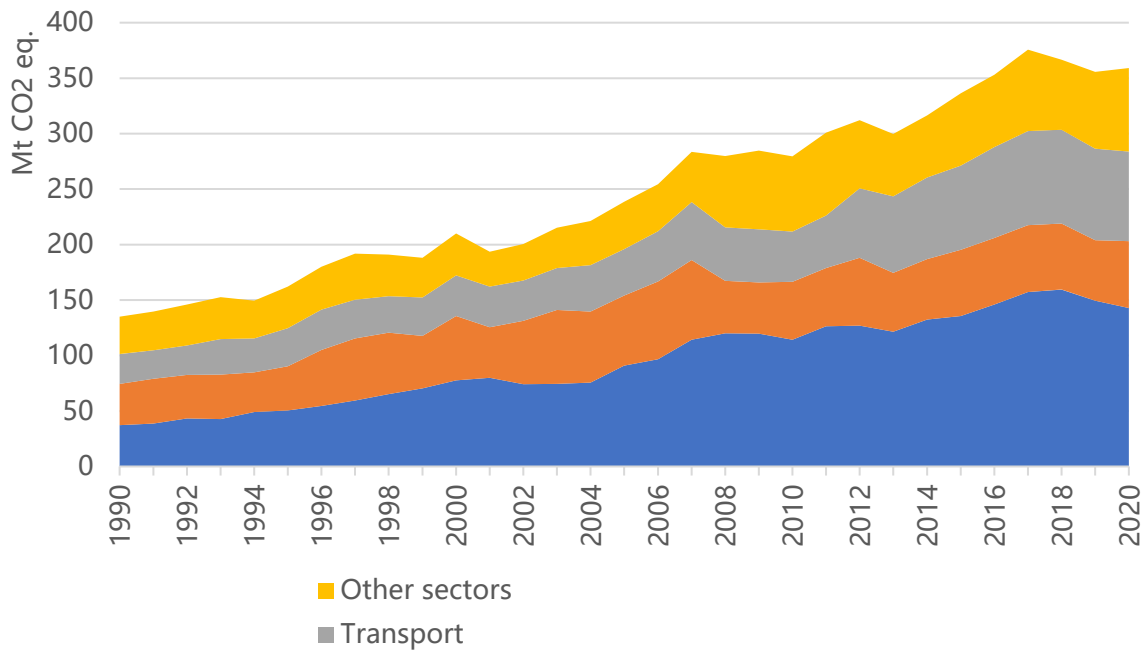
Energy sector is the major source of Turkish anthropogenic GHG emissions. In overall 2020 GHG emissions (excluding LULUCF), the energy sector had the largest portion with 70.2%. Energy sector CO2 emissions constituted 85.4% of total CO2 emissions in 2020. The non-CO2 emissions from energy-related activities represented rather small portion of the total national emissions. CH4 emissions were 16.9% of total national CH4 emissions and N2O emissions were 9.1% of total N2O emissions in 2020.[95]

[93] NIR, 2022.

[94] NIR, 2022.

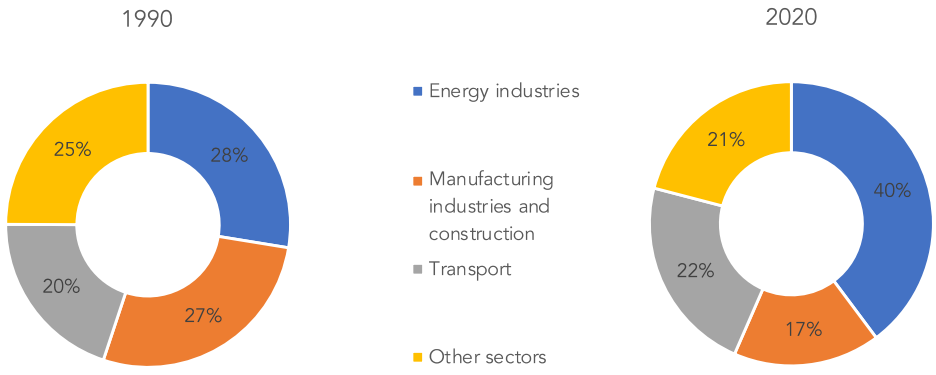
[95] NIR, 2022.

*Figure 42 – Energy Sector Emissions, 1990-2020*[96]




Total emissions from the energy sector for 2020 were estimated to be 368 Mt $CO_2$ eq. Energy industries were the main contributor, accounting for 38.9% of emissions from the energy sector. It is followed by the transport sector with 21.9%, other sector (fuel consumption at buildings and other emissions) with 20.5% and manufacturing industries with 16.4%.[97]

*Figure 43 - Fuel combustion $CO_2$ eq. emissions by sectors, 1990 and 2020*[98]




Energy sector GHG emissions increased by 163.3% between 1990 and 2020 whereas annual emissions from 2019 to 2020 decreased by 0.6% (2 167 Kt $CO_2$ eq.). Energy sector GHG

[96] Data source: CRF, 2022.

[97] NIR, 2022.

[98] Data source: CRF, 2022.

emissions mainly were coming from stationary combustion. Total emissions from stationary combustion were 278 Mt $CO_2$ eq. in 2020, equal to 53% of total national GHG emissions (excluding LULUCF).[99]

*Table 11 – Total emissions from fuel consumption by sectors, Mt $CO_2$ eq., 1990-2016*[100]

| Year | Energy | Fuel Combustion Total | Energy Industries | Manufacturing Industries and Construction | Transport | Other sectors |
|---|---|---|---|---|---|---|
| 1990 | 139 602 | 135,092 | 37,262 | 37,153 | 26,969 | 33,707 |
| 2000 | 216,025 | 209,879 | 77,725 | 57,925 | 36,465 | 37,764 |
| 2005 | 244,446 | 238,693 | 90,957 | 62,987 | 42,041 | 42,709 |
| 2010 | 287,840 | 279,614 | 114,151 | 52,298 | 45,392 | 67,773 |
| 2015 | 341,981 | 336,485 | 135,736 | 59,554 | 75,798 | 65,397 |
| 2016 | 361,686 | 353,091 | 145,940 | 60,039 | 81,841 | 65,270 |
| 2017 | 382,389 | 375,690 | 157,331 | 60,152 | 84,770 | 73,437 |
| 2018 | 374,145 | 366,483 | 159,409 | 59,576 | 84,617 | 62,881 |
| 2019 | 365,410 | 355,734 | 149,489 | 54,535 | 82,428 | 69,282 |
| 2020 | 367,577 | 358,995 | 142,927 | 60,150 | 80,680 | 75,238 |

### *Energy Industries*

Energy industries main sub sector is the public electricity and heat production category includes electricity and heat production of all electricity generation installations in operation, including auto producers. Auto producers were the facilities that produce electricity that they use for their purposes. By the end of 2020, total installed capacity reached 95,891 MW with a 5% increase from the previous year and nearly 5.9 times higher than the 1990 values. The total gross electricity consumption increased by 0.9% in 2020 compared to the previous year. In 2020, gross consumption was 306,109 GWh; meanwhile, in 2019, this figure was realized as 303,320 GWh.

Above mentioned installed capacities, and consumption figures covers to electricity production companies and auto producers as well. In 2020, hydro had a high share of 25.5% in all electricity

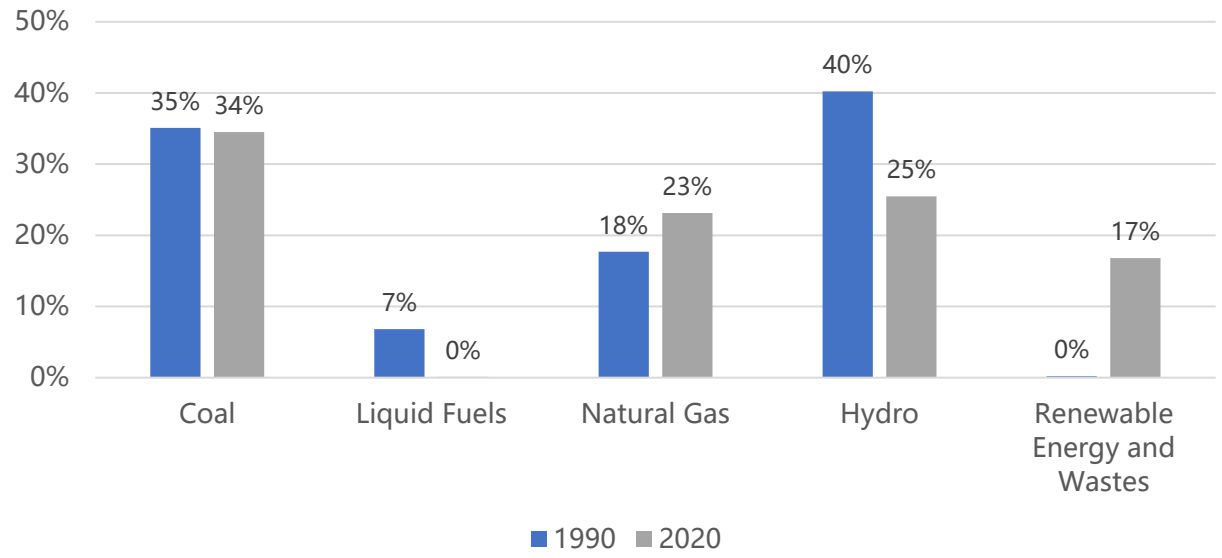
[99] NIR, 2022.

[100] NIR, 2022.

production, which was followed by natural gas (23.1%), other bituminous coal (22.1%), Turkish lignite (12.4%), other renewable and wastes (16.8%) and oil (0.11%). Due to weather conditions, from 2019 to 2020, electricity production from hydropower plants decreased by 12.1%. The amount of electricity produced from Turkish lignite has decreased from 46.87 TWh to 37.94 TWh. On the other hand, electricity production from other bituminous coal increased from 66.02 TWh to 67.87 TWh and natural gas from 57.29 TWh to 70.93 TWh.

In 2020 electricity production from fossil-fueled thermal power plants has accounted for 177,066 TWh of 306,703 TWh total electricity production, while in 2019, electricity production from fossil-fueled thermal power plants had accounted for 170,518 TWh of a total of 303,898 TWh total electricity production. Fossil fueled thermal share in electricity production slightly increased from 56.11% in 2019 to 57.73% in 2020.

*Figure 44 - Electricity generation and shares by energy resources, 1990 - 2020*

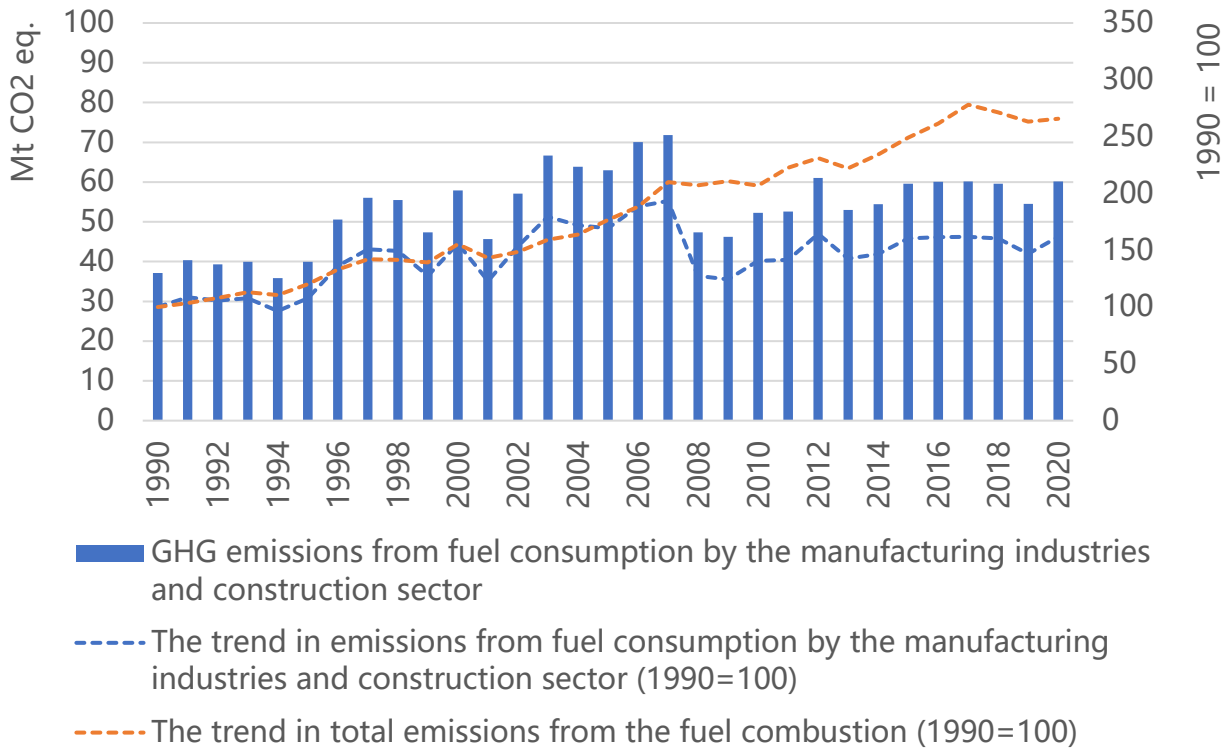



There was an increase in wind installed capacity from 7,591 MW in 2019 to 8,832 MW in 2020. Renewable Law, which came into force in 2005 later revised in 2011, provided some supporting mechanisms for purchasing electricity from solar, biomass, geothermal, wind, and hydraulic energy. In the year 2020, solar power plants installed capacity raised to 6,667 MW.

### *Manufacturing Industries and Construction Sector*

In 2020, manufacturing industries and construction sector contributed to 60.1 Mt $CO_2$ eq. emissions (Table 11). Increase trend in emissions from fuel consumption by manufacturing industries and construction sector was lower than the increase trend of emissions from fuel consumption by all sectors. (Figure 45) As a result, GHG emissions (in $CO_2$ eq.) by the manufacturing industries and construction sector as a share of total emissions from fuel combustion decreased from 27.5% in 1990 to 16.8% in 2020.

*Figure 45 – The Trend in the Emissions from Fuel Consumption by the Manufacturing Industries and Construction Sector (1990-2020)*[101]

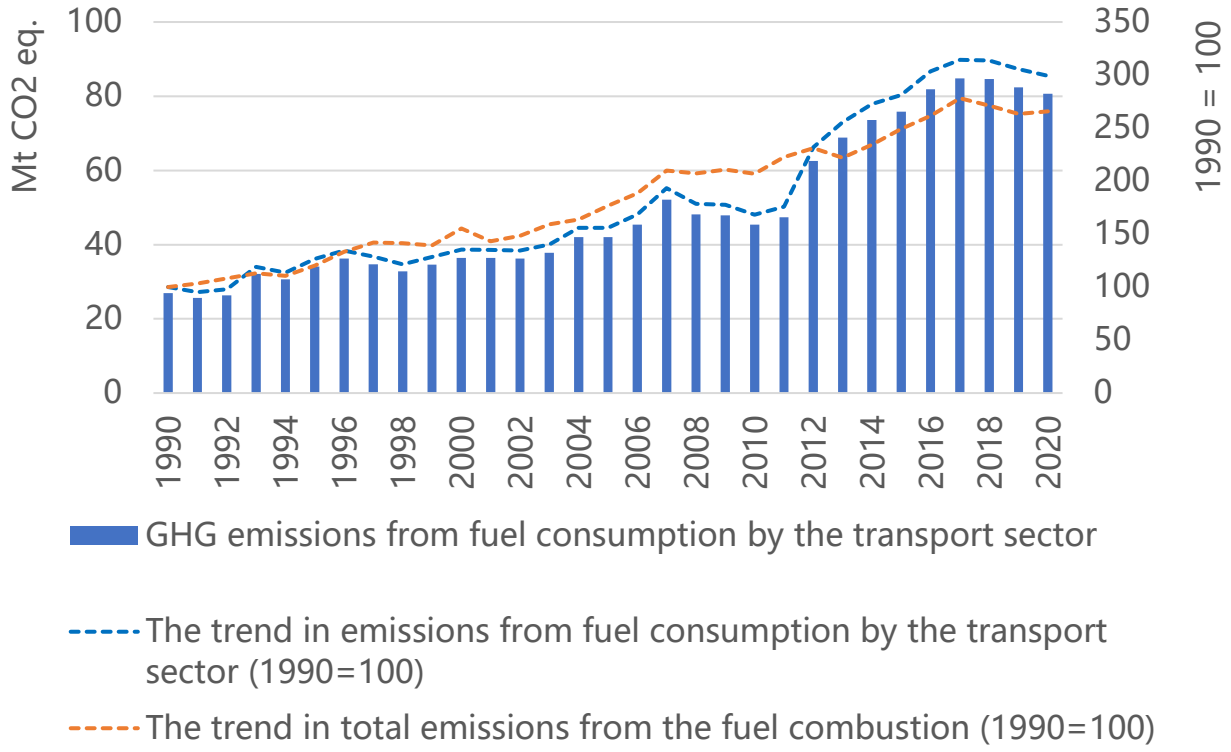



### *Transport*

In 2020, transport sector contributed to 80.7 Mt $CO_2$ eq. emissions (Table 11). Increase trend in emissions from fuel consumption by the transport sector was higher than the increase trend of emissions from fuel consumption by all sectors. (Figure 46) As a result, GHG emissions (in $CO_2$ eq.) from transport sector as a share of total emissions from fuel combustion increased from 20% in 1990 to 22.5% in 2020.

[101] Data source: CRF, 2022.

*Figure 46 – The Trend in the Emissions from Fuel Consumption by the Transport Sector (1990-2020)*[102]




As shown in below Figure 47, road transportation was the major $CO_2$ source contributing to 94.9% of transport emissions in 2020. Contribution of domestic aviation was 2.7%, domestic water-borne navigation was 1.6%, and railways was 0.4% in 2020. The share of pipeline transportation was 0.4%.

[102] Data source: CRF, 2022.

*Figure 47 - GHG emission by transport mode, 1990-2020*[103]

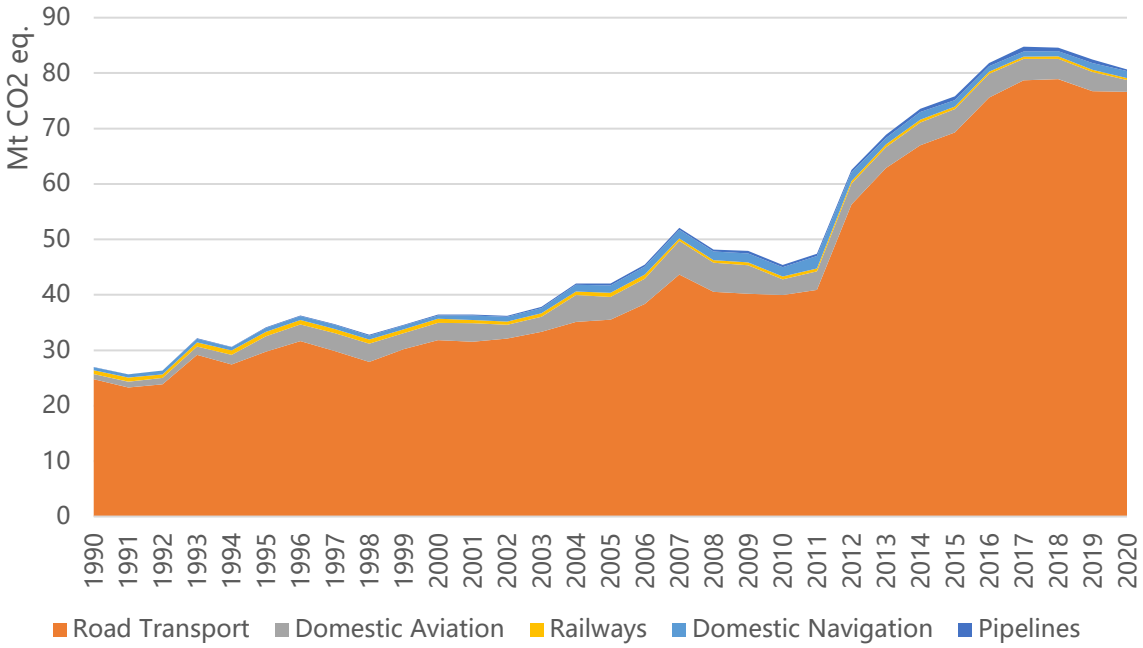
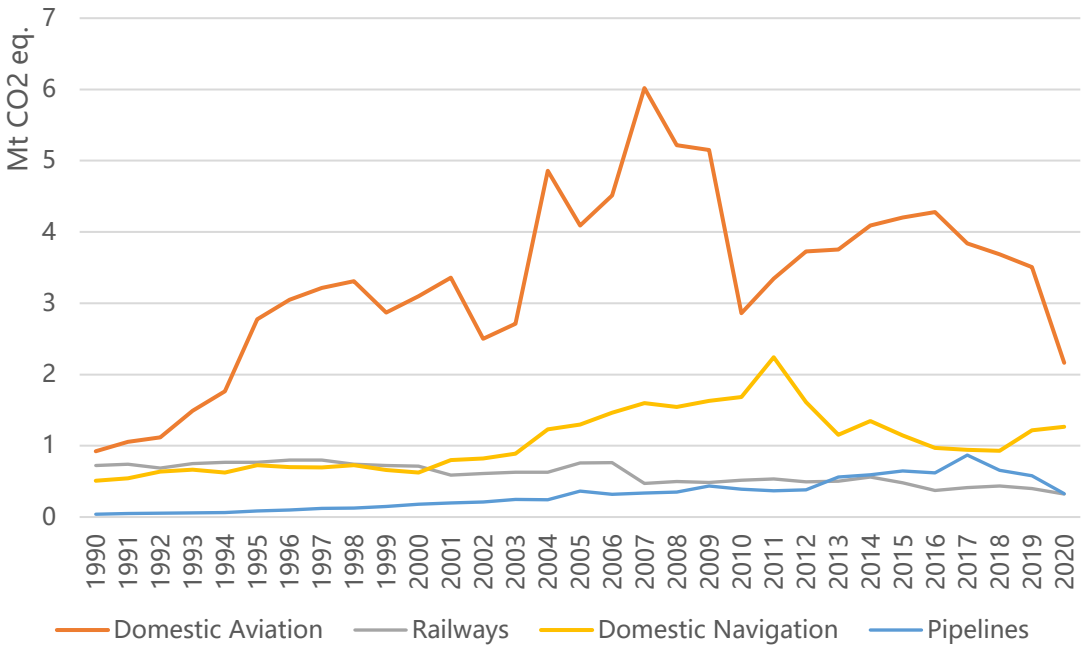



*Figure 48 - GHG emission trend by transport mode except road transportation, 1990-2020*[104]



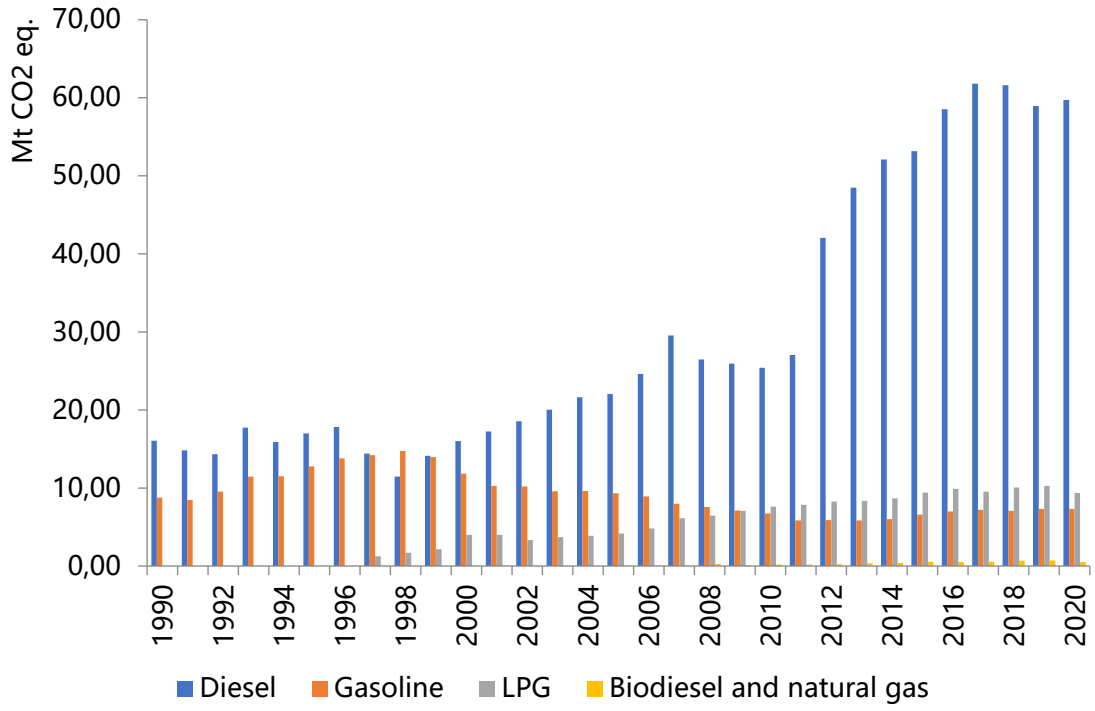

[103] Data source: CRF, 2022.

[104] Data source: CRF, 2022.

In road transportation, only diesel oil and gasoline were used until the year 1997. Utilization of LPG started in 1997 and consumption increased steadily. Then, diesel oil consumption and LPG consumption increased while gasoline consumption declined. From 2007 to 2010 period slowdown of economy was the main reason in decrease of diesel oil consumption, diesel oil consumption decreased probably because of the global economic crisis. After that, there was remarkable rise in diesel fuel oil consumption.

When analyzed in detail, it is determined that data of diesel fuel used in agriculture sector have not been separated from those used in road transportation since 2011. That is why there was a large increase in GHG emissions resulting from diesel fuel between 2011 (27,035 kt. $CO_2$ eq.) and 2020 (59,736 kt. $CO_2$ eq.), an increase of 121%. Therefore, whole increase in use of diesel fuel should not be attributed to transportation sector.

*Figure 49 - Emission distributions by fuel types in road transportation (1990-2020)*[105]

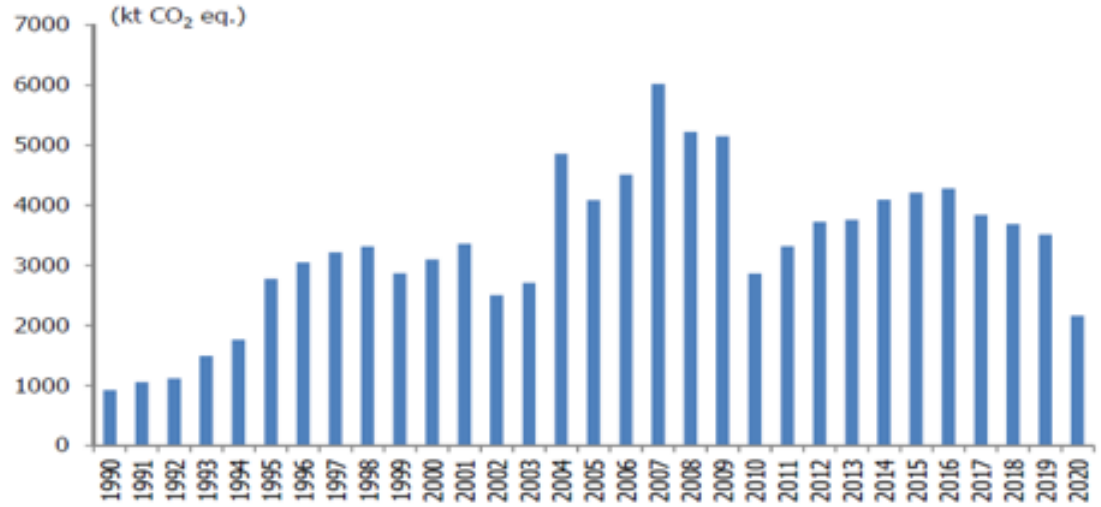



The domestic aviation source category was a key category in 2020, in terms of both the level and trend analysis of $CO_2$ emissions from the jet fuel. In domestic aviation only jet fuel was consumed. The total emissions and the emissions of $CH_4$ and $N_2O$ increasing trends as $CO_2$ eq. $CO_2$ eq. emissions have increased approximately 348% since 1990 and reached to 2.16 Mt $CO_2$ in 2020. The calculated amounts of $CH_4$ and $N_2O$ emissions were 0.99 kt. $CO_2$ eq. and 22.06 kt.

[105] Data source: CRF, 2022.

$CO_2$ eq. in 2020 respectively. There was a relatively large decrease in $CO_2$ emissions observed between 2009 and 2010 (44% decline) owing to the global economic crisis.

*Figure 50 - GHG emissions for domestic aviation, Mt $CO_2$ eq., 1990-2020*[106]



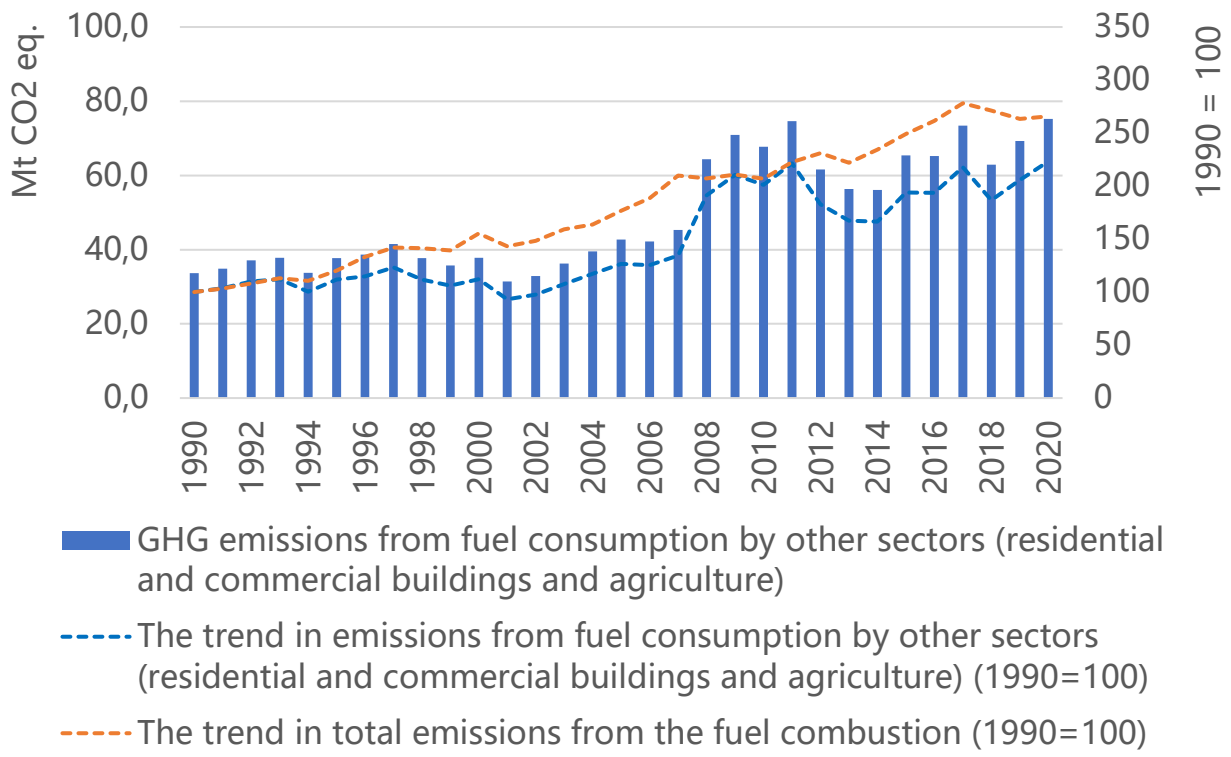

### *Other Sectors*

In 2020, other sectors category, which consist of emissions from fuel consumption at residential, commercial, and institutional buildings and at agriculture, contributed to 75.2 Mt $CO_2$ eq. emissions (Table 11). The emissions that are included in this category mainly arise from fuel consumption at residential buildings, which was 67% of the total of the category. Emissions from fuel consumption at commercial/institutional buildings had 18%, and fuel consumption in agriculture had 15% in the total of other sectors' emissions.

Increase trend in emissions from fuel consumption by the other sectors category was lower than the increase trend of emissions from fuel consumption by all sectors. (Figure 51) As a result, GHG emissions (in $CO_2$ eq.) by the other sectors category as a share of total emissions from fuel combustion decreased from 25% in 1990 to 21% in 2020.

[106] Data Source: NIR, 2022.

*Figure 51 – The Trend in the Emissions from Fuel Consumption by the Other Sectors (1990-2020)*[107]




### *Fugitive Emissions*

Fugitive emissions includes fugitive emissions from extraction, processing, storage and transport of fossil fuels. $CH_4$ emission from coal mining, $CH_4$, $CO_2$, $N_2O$ and NMVOC emissions from exploration, production/processing, transport/transmission, refining and storage of oil and natural gas were covered.

*Table 12 - Fugitive emissions from fuels, kt, 1990-2020*[108]

| Year | $CO_2$ | $CH_4$ | $N_2O$ | $CO_{2\ eq.}$ |
|---|---|---|---|---|
| **1990** | 220 | 172 | 0.0031 | 4 510 |
| **2000** | 168 | 239 | 0.0023 | 6 145 |
| **2005** | 142 | 224 | 0.0019 | 5 752 |
| **2010** | 156 | 323 | 0.0021 | 8 226 |
| **2015** | 155 | 214 | 0.0021 | 5 496 |

[107] Data source: CRF, 2022.

[108] NIR, 2022

| | | | | |
|---|---|---|---|---|
| **2016** | 158 | 337 | 0.0021 | 8 596 |
| **2017** | 157 | 262 | 0.0021 | 6 699 |
| **2018** | 174 | 299 | 0.0024 | 7 662 |
| **2019** | 183 | 380 | 0.0025 | 9 676 |
| **2020** | 195 | 335 | 0.0027 | 8 581 |

$CO_2$ and $CH_4$ were the main fugitive emissions in this category. $CH_4$ was emitted mainly from coal mining while $CO_2$ was emitted from venting and flaring. Fugitive emissions as $CO_2$ eq. have become 8 581 ktons in 2020. 30% of fugitive emissions as $CO_2$ eq. were from oil and gas systems and 70% were from solid fuels in the same year.

*Table 13 - Fugitive emissions from fuels by subcategory, 1990-2020 (kt $CO_2$ eq.)*[109]

| Year | Total | Solid Fuels | Oil and Natural Gas |
|---|---|---|---|
| **1990** | 4 510 | 3 598 | 912 |
| **2000** | 6 145 | 4 836 | 1 309 |
| **2005** | 5 752 | 3 941 | 1 811 |
| **2010** | 8 226 | 6 151 | 2 075 |
| **2015** | 5 496 | 2 733 | 2 763 |
| **2016** | 8 596 | 5 896 | 2 700 |
| **2017** | 6 699 | 3 681 | 3 017 |
| **2018** | 7 662 | 4 885 | 2 777 |
| **2019** | 9 676 | 6 770 | 2 906 |
| **2020** | 8 581 | 5 558 | 3 023 |

Total fugitive emissions for 2020 were 8.58 Mt $CO_2$ eq., representing 1.63% of total GHG emissions (excluding LULUCF). Oil and natural gas systems contributed 35.2% solid fuels were

[109] NIR, 2022

accountable for the remaining 64.7% of fugitive emissions. Overall fugitive emissions increased by 90.2% between 1990 and 2020. In 2014 a serious mining accident happened, and many underground mines were closed in the following year as a precaution, therefore in 2015 fugitive emissions were decreased remarkably. In overall, from 1990 to 2020, fugitive emissions from oil and natural gas systems increased by 231.4%. Emissions from solid fuels in fugitive sector were increased by 54.4% in the same period.

### 3.2.2 INDUSTRIAL PROCESSES AND PRODUCT USE

The GHG emissions from industrial processes and product use were released as a result of manufacturing processes. It means this category includes only emissions from processes and not from fuel combustion used to supply energy for carrying out the processes. For that reason, emissions from industrial processes are referred to as non-combustion.

The total GHG emissions from industrial processes and product use was 66 762.6 $CO_2$ eq. for the year 2020 which was 14.3% of the total emissions including LULUCF sector and 12.7% of all emissions excluding LULUCF in Türkiye. The most important GHG emission sources of IPPU in 2020 were cement production with 8.7% and iron and steel production 2.2% shares of the total national GHG emissions excluding LULUCF. The main gas emitted by the IPPU sector in 2020 was $CO_2$, contributing 88% (58 735 kt) of the sector emissions in 2020. HFCs, PFCs and SF6 contributed 9% (6 007 kt $CO_2$ eq.) while the share of $N_2O$ emissions was 3% (2 006 $CO_2$ eq.) and $CH_4$ emissions was 0.02% (16 kt $CO_2$ eq.).[110]

*Table 14 - Industrial processes and product use sector emissions, (kt $CO_2$ eq.), 2020*[111]

| GHG sources and sink categories | $CO_2$ | $CH_4$ | $N_2O$ | HFCs/ PFCs/SF6 | Total |
|---|---|---|---|---|---|
| Industrial processes and product use | 58 735 | 16 | 2 006 | 6 007 | 66 763 |
| Mineral industry | 47 109 | | | | 47 109 |
| Chemical industry | 1 085 | NO,NA | 2 006 | NO | 3 091 |
| Metal industry | 10 406 | 16 | NO | 38 | 10 460 |
| Non-energy products from fuels and solvent use | 134 | NA | NA | | 134 |
| Electronic Industry | | | | 59 | 59 |

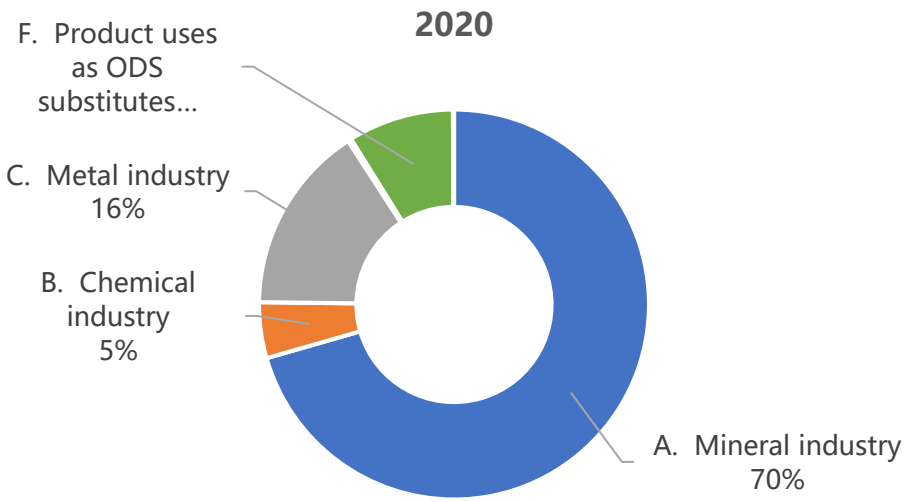
[110] NIR, 2022

[111] NIR, 2022

| | | | | | |
|---|---|---|---|---|---|
| Product uses as ODS substitutes | | | | 5 853 | 5 853 |
| Other product manufacture and use | NA | NA | NA | 57 | 57 |
| Other | NE,NA | NE,NA | NA | NA | NE,NA |

The mineral industry contributed 70.6% of the IPPU sector's emissions, the metal industry contributed 15.7%, product uses as ODS substitutes contributed 8.8%, while the chemical industry contributed 4.6% in 2020.

*Figure 52 - Emissions from industrial processes and product use by subsector, 2020*[112]

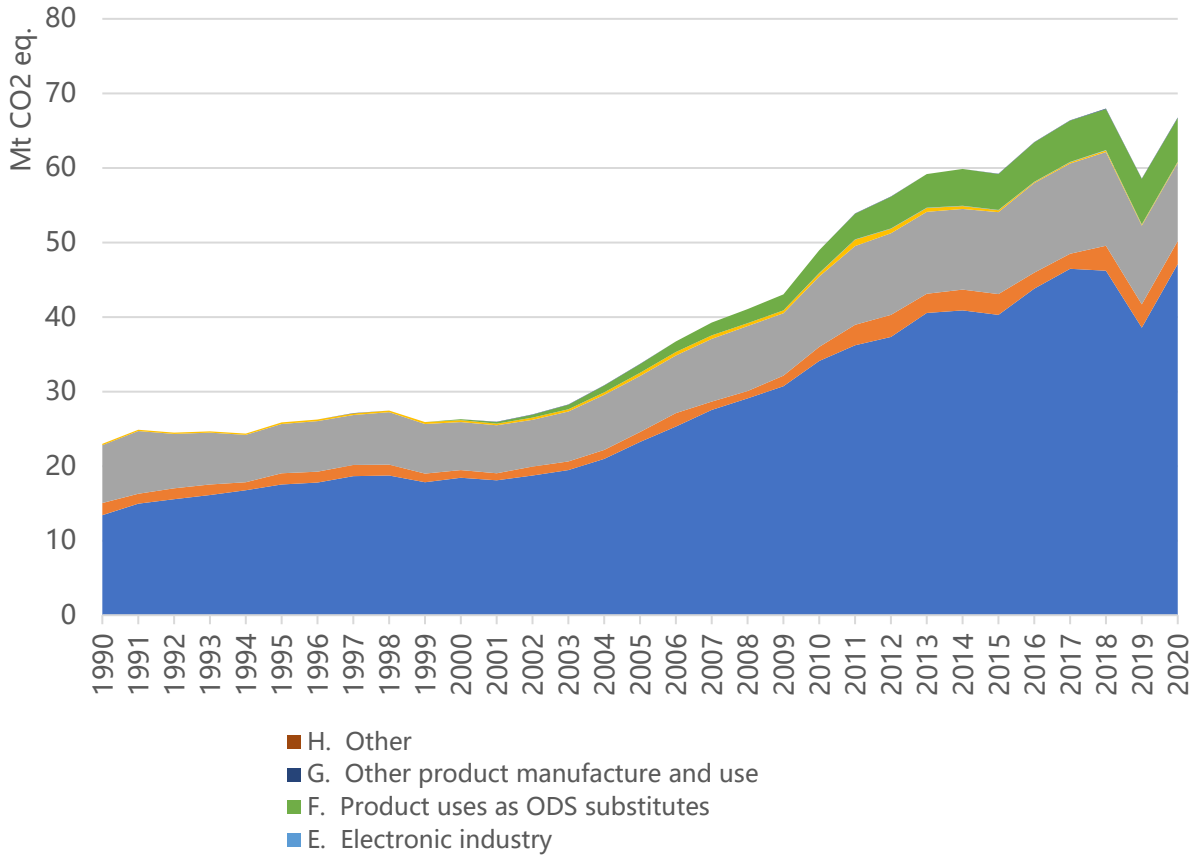



The average shares of the mineral industry, metal industry and chemical industry between the years 1990-2020 were 67.9%, 22.8% and 4.6%, respectively. The increases in sectoral emissions observed over the longer term were principally due to growth in emissions associated with the mineral industry, predominantly cement production, and metal industry, primarily iron and steel production. The increases in emissions in these sectors were because of the industrial growth and the increased demand for construction materials. Each source category's contribution to total emissions and to sectoral trends within the IPPU sector between 1990 and 2020 is shown in below Figure 53.[113]

[112] Data source: CRF, 2022.

[113] NIR, 2022

*Figure 53 - Emissions from industrial processes and product use by subsector, 1990–2020*[114]

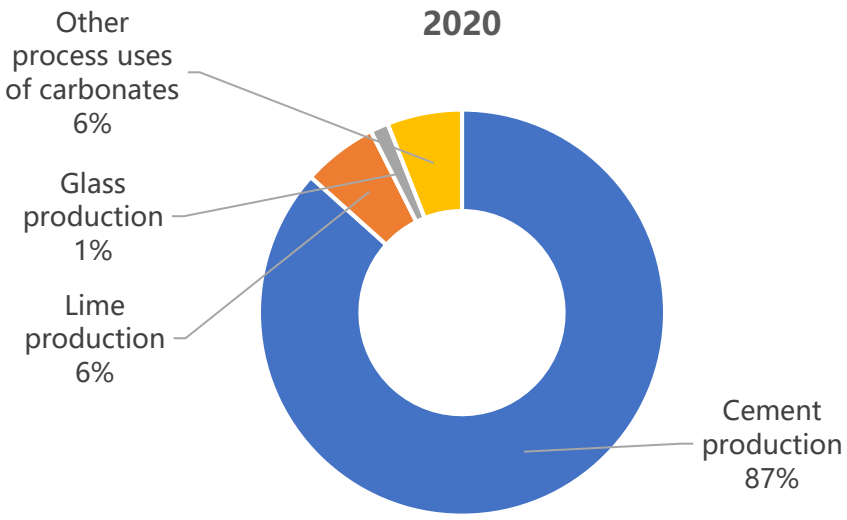



Non-fuel $CO_2$ emissions from cement and lime production and from limestone and dolomite use, glass production as well as emissions from ceramics production, soda ash use and non-metallurgical magnesia production were reported in mineral industry category.

Figure 54 presents the share of $CO_2$ emissions in this category for the year 2020. The dominant sector was cement production having an and storage from domestic coal enables the use of Türkiye's resources with added value. Coal Gasification and Hydrogen 86.6% share of $CO_2$ emissions in the mineral industry. The second and third sectors were other process uses of carbonates and lime production each having 6% share of $CO_2$ emissions. Glass production was responsible for 1.4% of emissions in the mineral industry.

[114] Data source: CRF, 2022.

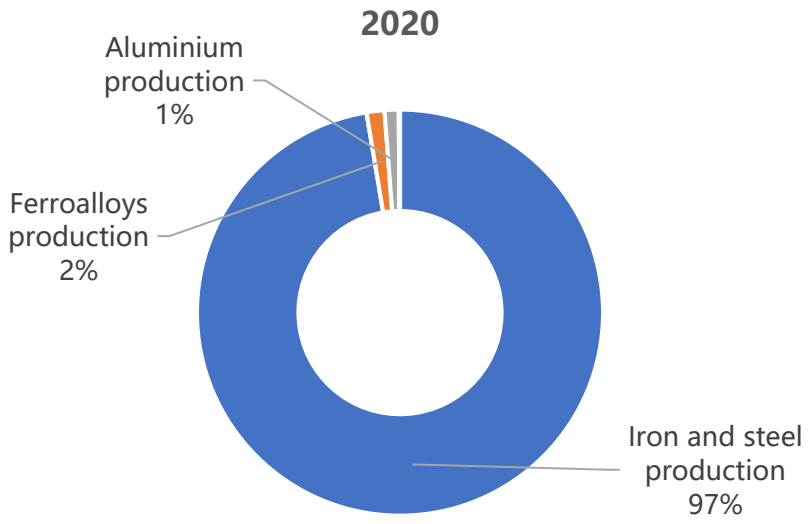
*Figure 54 - Share of CO2 emissions from mineral production, 2020*[115]




In 2020, the metal industry was responsible for 10 459.8 kt CO2 eq., 15.7% of total emissions from the industrial processes and product use sector. The vast majority of emissions in the metal industry (97%) were from iron and steel production. Aluminum production was responsible for 155.3 kt CO2 eq., 1.5% of metal emissions, and ferroalloys production 147.7 kt CO2 eq., 1.4% of metal emissions. Lead production was responsible for 9.4 kt CO2 eq. contributed 0.1% of sector emissions. (see Figure 55)

[115] Data source: CRF, 2022.

*Figure 55 - Emissions from metal industry, 2020*[116]




Between 1990 (7 747.6 kt $CO_2$ eq.) and 2020 (10 459.8 kt $CO_2$ eq.), emissions from the metal industry increased by 35%, again driven in large part by the iron and steel industry, emissions increased by 46.6% during the time period, from 6 921.5 kt $CO_2$ eq. in 1990 to 10 147.2 kt $CO_2$ eq. in 2020. This increase in emissions was partially offset by the elimination of PFC emissions in aluminum production (PFC emissions were 625.3 kt $CO_2$ eq. in 1990 and it was 37.8 kt $CO_2$ eq. in 2020). There was no magnesium production in Türkiye.[117]

### 3.2.3 AGRICULTURE

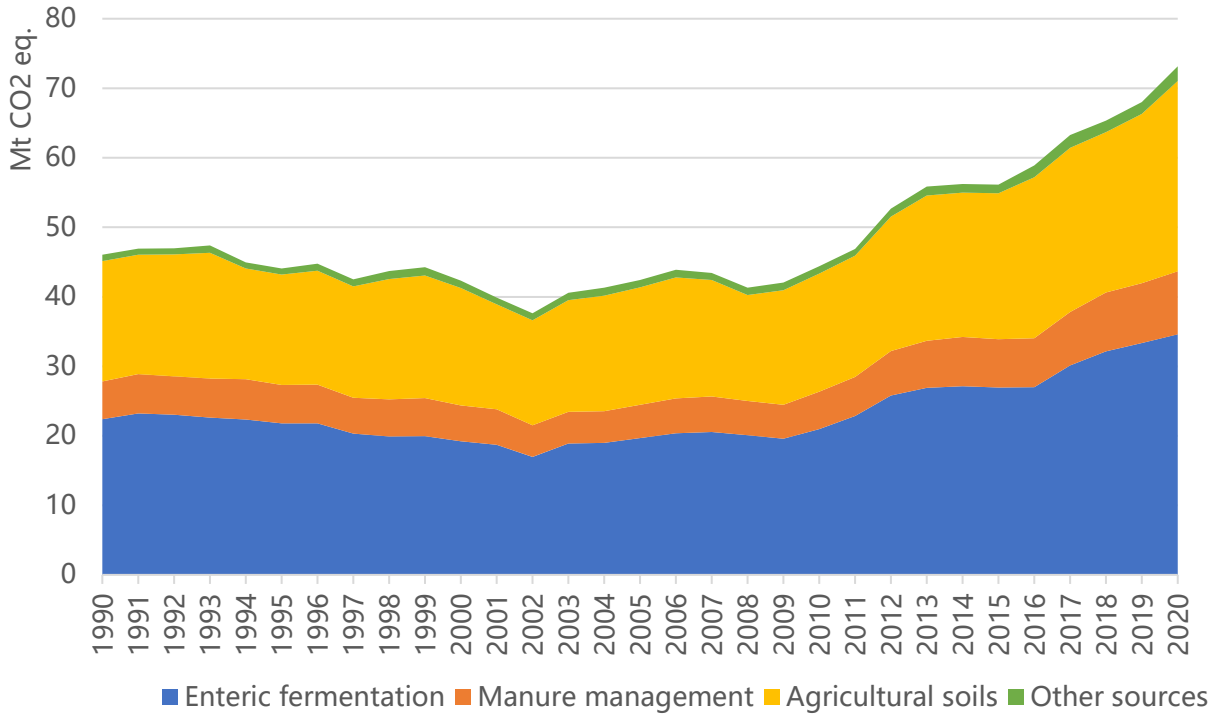
The total emission value calculated for the agriculture sector was 73 Mt $CO_2$ eq. for the year 2020 which was 15.7% of the total emission value including the LULUCF sector and 14% of all emissions excluding the LULUCF sector for Türkiye. The overall emission value for the sector increased from approximately 46.1 Mt $CO_2$ eq. to around 73 Mt $CO_2$ eq. (an increase of 58.4%) during the 31 years period after 1990. The biggest increase among the categories in absolute terms for the emissions was observed in the enteric fermentation category where the emissions increased by around 12 Mt $CO_2$ eq. (54%) from 22.4 Mt $CO_2$ eq. to 34.6 Mt $CO_2$ eq. for the same period.[118]

The primary reason for this increase was the change in activity data. Other significant increases in this thirty-one years period were seen in agricultural soils, manure management, and urea application where the amounts were 10 Mt $CO_2$ eq. (58.6%), 3.6 Mt $CO_2$ eq. (66.7%), and 1.2 Mt

[116] Data source: CRF, 2022.
[117] NIR, 2022.
[118] NIR, 2022.

$CO_2$ eq. (260%), respectively. Increases in emissions from enteric fermentation and manure management were largely a result of changes in activity data. Emissions for rice cultivation increased by around 0.2 Mt $CO_2$ eq. (161.3%) whereas the emissions for field burning of agricultural residues between 1990 and 2020 resulted in a decrease of 50.1%.

*Figure 56 - Cumulative emissions of agricultural categories, 1990–2020*[119]



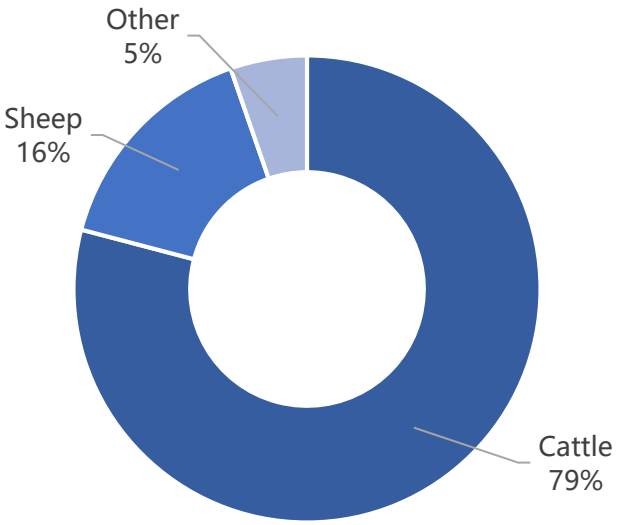

Furthermore, in relative terms, the biggest category in the agriculture sector was enteric fermentation having a 47.3% share for 2020, so it dominates the sector. In all reported years, 1990-2020, this category had an average share of 47.6% in the agriculture sector, starting with a share of 48.6% in 1990. The second biggest category was agricultural soils having a proportion of 37.4% for 2020 which increased from 35.8% in 2019. While having a percentage share of agricultural soils of 40.2% in 2004, its average share for the entire reporting period of thirty-one years was around 37.9%. Manure management's share presents somehow a more stable increasing trend, starting from 11.8% in 1990 and reaching 12.4% in 2020 while having an average of 12.1% for all reporting years. For 2020, remaining categories, which were rice cultivation, field burning of agricultural residuals, and urea application, had emission shares of 0.4%, 0.2%, and 2.3%, respectively. Though the share increased by around 65% for rice cultivation and 127% for urea application, the absolute terms were small and relative weights of

[119] Data source: CRF, 2022.

these two categories were low for the period 1990-2020. Despite these increasing values, the share for field burning of agricultural residues decreased from 0.8% to 0.2% for the reporting period. A graphical representation is given above in Figure, which presents the overall cumulative distribution and the trend for the reporting period of the agriculture sector.

In 2020, enteric fermentation contributed as high as 34 615 kt $CO_2$ eq., responsible for nearly half of agricultural emissions as stated above and 6.6% of Türkiye's total $CO_2$ eq. emissions. Dairy and nondairy cattle contributed 27 377 kt $CO_2$ eq. (79.1%) of emissions to the enteric fermentation category and besides sheep (domestic and merino) contributed 5 398 kt $CO_2$ eq. (15.6%) of emissions to this category. This source category in 2020 resulted in a value of 12 218 kt $CO_2$ eq. (55%) of increased emissions compared to 1990 levels (22 397 kt $CO_2$ eq).

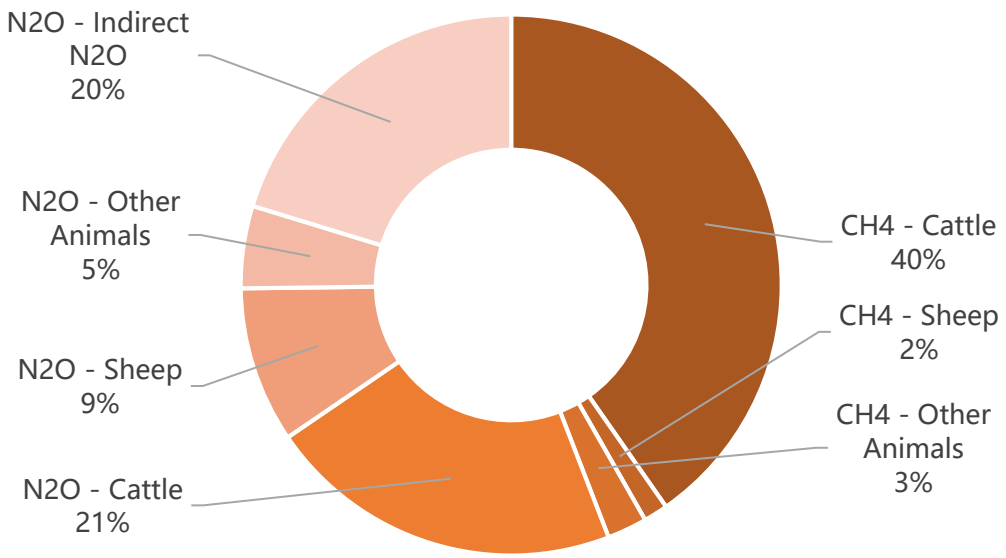
*Figure 57 - Enteric Fermentation Emission Sources, 2020*[120]




In 2020, emissions including $CH_4$ and $N_2O$ from the manure management category reached 9 060 kt $CO_2$ eq. This number represented 12.4% of emissions of the agriculture sector. Emissions from this source category in 2020 increased by 3 624 kt $CO_2$ eq., nearly 66.7% above its 1990 level of 5 436 kt $CO_2$ eq. Similarly, the increase is calculated as 1 647 kt $CO_2$ eq. for $CH_4$ emissions and 1 977 kt $CO_2$ eq. for $N_2O$ emissions and increasing percentages were 70% and 64.1%, respectively, for the period 1990- 2020.

[120] Data source: CRF, 2022.

*Figure 58 - Manure Management Emission Sources, 2020*[121]

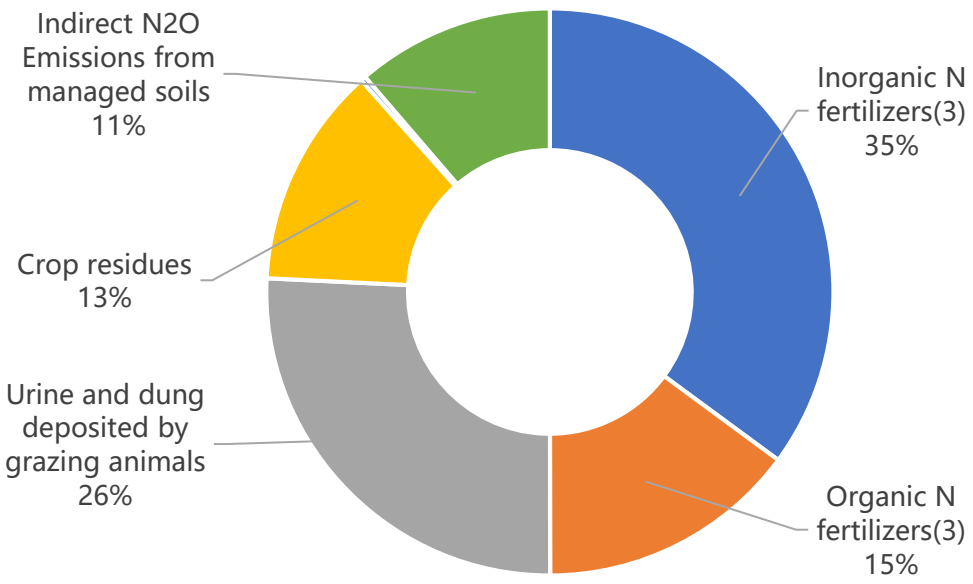



Manure management emissions can also be described as direct emissions consisting of $CH_4$ and $N_2O$ emissions with a share of 79.7% (7223 kt $CO_2$ eq.) and indirect emissions consisting only of $N_2O$ emissions with a share of 20.3% (1 837 kt $CO_2$ eq.).

Agriculture soils produced 91.9 kt $N_2O$ (27.4 Mt $CO_2$ eq.) emissions in 2020 and agriculture soils was the largest source category of $N_2O$ emissions in Türkiye. This figure represented 84.3% of $N_2O$ emissions in the agriculture sector, around 67.7% of Türkiye's $N_2O$ emissions (without LULUCF), and close to 37% of agricultural emissions. Emissions were 10 075 kt $CO_2$ eq. (58%) above the 1990 level of 17 314 kt $CO_2$ eq. in 2020 - the latest reporting year. Direct $N_2O$ emissions increased by 9 121 kt $CO_2$ eq. (60.1%) whereas indirect $N_2O$ emissions increased by 955 kt $CO_2$ eq. (44.7%) for the given period 1990-2020. The increase was due to the emission changes of direct and indirect $N_2O$ emissions from managed soils.

[121] Data source: CRF, 2022.

*Figure 59 - Sub-categories of Agricultural Soils Emission Sources, 2020*[122]




The increase was a result of the emission changes of direct and indirect N2O emissions from managed soils. The total change of direct N2O emissions was a result of increases in the subcategories inorganic N fertilizers, a subcategory of organic N fertilizers, urine and dung deposited by grazing animals, crop residues, and also decreases in cultivation of organic soils and two subcategories of organic N fertilizers.

### 3.2.4 LAND USE LAND USE CHANGE AND FORESTRY

The LULUCF sector of Türkiye was a net removal dominated by forests. The 22.8 Mha of forest area removed a net 48.2 Mt of $CO_2$ eq. from the atmosphere in 2020. Other land uses were net emissions while accounting equals to 5 percent of forest land removals. The total removals of the sector when HWP was added has been 59.5 Mt of $CO_2$ eq. representing a 3 percent increase compared to 1990.

[122] Data source: CRF, 2022.

*Figure 60 - The trend of LULUCF sector removals (Forest Land and HWP) 1990-2020*[123]

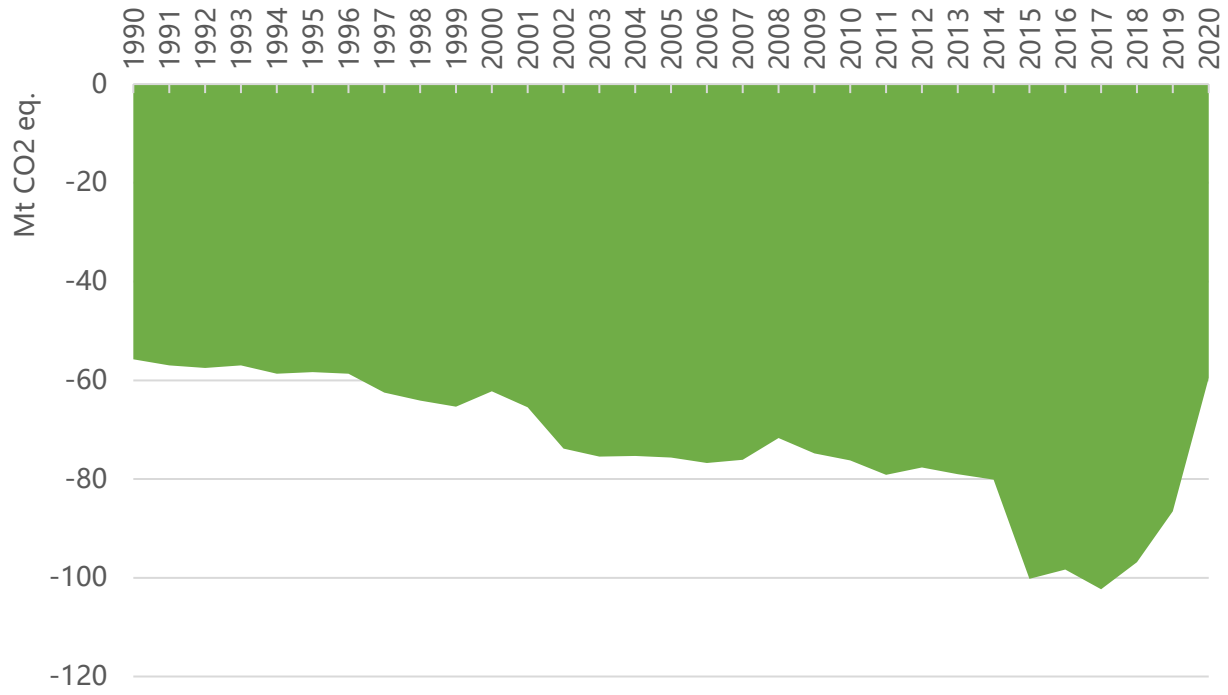



*Table 15 - Total emissions and removals from the LULUCF sector by source (kt $CO_2$ eq.)*[124]

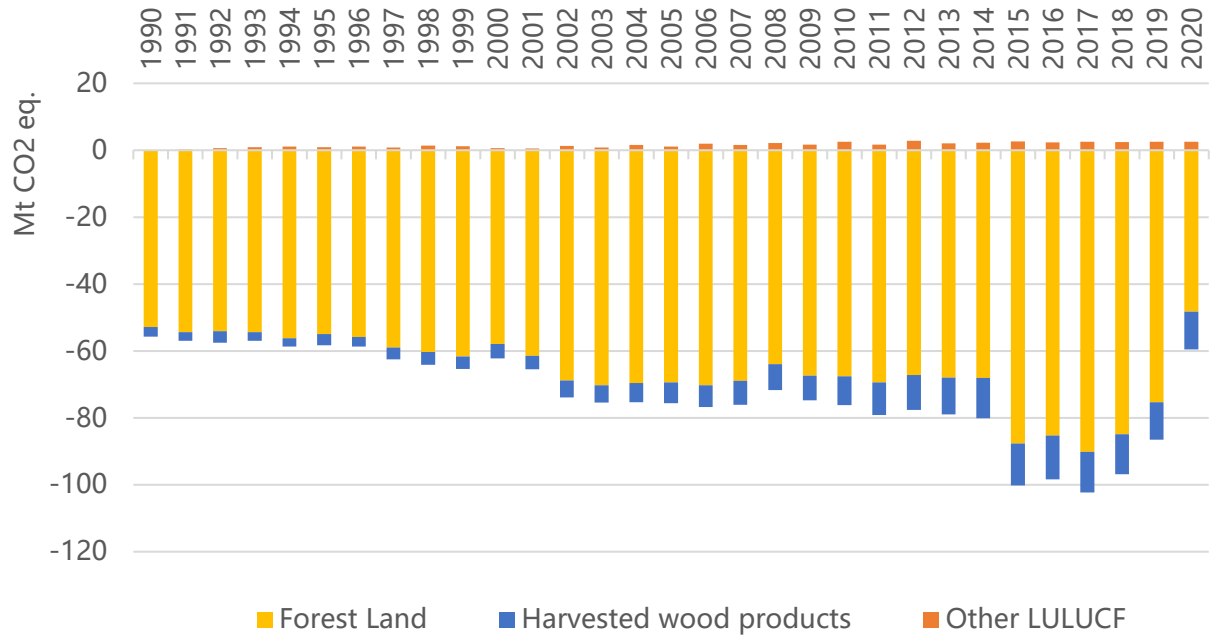
| Year | Total | Forest land | Cropland | Grassland | Wetlands | Settlements | Other land | Harvested wood products |
|---|---|---|---|---|---|---|---|---|
| 1990 | -55736 | -52830 | 0.69 | 0.03 | 0.01 | NO, IE | NO, NE, IE | -2907 |
| 2000 | -61566 | -57890 | 38 | 97 | 176 | 145 | 187 | -4337 |
| 2005 | -74535 | -69356 | 207 | 259 | 28 | 273 | 310 | -6285 |
| 2010 | -73620 | -67614 | 453 | 636 | 413 | 426 | 601 | -8587 |
| 2015 | -97538 | -87669 | 457 | 983 | -20 | 419 | 764 | -12541 |
| 2016 | -95972 | -85233 | 344 | 656 | 271 | 406 | 617 | -13102 |
| 2017 | -99830 | -90195 | 368 | 705 | 288 | 413 | 653 | -12133 |
| 2018 | -94413 | -84849 | 352 | 708 | 222 | 407 | 650 | -11973 |

[123] Data source: CRF, 2022.

[124] NIR, 2022.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2019 | -84032 | -75311 | 381 | 768 | 188 | 413 | 671 | -11215 |
| 2020 | -56948 | -48220 | 395 | 777 | 189 | 419 | 696 | -11 281 |

*Figure 61 - Trend of total emissions from the LULUCF sector, 1990-2020*[125]




LULUCF emissions or removals, in $CO_2$ equivalent, were variable over the reporting period 1990-2020. Generally, decreases in removals were influenced by fires and drought in the relevant areas. Moreover, rises were originated mainly from forest management, afforestation, rehabilitation of degraded forests, reforestations on forest land, etc.

In 2020, total $CO_2$ eq. emissions and removals of the LULUCF sector have decreased by 32.2% compared to 2019. Table 15 reports emissions and removals from the LULUCF sector by source.

The main reasons for the rise in removals for LULUCF were improvements in sustainable forest management, afforestation, rehabilitation of degraded forests, reforestations on forest land and conversion of coppices to productive forests in forest land remaining forest land, efficient forest fire management and protection activities, conversions to perennial croplands from annual croplands and grasslands, and conversions to grasslands from annual croplands. The main reasons for the decrease in removals were related to drought and biomass burning as

[125] Data source: CRF, 2022.

wildfire (e.g. the year 2008; 29 749 ha forest area burned), deforestation, conversions to wetlands (flooded land) and settlements.

### 3.2.5 WASTE

The waste sector includes GHG emissions from the treatment and disposal of wastes, open burning, wastewater treatment and discharge. Waste incineration emissions were included in the inventory however it was reported under the energy sector.

Total waste emissions for the year 2020 were 16.4 Mt $CO_2$ eq., or 3.1% of total GHG emissions (without LULUCF). Within the sector, 68.5% of the emissions were from solid waste disposal, followed by 31.3% from wastewater treatment and discharge, 0.12% from biological treatment of solid waste and 0.04% from open burning of waste.

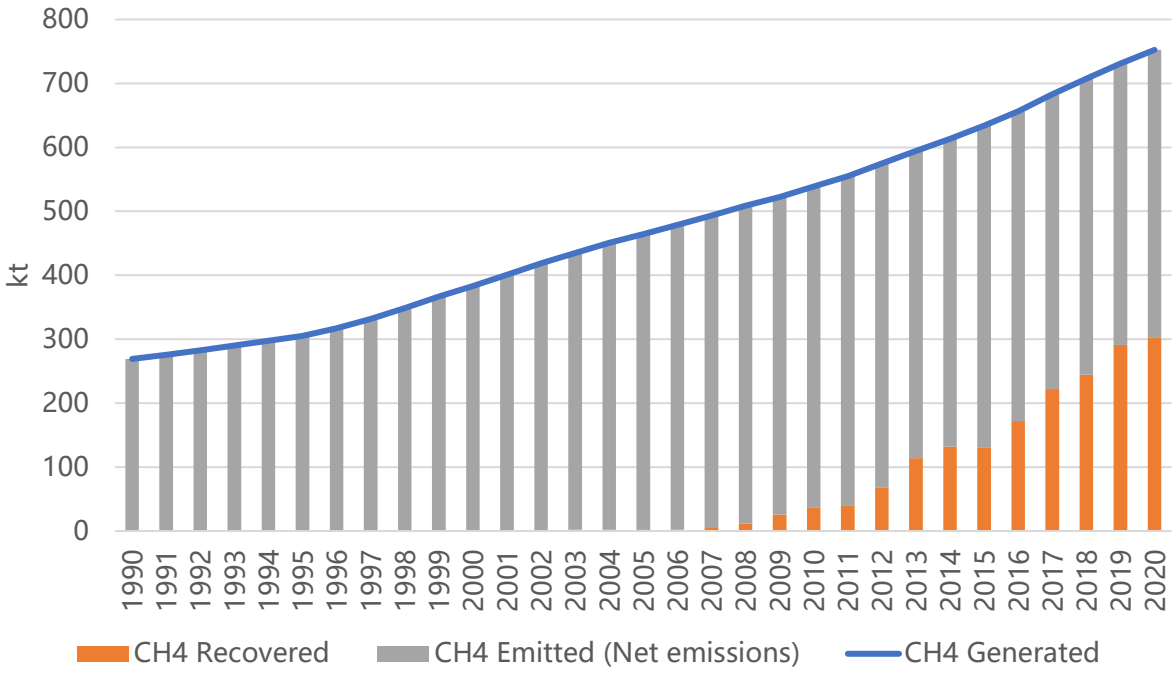
*Table 16 - Total emissions from the waste sector by source (kt $CO_2$ eq.)*[126]

| Year | Total | Solid waste disposal | Biological treatment of solid waste | Incineration and open burning of waste | Wastewater treatment and discharge |
|---|---|---|---|---|---|
| **1990** | 11,081 | 6,730 | 16 | 105 | 4,230 |
| **2000** | 14,341 | 9,582 | 17 | 87 | 4,656 |
| **2005** | 16,401 | 11,562 | 28 | 47 | 4,764 |
| **2010** | 17,446 | 12,564 | 30 | 37 | 4,815 |
| **2015** | 17,142 | 12,578 | 23 | 2 | 4,539 |
| **2016** | 16,720 | 12,113 | 24 | 4 | 4,579 |
| **2017** | 16,251 | 11,524 | 23 | 3 | 4,701 |
| **2018** | 16,588 | 11,578 | 20 | 2 | 4,987 |
| **2019** | 16,068 | 11,002 | 22 | 5 | 5,039 |
| **2020** | 16,402 | 11,237 | 21 | 7 | 5,138 |

[126] NIR, 2022.

Total emissions, in $CO_2$ equivalent, increased by 48% from 1990 to 2020 and 2.1% from 2019 to 2020. The trend was mainly driven by solid waste disposal.

*Figure 62 - $CH_4$ emissions from solid waste disposal, 1990-2020*[127]




Net methane emissions tend to decrease with the increase in methane recovery amount due to the increase in the capacity and number of methane recovery facilities producing electricity/heat energy from landfill gas in Türkiye.

## 3.3 NATIONAL INVENTORY SYSTEM

### 3.3.1 INSTITUTIONAL, LEGAL AND PROCEDURAL ARRANGEMENTS

The Turkish national inventory system is featured by centralized governance. The MoEUCC is the National Focal Point of the UNFCCC together with the UNECE and the Convention on Long-range Transboundary Air Pollution (CLRTAP) were responsible for climate change and air pollution policies and measures. Türkiye's main structure for the climate policy formulation is the Climate Change and Adaptation Coordination Board (CCACB). The national GHG inventory was prepared under the auspices of the "GHG Emissions Inventory Working Group" which was established in 2001 by the former CBCC. TurkStat was formally appointed as single national responsible authority to coordinate and implement national inventory activities from planning to management by Decision 2009/1 of the CBCC in 2009. TurkStat was also in charge of annual

[127] Data source: NIR, 2022.

inventory submission to the UNFCCC Secretariat and of responding to the ERT recommendations.

Also, the legal basis of the national inventory system is currently provided by the Statistics Law of Türkiye through the Official Statistics Programme (OSP). The OSP is based on the Statistics Law of Türkiye No. 5429 and was first prepared in 2007 for a 5-year-period and updated every 5 years. OSP identifies the basic principles and standards dealing with the production and dissemination of official statistics and produce reliable, timely, transparent and impartial data required at national and international level. For all kind of official statistics, the responsible and related institutions are defined; data compilation methodology and the publication periodicity/schedule of official statistics are specified. TurkStat is the responsible institution for the compilation of the national GHG inventory through the OSP and coordinates the activities of the GHG emission inventory working group established in the scope of OSP with the same composition as WG 3. The GHG emission inventory groups under CCACB. Indirect GHG emissions are calculated and reported by the MoEUCC herself regarding the responsibilities of Türkiye under UN LRTAP Convention.

The GHG national inventory is compiled by GHG Emission Inventory groups under the coordination of TurkStat. The institutions included in the working group are:

- Turkish Statistical Institute (TurkStat),
- Ministry of Energy and Natural Resources (MENR),
- Ministry of Transport and Infrastructure (MoTI),
- Ministry of Environment, Urbanization and Climate Change (MoEUCC),
- Ministry of Agriculture and Forestry (MoAF)

The national inventory arrangements are designed and operated to ensure the TACCC quality objectives and timeliness of the national GHG inventories. The quality requirements are fulfilled by implementing consistently inventory quality management procedures.

Responsibilities of the institutions involved in the national GHG inventory are shown in Table 17.

*Table 17 - Institutions by Responsibilities for National GHG Inventory*

| Sector | CRF Category | Collection of Activity Data | Selection of Methodology and Emission Factors | GHG Emission Calculation | Filling in CRF tables and preparing NIR | Quality control |
|---|---|---|---|---|---|---|
| **Energy** | 1 - Energy (Except 1.A.1.a- public electricity and heat production and 1.A.3-Transport) | MENR, TurkStat | TurkStat | TurkStat | TurkStat | TurkStat |
| | 1.A.1.a- Public electricity and heat production | MENR | MENR | MENR | MENR | MENR |
| | 1.A.3- Transport | MoTI, TurkStat | MoTI | MoTI | MoTI | MoTI |
| **Industrial Processes and Other Product Uses** | 2 - IPPU (except F-gases) | TurkStat | TurkStat | TurkStat | TurkStat | TurkStat |
| | F-Gases | MoEUCC | MoEUCC | MoEUCC | MoEUCC | MoEUCC |
| **Agriculture** | 3 - Agriculture | TurkStat | TurkStat | TurkStat | TurkStat | TurkStat |
| **Land Use, Land Use Change and Forestry** | 4 - LULUCF | MoAF | MoAF | MoAF | MoAF | MoAF |
| **Waste** | 5 - Waste | TurkStat | TurkStat | TurkStat | TurkStat | TurkStat |
| **Cross cutting issues** | | | | | | |
| **Key Source Analysis** | | | TurkStat | | | |
| **Uncertainty analysis** | | | | | | |

The national GHG inventory is subjected to an official consideration and approval procedure before its submission to the UNFCCC. The national inventory is subjected to a two-step official consideration and approval process. The final version of the NIR and CRF tables are first approved by the TurkStat Presidency and published in the official TurkStat press release. Subsequently, The MoEUCC as National Focal Point to the UNFCCC provides final checks and approval of the CRF tables via CRF web application tool as a final step prior to its submission to the UNFCCC.

TurkStat, as the Single National Entity is responsible for official inventory submission to the UNFCCC, and also responsible for responding to the UNFCCC expert review team recommendations on national inventory improvement and ensuring they are incorporated in the current and following NIR(s) in the broader context of its continuous improvement.

The inventory planning system of Türkiye is conducted in line with QA/QC (Quality assurance and quality control) plan. Planning stage is under the responsibility of GHG Inventory Working Group. Planning activities include data collection and processing, selection of emission factors estimation methodology, compilation of CRF and NIR, UNFCCC expert review team recommendations, documentation and archiving, verification through time series consistency and cross checks, reporting and publication process.

Information required for the inventory is mostly covered by OSP. Distribution of work for data gathering, processing and estimation of emissions are shown in Table 17. Fuel combustion emissions other than electricity generation and transport are calculated by TurkStat via using the energy balance sheets of the MENR. Emissions from industrial processes (excluding F-gases), agriculture, waste and fugitive emissions from coal mining, oil and gas systems are also calculated by TurkStat. The emissions originating from public electricity and heat production are calculated on the basis plant level data by the MENR; the emissions originating from transportation are calculated by the MoTI. The fluorinated gases are calculated by the MoEUCC. Emissions and removals from land use, land-use change, and forestry are estimated by the MoAF.

Also, country specific $CO_2$ emission factors of natural gas, Türkiye lignite, hard coal, fuel oil and diesel oil are calculated by using fuel, slag and ash analyses and gas chromatography results, by the MENR.

Every sector expert that performs the emission estimation has the responsibility to prepare the data entry to CRF reporter and other related sections or sub-sections of NIR. TurkStat compiles and makes the key source and does the uncertainty analysis, final quality checks and submits the national GHG inventory to the UNFCCC's secretariat.

TurkStat is also responsible for archiving the GHG inventory. Emission factors, activity data, calculation sheets, CRF and NIR outputs and the emission inventory are all archived on TurkStat's main server. All inventory related documents are also archived by the line Ministries for the CRF categories under their responsibilities.

### 3.3.2 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) AND VERIFICATION

QA/QC and verification procedures are an integral and indispensable parts of the national GHG inventory of Türkiye. The quality of the national inventory system is ensured by the QA/QC system, through the QA/QC plan adopted by the CCAMCB decision in 2014. The QA/QC plan introduces the structure and purpose of the QA/QC system, endorse the quality objectives. The main objective of the QA/QC plan is to ensure that the national GHG inventory is prepared in accordance with the quality objectives: transparency, accuracy, comparability, consistency, completeness (TACCC) as defined in UNFCCC reporting guideline (24/CP.19). Türkiye also considers three additional quality objectives as improvement, sustainability and timeliness.

Together with verification, the implementation of QA/QC procedures are considered integral parts of national inventory preparation and play a pivotal role not only to achieve the quality objectives but also for continuous reassessing and improving the national inventory where needed.

TurkStat is the designated body for overall implementation of the QA/QC system and its main purpose is to ensure the coordination of the QA/QC activities.

Quality Control (QC) is a system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled. QC activities include general QC procedures and category specific QC procedures.

General QC procedures include generic quality checks related to the calculations; data processing, completeness and documentations that are applicable to all inventory sources and sink categories. General QC procedures are applied routinely to all categories by sector experts using the check lists attached in Annex II of the QA/QC Plan during the acquisition of data and the emissions calculation procedures and during the compilation of NIR and the CRF tables.

Category-specific QC procedures complement general inventory QC procedures and are directed at specific types of data used in calculating GHG emissions for individual source or sink categories. These procedures require knowledge of the specific category; the types of data available and the parameters associated with emissions or removals and are performed in addition to the general QC check lists. Category specific QC procedures are also applied by sector experts using the check lists attached in Annex III of the QA/QC Plan.

QC activities are performed by sector experts compiling the GHG inventory. Each sector expert should fill and sign the check list, that the necessary QC checks were undertaken. Each sector

expert should carry out immediate corrections of the input data/emissions calculations where errors are found. If an issue cannot be resolved, such issues may then be incorporated into the inventory improvement plan. A copy of the completed checklist is sent to TurkStat and is archived in TurkStat main server. TurkStat undertakes further quality checks on compiled CRF and NIR.

In Türkiye, annual review of GHG inventory submission is considered as an QA activity. Türkiye's GHG inventory submission is subject to be reviewed by an international team of experts on an annual basis in accordance with decision 13/CP.20. The ERT develops an annual review report based on the findings of the review. These annual review reports are considered as supplementary to the QA procedures undertaken by experts in Türkiye. Findings in the annual review reports are considered feedback for improvement of the GHG inventory, and as such are included in Türkiye's inventory improvement plan.

The "Technical Assistance for New Era for Statistics Programme" which is co-funded by the European Union and the Republic of Türkiye, has been started in March 2019. Within the scope of this project, under sub-activity "National Greenhouse Gas Inventory", the experts from CITEPA – Technical Reference Center for Air Pollution and Climate Change – provided QA works for the energy, IPPU, agriculture and waste sectors of the Turkish GHG Inventory between December 2019 and February 2020.

In addition, GHG inventory submission of Türkiye is subject to review by an international team of experts on an annual basis in accordance with decision 13/CP.20. During the review week, Türkiye ensures that all institutions, organizations and responsible sector experts are available to provide necessary information and supporting documentation to the review team in a timely manner. The Expert Review Team (ERT) then develops an annual review report based on the findings of the review. These annual review reports are considered as supplementary to the QA procedures undertaken by experts in Türkiye. Findings in the annual review reports are considered feedback for improvement of the GHG inventory, and as such are included in inventory improvement plan of Türkiye.

Regarding verification, each Institution involved in national inventory development is responsible for its own verification activities. Sectorial experts within the Institution carry out the activities. In Türkiye, some level of verification happens on an annual basis, as Türkiye estimates and reports $CO_2$ emissions from fossil fuel combustion based on both the reference approach and the sectoral approach. Differences in the emissions estimated using these two approaches are described in the NIR. Also, lower tier IPCC methods applied for comparison in especially energy sector. Emissions calculated and reported on the basis of higher tiers (Tier 2 or Tier 3) are compared with emissions calculated by Tier1 method.

Detailed information about national inventory system is available in latest NIR of Türkiye which was submitted to UNFCCC in 2022.

### 3.3.3 REPORTING UNDER ARTICLE 3, PARAGRAPHS 3 AND 4, OF THE KYOTO PROTOCOL

Türkiye, as a Party included in Annex I with No commitments inscribed in Annex B to the Kyoto Protocol, has No obligation to report on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

### 3.3.4 NATIONAL REGISTRY

Türkiye, as a Party included in Annex I with No commitments inscribed in Annex B to the Kyoto Protocol, has No obligation to report on the National Registry.

# 4 POLICIES AND MEASURES

This chapter elaborates Türkiye's policies and measures relevant to the reduction of greenhouse gas emissions and strengthening removals.

## 4.1 INSTITUTIONAL, LEGISLATIVE AND POLICY FRAMEWORKS AND MONITORING AND EVALUATION APPROACH

### 4.1.1 OVERVIEW

Türkiye became a party to **UNFCCC** on 24 May 2004, ratified the Kyoto Protocol on 26 August 2009, and ratified the **Paris Agreement** on 7 October 2021.[128] Türkiye, a candidate country of the European Union (EU), aims to ensure the **full harmonization of the EU Climate Acquis**. In 2021, Türkiye declared to reach a **net-zero emission target by 2053**. Within these frameworks, transformation in the institutional, legal, and policy setup has accelerated in several paths over the recent years. The following sections describe the recent changes and current status of legal, institutional, and policy frameworks of Türkiye and their impacts to contribute to the global efforts to fight against climate change.

### 4.1.2 POLICYMAKING AND INSTITUTIONAL FRAMEWORK

**The Climate Change and Adaptation Coordination Board (CCACB)**, consisting of 22 member organizations is the main policy formulation entity streamlining climate policies.[129] The CCACB is structured to ensure a high degree of technical and political expertise in different sectors, as well as the widest possible representation of relevant institutions and stakeholders. Therefore, besides the relevant ministries, the CCACB includes representatives from public institutions, private sector and NGOs such as Turkish Statistical Institute (TurkStat), Turkish Union of Chambers and Commodity Exchange (TOBB), Turkish Industry and Business Association (TÜSİAD). The CCACB has several Working Groups which meet at least twice a year, provide technical support to the Board, carry out the activities envisaged by Board Decisions and operate according to their working programmes.

[128] On 7 October 2021 the Paris Agreement was ratified by the Parliament with the Law No. 7335 and entered into force on 10 November 2021.

[129] The Board consists of senior level representatives from the following institutions: MoEUCC (coordinator), chief climate negotiator, Ministry of Foreign Affairs, Ministry of Energy and Natural Resources, Ministry of Treasury and Finance, Ministry of Interior, Ministry of National Education, Ministry of Health, Ministry of Industry and Technology, Ministry of Agriculture and Forestry, Ministry of Trade, Ministry of Transport and Infrastructure, Presidency of Strategy and Budget, Council of Higher Education, Directorate of Climate Change, Scientific and Technological Research Council of Türkiye, TurkStat, Turkish Directorate of Environment Agency, Union of Chambers and Commodity Exchange, Turkish Industry and Business Association, Independent Industrialists' and Businessmen's Association, and The Union of Municipalities of Türkiye.

**The Directorate of Climate Change (DCC)** affiliated to **the Ministry of Environment, Urbanization and Climate Change (MoEUCC)** is the key administration on climate change.[130] The DCC is the National Focal Point for the UNFCCC, Kyoto Protocol, Vienna Convention, Montreal Protocol and Paris Agreement. As such, the DCC bears the responsibility for coordinating the preparatory work carried out by relevant ministries for the climate negotiations, coordinates the activities to develop Türkiye's policy in the field of climate change and protection of ozone layer and organize the CCACB. The DCC also coordinates the drafting and adaptation of national policy documents such as **Nationally Determined Contribution (NDC)**, **National Climate Change Strategy (NCCS)** and **National Climate Change Action Plan (NCCAP)**. It coordinates the activities of the MoEUCC within the framework of Türkiye's obligations under international commitments, such as preparation of **National Communications** and **Biennial Reports**.[131]

Relevant ministries such as **the Ministry of Energy and Natural Resources (MENR), the MoEUCC, the Ministry of Transport and Infrastructure (MoTI), the Ministry of Industry and Technology (MoIT), the the Ministry of Agriculture and Forestry (MoAF), Ministry of Treasury and Finance (MoTF), the Ministry of Trade (MoT)** and other institutions develop initiatives and implement activities that supports the fight against climate change. Policies and measures that aim to reduce GHG emissions and increase resilience against climate change are developed within the framework of the decisions taken at the CCACB. **The Presidency of Strategy and Budget** is another key administration which coordinates the development of national policies and their connection to annual plans and investments. The **TurkStat** is the main responsible authority to coordinate and implement national GHG inventory activities, being also the National Focal Point for national inventory in charge to submit the final yearly document to the UNFCCC Secretariat. Relevant Ministries provide data to TurkStat to support the preparation of the national GHG emission inventories.

**Municipalities** are important administrations in combating climate change, since they are responsible for taking a wide range of decisions that could contribute to the successful achievement of the national targets. More specifically, municipalities are in the position to implement crucial actions on transport emissions, and waste management. They could also influence buildings sector emissions through urban planning.

[130] With the recent Presidential Decree, the name of the Ministry of Environment and Urbanization (MoEU) has be en changed to the Ministry of Environment, Urbanization and Climate Change (MoEUCC). The Directorate of Clim ate Change (DCC) affiliated to the Ministry has been established. In addition, with the same Decree, CCACBM was restructured as the Climate Change and Adaptation Coordination Board (CCACB).

[131] At the DCC, 45% of the staff, which consists of managers, experts, engineers, and other public personnel, are w omen. In addition, six of eleven (one director, three deputy directors, and seven heads of department) middle and senior managers of the Directorate are women.

Türkiye uses participatory approaches for the development of climate policy. The **Climate Council**, held in Konya between 21-25 February 2022, brought all relevant stakeholders together, including civil society, private sector, public institutions, international organizations, local governments, and academia. The Council was organized with the main theme "**2053 net zero emission goal: Türkiye's green development revolution**" and with the aim of introducing Türkiye's new climate change vision and green transformation understanding in cooperation with stakeholders. The 217 decisions which were adopted with a participatory and transparent process by the Council will serve as a reference point for the political decisions that Türkiye will take concerning climate actions in the coming period. Thus, the outcomes of the Climate Council have been published as a guidance document for Türkiye to combating climate change.[132]

### 4.1.3 LEGISLATIVE FRAMEWORK

Türkiye's main legislation for the protection of the environment is the **Environment Law** (law no. 2872). The Law outlines Türkiye's environmental policy in general terms and it embraces the **"polluter pays"** principle. The process of establishing a **climate law** continues.[133]

Türkiye's current legislative framework on climate change is mainly led by international concerns regarding climate change, especially the UNFCCC process and Türkiye's accession process to the EU. In order to make progress in its path to join the EU, Türkiye is determined to align its national legislation, administrative and institutional set up with the current **EU Acquis** distributed into 35 Chapters. Among these, **Chapter 27** covers **Environment and Climate Change**. Legislations have been adopted on air quality protection, air pollution control, landfill, integrated waste management, wastewater, chemicals, noise management, environmental impact assessment (EIA), strategic environmental assessment (SEA), ozone depleting substances and Monitoring of GHG emissions. A detailed overview of the Sectoral legislative framework is provided in Section 4.2. under each sector. Türkiye aims to improve enforcement of these legislation.

### 4.1.4 MAIN POLICY DOCUMENTS

The **11th Development Plan[134],** adopted by the Grand National Assembly of Türkiye, is the main policy document of the country for the period between 2019 and 2023. The Plan was

[132] MoEUCC, 2023_c. Seven decisions were formed at the intersection of climate change and gender equality and aimed at women's leadership and empowerment in fighting climate change.

[133] Preliminary studies for a Climate Change Law were finalized and submitted to the Grand National Assembly of Türkiye (GNAT) for drafting and negotiation of Law by the parameters in the law-making process. The findings of the preliminary studies were submitted as a draft Climate Law proposal. The draft text aims to establish the legal basis of the mitigation and adaptation targets, set up a national emissions trading system, planning and implementation tools in line with the green growth and Net-Zero Target in tackling climate change, as well as to improve the legal basis for effective climate action in Türkiye.

[134] The plan was published in the Official Gazette dated July 23, 2019 and entered into force.

adopted on 18 July 2019 and sets out the national development policy with a multi-sectoral approach. The timeframe of the plan is for 5 years. The Plan envisages a stable and sustainable economic growth and raising the competitiveness and welfare of Türkiye.

The main policy documents that are dedicated only to Türkiye's Climate Change policies are **Climate Change Strategy (2010-2023) (NCCS)**[135] and **National Climate Change Action Plan (2011-2023) (NCCAP)**[136]**.**

Türkiye submitted its first **Nationally Determined Contribution (NDC)** in 2021 and is planning to update it in 2023. The NDC included forecasts based on currently implemented and future policies.[137]

The **Green Deal Action Plan of Türkiye**[138] contains actions necessary for executing the green transformation of Türkiye's industry, and measures to adopt for harmonizing with the EU's Green Deal, especially in areas related to trade and industry. The Action Plan including a total of 32 objectives and 81 actions under 9 main headings covers carbon border adjustments, green and circular economy, green finance, clean, economic and secure energy supply, sustainable smart mobility, and sustainable agriculture, combating climate change, diplomacy, and European Green Deal information and awareness activities.

**Türkiye National Energy Plan**[139]**,** and the **National Energy Efficiency Action Plan (NEEAP)**[140] are two key documents in terms of energy policies which impact emissions in various sectors. In addition, there are several other national strategies and action plans which have an impact on national emissions. The policy documents listed above, and these other strategies/plans are presented in detail in Section 4.2.

The **12th Development Plan** of Türkiye, being prepared for the 2024-2028 period, and its **long-term strategy** towards 2053, will accommodate the increasing climate ambition of Türkiye by harmonizing climate targets and economic growth, streamlining the sustainable development approach aimed for all sectors, primarily the manufacturing industry, mainly based on efficiency. Türkiye is implementing a substantial and rigorous package of new policies and strategies across the economy to meet its **Net-Zero Target**. The **updated NDC** has been under preparation in the context of long-term planning and sustainable development priorities. Since combating climate change requires an inclusive and sustainable development approach, policies to combat climate

[135] MoEU, 2010.

[136] MoEU, 2012.

[137] NDC, 2022. (Türkiye initially submitted the same document as INDC in 2015)

[138] Ministry of Trade, 2021.

[139] MENR, 2022.

[140] MENR, 2018.

change are determined in line with the Development Plan. Türkiye's new 2030 target is based on the modeled impact of these policies and strategies and is aligned with its Net-Zero Target.

### 4.1.5 KEY TARGETS

Türkiye's main targets related to decrease GHG emissions are below:

- Türkiye's **first NDC** suggests a **reduction of 21%** of its **GHG emissions** compared to the business-as-usual level **by 2030.**[141]
- Türkiye aims for **net-zero emissions by 2053**.
- Türkiye's **updated first NDC** is **expected to increase the reduction target to 41%** compared to the business-as-usual level **by 2030.**
- Moreover, **the updated NDC** aims **peak emissions by, at the latest, 2038**.

The **11th Development Plan**'s selected key policy targets related to climate change are presented below:

*Table 18 – Climate Change Related Key Targets of the 11th Development Plan*[142]

| Group at the 11th Development Plan | Related Sector | Target | Baseline 2018 | Target 2023 | Current 2022 |
|---|---|---|---|---|---|
| Environmental Targets | Energy | Avoided $CO_2$ Emissions with Newly Installed Renewable Power Plants (Million Tons, Cumulative) | - | 18.0 | 19.6 |
| Energy Sector Targets | Energy | Share of Natural Gas in Electricity Production (%) | 29.85 | 20.7 | 22.9 |
| Energy Sector Targets | Energy | Share of Renewable Resources in Electricity Generation (%) | 32.5 | 38.8 | 41.7 |
| Energy Sector Targets | Energy | Amount of Electricity Produced from Domestic Sources (TWh) | 150.0 | 219.5 | 197.5 |
| Urban Infrastructure Targets | Waste / Waste Management | Recovery Rate of Waste within the Scope of Zero Waste Project (%) | 13 | 35 | 30 |

[141] The NDC estimated that Türkiye's GHG emissions would reach 1,175 billion tons of $CO_2$eq without measures th at year, and with the measures foreseen at the NDC, it would decrease to approximately 929 million tons of $CO_2$e q.

[142] 11th Development Plan, 2019.

| | | | | | |
|---|---|---|---|---|---|
| Urban Infrastructure Targets | Waste / Waste Management | Proportion of Municipal Population Given Landfill Services (%) | 75 | 100 | 88 |
| Urban Infrastructure Targets | Transport | Urban Rail Systems Network Length (km, cumulative) | 747 | 1,154 | 864 |
| Urban Infrastructure Targets | Transport | Bike Path Network Length (km, cumulative) | 1,048 | 4,048 | 1,967 |
| Logistics Targets | Transport | Share of Railway in Total Freight Transport (in modes of national ter- ritorial transport, %) | 5.15 | 10 | N.E. |
| Logistics Targets | Transport | Railway Line Efficiency (Passenger-Km+Tonne-Km) / (Lenght of Main line) | 1.48 | 2,.77 | N.E. |
| Logistics Targets | Transport | Electrified Line (%) | 43 | 77 | 47[2] |
| Targets in Agriculture Sector | Forestry / LULUCF | Ratio of Forest Areas to Country Area (%) | 29.4 | 30.0 | 29.8 |

Türkiye also announced fundamental targets at the **Türkiye National Energy Plan[143].** According to the plan, by 2035, Türkiye will reach approximately:

- 52.9 GW of solar, 29.6 GW of wind of which 24.6 GW onshore and 5 GW offshore, 35.1 GW of hydroelectric and 5.1 GW geothermal and biomass installed power capacity,
- 7.2 GW of nuclear installed power capacity,
- 7.5 GW battery power storage and 5.0 GW electrolyzer capacity.

According to the plan, renewable energy sources, which had a 16.7% share in primary energy consumption in 2020, will increase to 23.7% in 2035. Energy intensity will be decreased by 35.3%.

Türkiye's sectoral targets are also presented on in Section 4.2 under each sector.

### 4.1.6 MONITORING AND EVALUATION OF POLICIES AND MEASURES

Each Ministry overseeing respective policies and measures are responsible for monitoring and evaluation of the implementation status and GHG emission reduction impacts of those policies. However, as the National Focal Point for the UNFCCC, the MoEUCC gathers the information and

[143] MENR, 2022.

coordinates the reporting of the progress through National Communications and Biennial Reports. The Turkish Statistical Institute (TurkStat) ensures the collection of GHG emission data as the UNFCCC Focal Point for National GHG Inventories.

Monitoring of the Development Plans are important processes which also contributes to the monitoring and evaluation of the achievement of Türkiye's climate policies. The realization information of the activities determined to achieve the policies and measures in the Development Plan is entered into the Presidential Plan Program Monitoring and Evaluation System (CPPIDS) system on a quarterly basis by the officers specified for each activity which are determined by each administration for activities. The results are monitored by the Presidency of Strategy and Budget (SBB) over the CPPIDS.

**The National Energy Efficiency Action Plan Monitoring and Steering Board (NEEAP MSB)**[144] was established by the Presidential Circular on December 7, 2019 within the scope of the National Energy Efficiency Action Plan. The Board is responsible to determine energy efficiency strategies at the national level, prepare action plans and programs, monitor implementation levels of the National Energy Efficiency Action Plan and ensure coordination for effective implementation.

**The Monitoring, Reporting and Verification (MRV)** of GHG emissions system also contributes to monitoring, evaluation, and policy formulation.

The MoEUCC is developing a legislation and a new online system entitled E-YIDEP which the municipalities will upload their LCCAPs thus, the Ministry will be able to monitor LCCAPs.

## 4.2 POLICIES AND MEASURES AND THEIR EFFECTS

Türkiye's overall climate change policy is framed with several cross-cutting and sectoral policies, strategies and action plans that are based on the national legislation in relevant sectors. Below both cross-cutting and sectoral policies are given in detail.

### 4.2.1 CROSS-CUTTING POLICIES AND MEASURES

#### *Overview*

The **11th Development Plan**, adopted by the Grand National Assembly of Türkiye (GNAT) on July 18, 2019, was published in the Official Gazette dated July 23, 2019 and entered into force. The Plan is a national policy with a multi-sectoral approach. The plan was approved by the

[144] The Board consists the high level representatives from Presidency of Strategy and Budget, Presidency of The Republic of Türkiye Economic Policy Board, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, Ministry of Treasury and Finance, Ministry of Interior, Ministry of Education, Ministry of Health, Ministry of Industry and Technology, Ministry of Agriculture and Forestry, Ministry of Transport and Infrastructure, Energy Market Regulatory Authority, Union of Municipalities of Türkiye and Union of Chambers and Commodity Exchanges of Türkiye.

GNAT's Decision 1225/2019 and sets the country's vision for stronger, sustainable socioeconomic development. Development Plans are prepared by the Presidency of Strategy and Budget (SBB) with the active participation of all institutions and organizations and adopted by the GNAT. The Annual Presidential Programs define which administrations will carry out the policies and measures determined in the Development Plans through which activities in the relevant year. Public administrations prepare their budgets in accordance with the development plan, medium-term program, annual presidential program, strategic plans, and performance programs. The 11th Development plan sets several policies, measures (see following sections on sectoral policies) and target regarding the climate actions (see Section 4.1.5.). The **12th Development Plan (2024-2028)** is under development. Within the scope of the plan, a long-term low emission development strategy (Long-Term Strategy) is being drafted.

**National Climate Change Strategy (2010-2020) (NCCS),** covering the 2010-2020 period, was prepared with contributions from a variety of stakeholder groups including CCACB members, public and private sector representatives, universities and NGOs, and approved by the Higher Planning Council on May 3, 2010. It is one of the key policy documents which frames Türkiye's contribution to global efforts to fight against climate change. The NCCS describes Türkiye's vision as "becoming a country fully integrating climate change-related objectives into its development policies, disseminating energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts for tackling climate change within its "special circumstances", and providing its citizens with a high quality of life and welfare with low-carbon intensity". The NCCS includes a set of objectives to be implemented in the short term (within one year), the mid-term (undertaken or completed within 1 to 3 years), and long term (undertaken over a 10-year period). It also guides the actions (such as energy efficiency measures, usage of renewable sources, transportation type) for GHG emission reduction in the energy, transportation, industry, waste, land use, agriculture and forestry sectors to tackle climate change during the period 2010-2020.[145]

**National Climate Change Action Plan (2011-2023) (NCCAP),** is the main policy document that identifies sectoral climate actions to fight against climate change and to meet **Nationally Determined Contribution (NDC)** targets. NCCAP was prepared within the framework of NCCS, 9th Development Plan and other national policies and strategy documents in 2011. NCCAP includes strategic principles and goals on greenhouse gas emissions reductions and adaptation to climate change for the period of 2011-2023. It lays down cross- sectoral mitigation measures from short to long term, including provisions for cross-cutting issues for data collection, reporting, monitoring, and verification. The NCCAP sets clear objectives for both mitigation and adaptation aspects of climate change. It was prepared on the basis of the sectors specified both

[145] MoEU, 2010

in Annex-A of the Kyoto Protocol and UNFCCC National Communication and GHG Inventory reporting formats and includes the goals and actions on energy, buildings, transportation, industry, waste, agriculture, land use and forestry, climate change adaptation and cross-cutting issues. The plan emphasizes "proliferate energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts for tackling climate change within Türkiye's special circumstances and providing its citizens with a high quality of life and welfare with low-carbon intensity". NCCAP identifies short, medium and long- term goals under eight topics (energy, industry, forestry, agriculture, buildings, transportation, and waste and climate change adaptation).[146]

Some key elements of the NCCAP are indicated below:

- Energy efficiency measures in the building sector, such as improving insulation and promoting the use of energy-efficient appliances.
- Expansion of renewable energy sources, such as wind, solar, and geothermal power.
- Increased use of public transportation, as well as the promotion of hybrid and electric vehicles.
- Implementation of emissions standards for industry, particularly in the cement, iron and steel, and petrochemical sectors.
- Afforestation and reforestation activities to increase carbon sequestration.

Moreover, NCCAP foresees activities to establishment a base for National Emission Trading System:

- Identifying key sectors for the carbon markets, and identifying the GHG reduction potential in the relevant sectors;
- Making legislative arrangements to enable public institutions regulatory and supervisory role in the emissions trading system;
- Beginning infrastructure development for establishment of the National Emissions Trading System;
- Carrying out activities to increase awareness in carbon markets in Türkiye;

Türkiye is currently preparing new **national climate change strategy** and **national climate change action plan.**

The "**Green Deal Action Plan**" of Türkiye has been published on 16th July 2021 with the Presidential Circular numbered 2021/15. The Action Plan including a total of 32 objectives and 81 actions under 9 main headings dwells on green transformation of Türkiye's industries and adoption of measures for harmonizing with the EU's Green Deal, especially in areas related to trade and industry. For the effective implementation of the Action Plan, on a technical level,

[146] MoEU, 2012.

twenty “Specialized Working Groups” have been established in sectors such as textile, construction, cement, aluminum and steel, as well as horizontal areas such as energy, finance and technology.

Table 19 contains Türkiye's cross-cutting policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

*Table 19 – Cross-cutting policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Establishment of an Emissions Trading System | Cross-cutting | $CO_2$, $N_2O$, PFCs | Reducing GHG emissions of high emitting installations which has high GHG emissions | Regulatory, Economic | Planned | - | MoEUCC | NE |
| 2 - Monitoring, Reporting and Verification (MRV) of Greenhouse Gas Emissions of High GHG Emitting Installments | Cross-cutting | $CO_2$, $N_2O$, PFCs | Increasing the knowledge and data on Türkiye's GHG emissions | Information | Implemented | 2014 | MoEUCC | NE |
| 3 - Establishment of Voluntary Carbon Market | Cross-cutting | $CO_2$, $N_2O$, $CH_4$ | Increasing financial support to low-carbon development projects | Voluntary | Implemented | 2010 | MoEUCC | NE |
| 4 - Eco-Design and Energy Labelling and Environmental Labelling | Cross-cutting | $CO_2$ | Increasing energy efficiency of products which use electric energy | Regulatory | Implemented | 2010 | MoIT | NE |
| 5 - Promotion of Local Climate Change Action Plans | Cross-cutting | $CO_2$, $N_2O$, $CH_4$ | Increasing local climate action of municipalities | Voluntary / Regulatory | Implemented / Planned | 2018 / - | MoEUCC /Municipalities | NE |

#### *4.2.1.1 Establishment of an Emissions Trading System (ETS)*

Türkiye aims to work on identifying critical sectors for the carbon markets and identifying their GHG reduction potential in the relevant sectors since the first NCCAP. The Climate Council (2022) included a Carbon Pricing and Green Finance commission. The suggestion by the Council was the **establishment of an Emissions Trading System (ETS)** that is consistent with Türkiye's national circumstances. The draft Climate Law, which will be the legal basis to introduce the ETS, has been prepared and shared with the members of the **CCACB** for their feedback. The MoEUCC started preparations with the World Bank for Partnership for Market Implementation (PMI) project regarding the implementation phase towards an ETS.

*Box 1 - The history of ETS in Türkiye*

The history of ETS preparations in Türkiye dates back to 2014 in terms of concreate actions. It can be stated that with the Partnership for Market Readiness, which has been worked in partnership with the World Bank, capacity has been created in many different topics. The studies carried out within the scope of the 1st Implementation phase of the Partnership covering the years 2013-2018 are as follows: Pilot studies of a reliable and robust monitoring, reporting and verification (MRV) system on which the ETS will operate are among the first outputs. The MRV system, which continues its activities by detailing on pilot studies, has been a system where emissions of emission-intensive sectors are monitored since 2015. Currently, almost half of the country's emissions are monitored by the MRV system via monitored 715 facilities. Some of the analyzes carried out within the scope of PMR include, market-based emission reduction policy options evaluation for Türkiye, the analysis of the economic, fiscal and sectoral impacts of a carbon pricing policy and sectoral assessment study of the carbon leakage risk, which is another issue to be considered in the allocation process in carbon pricing policies.

The main works carried out within the scope of the 2nd Implementation phase of the PMR covering the years 2019-2021 are as follows: Studies were carried out to improve the legal and institutional infrastructure in the context of the ETS implementation. In this regard, in addition to the recommendations regarding the institutional division of labor, draft legislation studies and sub-legislation drafting studies regarding the sub-processes of the ETS have been put forward. A preliminary study has been carried out on the determination of a cap for the ETS and the development of the national allocation plan. Besides, a pilot ETS simulation application was created as a gamification application and used with relevant stakeholders. Finally, a pilot registration system software was created for the ETS registry.

Following the studies under PMR, Türkiye is starting the preparations for the implementation of the ETS with a PMI project. Application for the PMI was forwarded in September 2022 and was approved by the World Bank in January 2023. It is expected that the PMI will last about 5 years, focusing on the technical and institutional preparations towards the national ETS.

#### *4.2.1.2 Monitoring, Reporting and Verification (MRV) of GHG emissions*

The **By-Law on Monitoring of Greenhouse Gas Emissions**[147] has been promulgated on Official Gazette No. 29003 on 17 May 2014 and came into force in order to regulate the principles and procedures for monitoring, verifying and reporting of greenhouse gas emissions arising out of the activities listed in Annex-1 of the legislation. According to the By-Law, manufacturing sector representatives of energy-intensive sectors such as electricity and steam production, petrol refineries, petrochemistry, cement, iron-steel, aluminum, brick, ceramic, lime, paper and glass production regularly report and verify their annual GHG emissions.

Implementation of the legislation regarding monitoring, reporting and verification of GHG emissions has accelerated over the recent years. Monitoring plans have been received from the installations that are subject to the legislation. Preparation of monitoring reports and their verification is ongoing. In order to facilitate the implementation of the legislation in an effective way, a web portal has been developed where installations can prepare their monitoring plans and monitoring reports online. Also, training courses have been organized in order to develop capacities for accredited verifiers and certified verification companies.

The By-Law and the two Communiques under the framework of the By-Law have been developed as a part of efforts to align with the Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.[148] Communique on Monitoring and Reporting Greenhouse Gases was published on Official Gazette No 29068 on 22 July 2014. Communiqué Amending the Communiqué on Greenhouse Gas Emissions Monitoring and Reporting was published in the Official Gazette No. 31386 of 5 February 2021. The legal document aimed at providing the principles and procedures for monitoring and reporting the greenhouse gas emissions originating from the activities listed in Annex 1 of the By-Law on Monitoring Greenhouse Gas Emissions. Communique on Verification of Greenhouse Gas Emission Reports and Authorization of Verification Institutions has been published on Official Gazette No 29314 on 2 April 2015. This Communiqué was repealed by the Communiqué on Verification of Greenhouse Gas Emission Reports and Accreditation of Verifiers which was published in the Official Gazette No. 30258 of 2 December 2017. Communiqué

[147] This By-law has been amended two times since then. Firstly, By-law Amending the By-law on Monitoring Greenhouse Gas Emissions was published in the Official Gazette No. 29757 of 29 June 2016 and the second amendment was published in the Official Gazette No. 30082 of 31 May 2017.

[148] The pieces of legislation were enacted in parallel with Commission Regulations (EU) No. 601/2012 (Monitoring& Reporting) and No. 600/2012 (Verification& Accreditation) and also Regulations No 2067/2018, 2066/2018 within the scope of the Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (EU ETS Directive).

Amending the Communiqué on Verification of Greenhouse Gas Emission Reports and Accreditation of Verifiers was published in the Official Gazette No. 31873 of 21 June 2022. The legislation came into force in order to determine the principles and procedures regarding the features of verification institutions that will carry out these verification processes. The verification system established within the scope of the By-Law provide for verification control of emission reports prepared on a facility basis by on-site inspection of independent institutions before submitting to the Ministry. Production of transparent, accurate, comparable, complete and consistent data and information regarding greenhouse gas emissions on a facility basis are provided through implementation of these regulations and communiques.

#### *4.2.1.3 Voluntary Carbon Market*

Türkiye has been working on the **voluntary carbon market** and following up the negotiations in **Article 6 of the Paris Agreement**. In this context, a study called **"State of the Voluntary Carbon Market in Türkiye and implications of engaging with Article 6 of the Paris Agreement"** was conducted in 2022 with the aim of making an inventory of the current projects in the voluntary carbon market that are hosted by Türkiye and analyze various scenarios for participating Article 6 of the Paris Agreement. Taking into account the requirements of authorization and corresponding adjustment under the Article 6 market-based mechanisms, Türkiye will constitute a strategic analysis with its NDC on the decision to participate in Article 6, and will construct several roadmaps considering its national priorities.

#### *4.2.1.4 Ecodesign and Energy Labelling and Environmental Labelling*

Türkiye adopted the **By-law on Environmentally Responsible Design of Energy-Related Products** in 2022 fully harmonized with the EU eco-design acquis (2009/125/EC).[149] Ministry of Industry and Technology. Moreover, **the By-law on Framework For Energy Labelling** fully harmonized in parallel to the EU Regulation (2017/1369/EU). The Ministry published communiques on energy labelling and eco-design requirements for several energy related products.

Moreover, the **By-law on Environmental Labelling** entered into force in line with Regulation (EC) No 66/2010 of the European Parliament and of the Council on ecolabelling.[150] The By-law regulated environmental label specifications for seven products and service items, including glass, hand washing dish detergents, personal care and cosmetics, ceramic coating, textile, cleaning paper product groups, and tourist accommodation service group.

[149] Official Gazette dated 5 February 2022 and numbered 31741. Previously, Türkiye adopted the By-law on Environmentally Responsible Design of Energy-
Related Products in 2010 harmonizing previous versions of the EU directives on the issue.

[150] Official Gazette dated 19 October 2018 and numbered 30570.

Detailed list of implementing communiques on eco-design and energy labelling is in the Annex I - Türkiye's Eco-design, Eco-label and Automotive legislation.

#### *4.2.1.5 Local Climate Actions*

On the local level, various local authorities implement policies and measures in order to reduce GHG emissions, increase resource efficiency, increase resilience to climate change impacts and increase public awareness on climate change. **11th Development Plan** requires preparation of climate action plans for seven geographical regions of Türkiye specifically focusing on adaptation measures. These regional climate actions, mainly focused on adaptation measures, were prepared.

The MoEUCC has set the target of **preparing local climate change action plans LCCAPs** in **all 30 metropolitan municipalities of Türkiye** within the scope of the 2019-2023 Strategic Plan of the Ministry. For this purpose, the Ministry has been supporting local authorities with various methods such as training programs, technical guidelines, and grant programs in order to spread these action plans. EU funded IklimIN Project Grant Programme (2017-2020) and a nationally funded TÜBİTAK-MAM Project (2022) have been implemented to support local climate action. Several LCCAPs were prepared under these two projects. **The Climate Council (2022)** resolute on 25 decisions on local climate action and 5 of those have been prioritized. These decisions include development of guidelines and tools to support preparation of LCCAPs.

A **draft by-law on the preparation of local climate change action plans (LCCAPs)** have been developed by the MoEUCC. This draft by-law aims to increase the number of LCCAPs prepared and implemented by local authorities. These plans will cover provincial administrative borders and include mitigation and adaptation actions together with local GHG emission inventories. Local authorities will be required to monitor, evaluate and update their plans.

**Integrated Urban Development Strategy and Action Plan (2010-2023) (KENTGES)** was adopted in 2010 for the period of 2010-2023. KENTGES is a cross cutting strategy document in terms of low carbon and sustainable development. Plan mentions studies and actions to be performed at central and local levels regarding transport, housing and land supply, disasters, natural and cultural assets, climate change, life quality, social policies and participation. In the Plan, the main principles and values regarding climate change and sustainable development are:

- Paying attention to ecological balance in natural resource use;
- Ensuring healthy, safe, and quality environment, free from natural and technological disasters and risks;
- Improving use of a sustainable transportation systems as well as use of renewable energy resources;
- Paying attention to environmental, natural and ecological equality;

- Encouraging methods to decrease impacts of consumption patterns on natural and cultural environment in settlements.

The **National Smart Cities Strategy and Action Plan (2020-2023)** is prepared at the national level, shaped by common sense and scientific perspective, including public institutions and organizations, local governments, private sector, NGOs and universities. The Plan was published by a Presidential Circular and entered into force. It is aimed to implement smart city technologies and solutions to apply and disseminate on a regional and global scale. Local Smart City Strategy and Roadmap Guide, Smart Cities and Connected Data Guide, New Urban Agenda and Smart Cities Guide documents have been prepared. Monitoring and evaluation studies regarding of the Plan were carried out.[151]

**National Strategy of Regional Development (NSRD)** determines the national priorities in regional development policies and functions as a blueprint for the regional development plans of 26 regional development agencies (DAs), action plans of regional administrations, other national and regional development strategies, the public investment and budgeting process, and specific territorial development programs. The new NSRD (2024-2028) is in the preparation phase and its vision is "With its globally competitive, prosperous and resilient regions and by using its local dynamics completely developed Türkiye" The elaboration process of the new NSRD involves input, consultation, and negotiation with various stakeholders, including the public and private sectors, NGOs, universities, development agencies (DAs), and local entities. NSRD is intended to serve as the primary coordination document for regional development policies and to be the second comprehensive strategy document focused on addressing regional development disparities and enhancing regional competitiveness in Türkiye. Within the scope of the new NSRD, nine themes have been determined: urban development, rural development, social policies, industry-logistics-transportation, green growth, R&D and innovation, entrepreneurship, digitalization and tourism. Strategies have been developed for the 2024-2028 period under these themes. After undergoing technical evaluations, the strategy will be approved by the Presidency of the Republic of Türkiye.

Regional development plans were primarily drafted and approved between 2009 and 2010 for the period of 2010-2013 for all regions. The second generation of regional development plans (2014-2023) was approved and became operational in 2014. The development of the third generation of regional plans is still underway and it is expected that they will be approved and operationalized in the latter half of 2023. In line with the NSRD, one of the priority areas of regional development plans is green growth and it is aimed to tailor climate change and green growth policies according to regions' needs and priorities.

[151] MoEU, 2019

### 4.2.2 ENERGY INDUSTRIES

*Overview*

The energy sector is responsible for approximately 85.4% of Türkiye's $CO_2$ emissions. This situation increases the urgency of the decarbonization process of the sector from the perspective of combating climate change. Various policy documents such as National Energy and Mining Policy (2017) ,11th Development Plan and the Strategic Plan of the MENR (2019-2023); have been published in recent years which directly or indirectly targets GHG emission reduction in the energy sector.

**11th Development Plan (2019-2023)** defines Türkiye's main energy objective as "to ensure uninterrupted, high-quality, sustainable, reliable and affordable energy supply." and The Development Plan focuses on facilitating competitiveness and efficiency increase in all fields. Policies and measures to reduce carbon emissions in energy sector are as follows:

- Nuclear Power Plants (NPPs) will be included in the electricity generation portfolio, efforts will be continued to increase the share of nuclear energy in electricity generation and institutional capacity will be strengthened.
- Construction of the first unit of Akkuyu NPP will be completed and electricity production will be started in 2023.
- In addition to the Akkuyu NPP, the work on the installation of two additional NPPs will continue.
- Energy efficiency in existing buildings will be promoted through support systems.
- Energy Efficiency in Public Buildings Project will be implemented.
- National Green Building Certificate System will be established.
- Buildings that are more efficient and produce their own energy will be expanded.
- Thanks to YEKA-like models, renewable resources will be used more intensively in the generation of electrical energy.
- Electricity generation from renewable energy sources will be increased and necessary planning and investments will be realized in order to ensure the safe integration of renewable energy generation to the grid.

The **Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy** (No 5346) has entered into force in 2005 in order to progress on extending the use of renewable energy resources for power generation, increasing resource diversity, reduction of waste, protection of the environment, and development of renewable technology manufacturing industry. By the Law No. 7257 amending the Renewable Energy Law No. 5346, which was published in the Official Gazette No. 3122 of 02 December 2020, new renewable energy support mechanism which will be forced on July 1st, 2021, is formed and By the

Presidential Decree No. 3453 was published in the Official Gazette No. 31380 of January 30th, 2021, new renewable energy support mechanism's details were announced.

As a roadmap for energy policies in Türkiye, **Strategic Plan of the MENR (2019- 2023)** targets "providing the highest contribution to national welfare by utilizing energy and natural resources in the most efficient and environmentally-conscious manner". The plan is important due to direct impact of the energy sector emissions on climate change. Some targets in the document are listed as follows:

- the ratio of installed electrical power based on renewable energy resources to the total installed power will be increased
- to have a strong and reliable energy infrastructure; natural gas storage and number of residential areas which uses natural gas will be increased.
- energy efficiency measures with rehabilitation of the state-owned power plants, using more efficient street lightings (LED), and expanding regional heating systems
- nuclear energy will be included and increasing its share in energy supply will continue.

The **Türkiye National Energy Plan** has been prepared in accordance with Article 20, which is titled as Security of Supply, of the Electricity Market Law No. 6446 and Additional Article 2 of the Natural Gas Market Law No. 4646. With this plan, it was aimed to forecast the energy sector in line with Türkiye's long-term greenhouse gas emission target. The plan published on December, 2022 by the MENR. According to the Plan, Türkiye will reach approximately 33 GW of solar installed power capacity, 18 GW of wind installed power capacity, 35 GW of hydroelectric installed power capacity and 7.2 GW of nuclear installed power capacity by 2035. Türkiye also plans to reach the currently unavailable battery and electric power capacity 2.1 GW and 1.9 GW by 2030, respectively at the same year.[152]

**Hydrogen Technologies Strategy and Roadmap of Türkiye, Carbon Dioxide Capture and Utilization Technologies Roadmap and Implementation Plan for Türkiye** and **Offshore Wind Roadmap of Türkiye** are planned to be published in 2023. Hydrogen production supported by carbon capture, utilization and storage from domestic coal enables the use of Türkiye's resources with added value. Coal Gasification and Hydrogen Production R&D carried out in Çayırhan and Soma TRIJEN Project are important steps in this field.

Energy efficiency has also been an important part of Türkiye's energy and climate policy over the last decade. The Department of Energy Efficiency and Environment under the MENR is responsible for coordination of energy efficiency activities all across the country. Several other institutions like MoEUCC, MoIT, MoTI, Small and Medium Enterprises Development Organization (KOSGEB) also carry out studies and projects for energy efficiency.

[152] MENR, 2022.

The **Energy Efficiency** (Law, No: 5627) entered into force in 2007. The law provides a legal framework for policies, strategies and activities regarding effective use of energy, prevention of loss, relieving the burden of energy cost on the economy and protecting the environment.

The **Energy Efficiency Strategy Paper (2012-2023) (EESP),** which sets a long-term target of 20% reduction in energy intensity by 2023, compared to 2011 figures, was approved by Türkiye's High Planning Council on February 27, 2012.[153] The document provides a roadmap of energy-efficiency actions for all sectors of Türkiye by defining responsibilities for institutions, by and to increasing collaboration between NGOs and the private sector and identifies measurable, concrete policy activities necessary for reaching the targets. The EESP describes seven strategic purposes and corresponding strategic targets with the focus on the industry, the electricity system, private/public buildings, electrical products, and transport. The following issues were determined as strategic goals and activities were foreseen depending on these goals:

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

Component 4 of the Plan explicitly requires two actions related to energy performance of public buildings:

- disseminating energy efficiency investments in public buildings by various financing methods including energy performance contract borrowing model that allows debt repayment with savings obtained after project implementation

[153] MENR, 2010.

- converting the external structures surrounding the buildings and the heating systems in old buildings with low and/ or insufficient insulation to thermally insulated ones, which also meet the current standards.

**National Energy Efficiency Action Plan (2017-2023)**[154] was adopted in January 2018 which emphasizes the importance of sustainable development along with competitive and green growth in Türkiye. The plan involved 55 actions defined in buildings and services, energy, transport, industry and technology, agriculture, cross-cutting sectors/ areas. These actions are expected to require an investment of 10.9 billion USD until 2023, and to lead to a cumulative energy saving of 23.9 million tons of oil equivalent (Mtoe), which corresponds to a 14% reduction in primary energy consumption of Türkiye until 2023. In addition, a cumulative saving of 66.6 million tons $CO_2$ emission is also expected until 2023. The preparation of Türkiye's **new energy efficiency strategy for 2030** and **2nd NEEAP (2024-2030)** has been launched by the MENR.[155]

According to the Department of Energy Efficiency and Environment data, between 2000-2020 there was an annual decrease of 1.4% in both primary energy intensity index and final energy intensity index. In 2020, the primary energy intensity increased 0.26% when compared to the previous year whereas the final energy intensity increased 0.95%. If we are to make a comparison with the data in 2000, the primary energy intensity and the final energy intensity indices improved 24.5% and 24.8% respectively (DEEE, 2021). According to the energy efficiency index (ODEX), there has been an improvement of 24.8% in total and 1.8% on an annual basis in Türkiye during the period of 2000-2016 in terms of energy efficiency.

Türkiye commenced efforts to enact energy efficiency legislation and to pursue EU alignment process with the adoption of the **Energy Efficiency Law No. 5627 (EE Law)** in 2007, which targets industrial facilities, the building, service and transport sectors, and also power plants; generation, transmission and distribution networks. Following the publication of the Energy Efficiency Law in 2007, secondary regulations such as the **By-law on the Energy Performance of Buildings**, the **By-law on energy efficiency of the utilization of energy resources and energy**, the **By-law on Supporting Energy Efficiency in small and medium-sized enterprises**, the **communiqué on procedures and principles regarding the calculation of efficiency of cogeneration and micro-cogeneration** has been developed. The EE Law introduced, among other measures, energy audits, an energy management program, the establishment of EE

[154] MENR, 2018.

[155] So far, 7 workshops were conducted in selected cities to discuss energy efficiency in agriculture, transportation, municipal services, buildings, heating & cooling sector, energy management and finance with the participation of around 800 people from public institutions, private sectors, universities, NGOs and sector associations. The works hops on energy efficiency in industry and supply side will be held in November, 2022. And finally, new energy effic iency strategy and 2nd NEEAP will be prepared based on the feedbacks received from the workshops.

companies and financial support schemes. Regulations issued in accordance with the EE Law are;

- The **By-law on Energy Performance of Buildings (EPB)** dated 2008 and amended in 2010, 2011, 2017 and 2022 introduces a common methodology for calculating the energy performance in buildings and sets **Minimum Energy Performance Standards (MEPS)** for new buildings and buildings subject to major renovation.
- The **Communiqué on Procedures and Principles Regarding the Calculation of Efficiency of Cogeneration and Micro-cogeneration** was published in 2014 in parallel with EU Directive (2012/27/EU).
- The **By-law on Supporting Energy Efficiency in SMEs**,
- Similarly, Türkiye has also adopted the **EU Eco-Design and Labelling Directives** (2010/30/EU and 2009/125/EU).

As per EE Law, energy management activities are mandatory for buildings and industrial establishments of particular size. Accordingly, energy managers have to be appointed at;

- Industrial enterprises which have total annual energy consumption of 1000 toe or more
- Commercial and service buildings which have total construction area over 20,000 m2 or total annual energy consumption over 500 toe,
- Public buildings which have total construction area over 10,000 m2 or total annual energy consumption over 250 toe,
- Organized industrial zones,
- Thermal power plants which have over 100 MW of installed capacity

Table 20 contains Türkiye's energy sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

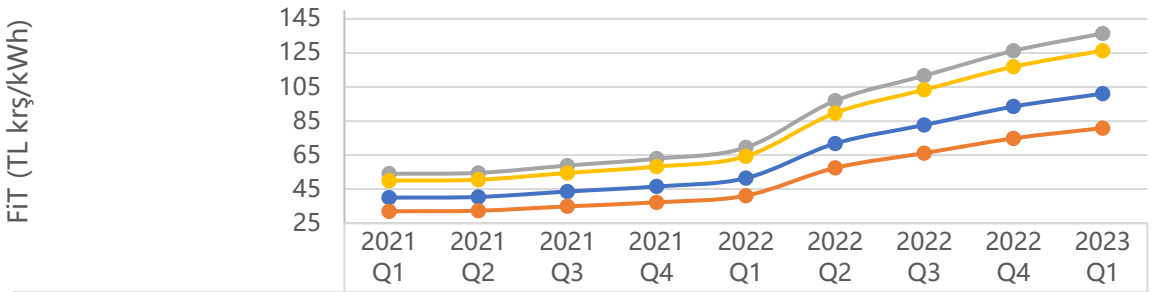
*Table 20 – Energy sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Renewable Energy Sources Support Mechanism (YEKDEM) | Energy | $CO_2$ | Increase in renewable power generation | Regulatory, Fiscal | Implemented | 2011 | MENR, EMRA | NE |
| 2 - Renewable Energy Resource Areas (YEKAs) | Energy | $CO_2$ | Increase in renewable power generation | Fiscal, Economic | Implemented | 2016 | MENR | NE |
| 3 - Electricity Generation from Nuclear Energy | Energy | $CO_2$ | Decreasing GHG emissions through use of nuclear energy | Infrastructure Development | Adopted | 2010 | MENR | NE |
| 4 - Cogeneration and Trigeneration | Energy | $CO_2$ | Dissemination of cogeneration systems with the cogeneration plant efficiency certificate issued for the facilities that provide minimum efficiency value, electricity/heat ratio value and primary energy saving of at least ten percent or more | Regulatory | Implemented | 2014 | MENR | NE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 - Mandatary Energy Audit Programs | Energy | $CO_2$ | Determination of energy saving potential in industry, building, service and energy | Regulatory | Implemented | 2012 | MENR | NE |
| 6 - Energy Sector Research and Development Projects Support Program (ENAR) | Energy | All gases | Promotion of sustainable energy policies, supply security, local energy technologies and industry products and systems. | Economic, other | Implemented | 2010 | MENR | NE |
| 7 - Incentives to Energy Transformation in Agriculture Sector | Energy | $CO_2$ | Promotion of water and energy efficient irrigation systems through financial support and awareness raising Sustainable Energy Financing Mechanism for Solar Photovoltaic Systems in Forest Villages in Turkey | economic, regulatory, informative, other | Implemented | 2017 | MENR | NE |
| 8 - Inspection Regulation | Energy | $CO_2$ | | Regulatory | Implemented | | MENR | NE |
| 9 - Public lighting | Energy | $CO_2$ | Decreasing GHG emissions resulted from public lighting | Infrastructure Development | Implemented | | MENR | NE |
| 10 - Development of Electricity Storage Capacity | Energy | $CO_2$ | Supporting increase of renewable power generation | Infrastructure Development | Planned | | MENR, EMRA | NE |
| 11 - Energy management Program | Energy | $CO_2$ | Increasing energy efficiency of end-use, public and energy sectors | Regulatory | Implemented | 2007 | MENR | NE |

#### 4.2.2.1 *Renewable Energy Sources Support Mechanism (YEKDEM)*

The introduction of the **Renewable Energy Sources Support Mechanism (YEKDEM)** has significantly accelerated renewable energy investments especially for wind and solar power. Within the frame of the support mechanism, the retail companies assigned by EMRA are required to purchase the produced electricity from the electricity manufacturers which are subject to this mechanism on the tariffs regulated by the legislation and the electricity manufacturer cannot sell the produced electricity to other companies under the open market conditions. The feed-in tariff prices which are given below are applied for the periods specified afront side, for electricity generation facilities based on renewable energy resources with RES Certificate which will be commissioned from 1 July 2021 until 31 December 2025. These prices are escalated on the basis of source within a period of three months each year, according to Domestic Producer Price Index, Consumer Price Index, the average daily US dollar and Euro forex buying rates.




| | 2021 Q1 | 2021 Q2 | 2021 Q3 | 2021 Q4 | 2022 Q1 | 2022 Q2 | 2022 Q3 | 2022 Q4 | 2023 Q1 |
|---|---|---|---|---|---|---|---|---|---|
| Hydro | 40 | 40,4 | 43,59 | 46,56 | 51,44 | 71,75 | 82,65 | 93,47 | 101,06 |
| Wind/Solar/Waste Gas | 32 | 32,32 | 34,87 | 37,25 | 41,16 | 57,41 | 66,13 | 74,79 | 80,86 |
| Geothermal/Biometh. | 54 | 54,54 | 58,84 | 62,85 | 69,44 | 96,86 | 111,58 | 126,18 | 136,43 |
| Thermal Removal | 50 | 50,5 | 54,48 | 58,2 | 64,3 | 89,69 | 103,32 | 116,84 | 126,33 |

With the contribution of the YEKDEM, in terms of power generation, renewable energy installed capacity reached to 56,395 MW (54% of total installed capacity) at the end of the 2022. Approximately 74% of the renewable energy was generated from the hydraulic sources and wind.[156] According to TEIAS (Turkish Electricity Transmission Corporation) data, the wind power plant installed capacity, which used to be 18.9 MW in 2002 reached 6,516.2 MW at the end of 2017 and 11,396 MW at the end of 2022 with 358 power plants in total.

#### 4.2.2.2 *The By-Law on Renewable Energy Resource Areas (YEKA)*

The **By-Law on Renewable Energy Resource Areas (YEKA)** entered into force in 2016 for ensuring effective and efficient use of Türkiye's renewable energy sources by forming large-scale Renewable Energy Resource Areas (YEKAs) on either property belonging to public /

[156] MENR, 2022

treasury or privately-owned property, rapidly completing investment projects by assigning these areas to investors, while ensuring high-tech equipment used in the renewable energy-based generation facilities. Also, the government awards limited-time purchase guarantees to support renewable energy investments and to incentivize local manufacturing of renewable generation assets. Basically, YEKA model has two allocation models. One requires developers to include domestic businesses or establish domestic factories and to create employment for the local labor force and invest in R&D. The other one requires developers to use local production. Also, the By-Law requires that the equipment which will be used in electricity generation plants be supplied from a domestic manufacturer and to have a domestic goods certificate. This method will ensure that the local industry receives support in the renewable energy production as well. Moreover, the localization requirements also provide direct economic benefits for Turkish factories and manufacturers, in addition to accelerating development of subsidiary industries. By-Law on Renewable Energy Resource Zones, which has come into force on October 9, 2016, introduced a new investment model to support renewable energy investments and incentivize local manufacturing of renewable generation assets. The main purposes of the By-Law are to use renewable energy resources much more efficiently and effectively by identifying renewable energy zones on the public, treasury, or private-owned territories; to realize the renewable energy investments much more rapidly; to manufacture renewable energy equipment in Türkiye; to use locally-manufactured equipment/components; and to contribute to research and development activities through technology transfer

In order to encourage generation facilities based on renewable energy resources, 10% of the relevant fees are collected in applications for pre-license and license applications to establish a production facility based on renewable energy sources, and in the pre-license and license amendment transactions. In addition, for the generation facilities based on the specified resources, annual license fee is not charged for the first 8 years from the date of the first temporary acceptance of the generation facility.

From the production facilities based on renewable energy resources that are in operation as of 18 May 2005 and which will be operational until 31 December 2025; 85% discount is applied to permit, rent, easement and usage permit fees for 10 years from the date of license, from transportation routes and energy transmission lines up to the connection point to the system specified in their licenses, including those to be transferred to Turkish Electricity Transmission Corporation (TEIAS) and distribution companies.

Due to the financial initiatives that have been implemented over the recent years, the installed power for solar-based electricity generation, which used to be 40.2 MW with 112 solar plants at the end of 2014, increased up to a total of 3,420.7 MW with 3616 solar plants at the end of 2017 and reached 9,425 MW with 9,353 solar plants as of the end of 2022. The installed solor power accepted, without a license yet, at the end of 2021 correspond on its own to 6908 MW. Given

the licensed projects as well as previously licensed ones becoming operational, this number is expected to rise.

#### *4.2.2.3 Electricity Generation from Nuclear Energy*

In several policy documents, such as the **11th Development Plan** and **Türkiye National Energy Plan** nuclear power will be one of the options to provide supply security and reduce GHG emissions. Within this framework, an intergovernmental agreement has been signed between the Republic of Türkiye and the Russian Federation for the construction and operation of the **Akkuyu NPP**, with four units and 4800 MW installed capacity, on 12 May 2010. The first unit of Akkuyu NPP is planned to be completed and commissioned till 2025.

The second NPP project is planned to realize in Sinop province. The MoEUCC granted an EIA positive decision on 11 September 2020. In addition, more NPP projects are under negotiation and site survey studies are ongoing.

**Türkiye National Energy Plan**, announced by the MENR, covers the years from 2020 to 2035. The target for the installed power of nuclear energy is 7.2 GW by 2035. The plan forecasts nuclear energy with a 29.3% share of the primary energy supply by 2053 following the net-zero carbon emission target. Türkiye strives to increase the share of nuclear power in the primary energy supply following the 11th Development Plan.

#### *4.2.2.4 Cogeneration and Trigeneration*

Türkiye also has a great cogeneration and trigeneration potential which is estimated to be 200 MW annually. According to Communiqué dated 2014; micro cogeneration systems and cogeneration facilities which have efficiency certificate of the Department of Energy Efficiency and Environment are exempt from license obligation to generate their own power on site.

There is an exemption to obtain license for high efficiency cogeneration plants and small scale renewable energy power plants (up to 1 MW). They can also generate unlicensed electricity in power plants based on renewable energy sources of a certain size established for on-site production and can sell excess electricity through the feed-in-tariff network.

One of the most important technologies that can be applied to reduce our energy consumption and meet the needs in the most efficient way is cogeneration systems. Cogeneration systems reduce energy imports by saving primary energy. For this reason, care is taken to support cogeneration systems in the policies created by the MENR. With the **By-law on Unlicensed Electricity Production in Electricity Market**, cogeneration power plants to be established to meet their own needs are exempted from obtaining licenses and establishing companies. Efficiency certificates have been issued for these plants by our Ministry since 2014. So far, 211 plant efficiency certificates have been issued. 85 of the certified plants are in the industrial sector and 15 are those that generate electricity from waste heat. An impact analysis study was carried

out by collecting the production consumption data of the plants for which the efficiency certificate was given. It has been determined that an investment of 500 million dollars was made in the 2014-2020 period, a cumulative savings of 240 million dollars was achieved as a result of the investments, and an annual $CO_2$ reduction of 1.2 million tons was achieved.

#### *4.2.2.5 Mandatory energy audits programs*

Pursuant to the EE Law and the **By-law on Increasing Efficiency in the Use of Energy Resources and Energy**, relevant sides oblige to conduct energy audits in;

- Industrial plants with a consumption of more than 5,000 toe per year,
- Buildings in the services sector with a total built area over 20,000 m2,
- Public buildings with a total construction area over 10,000 m2 or with an annual energy consumption above 250 toe.

The audits need to be renewed every four years and every ten years for public buildings.

As a new obligation; thermal plants having an installed power capacity of more than or equal to 20 MW will conduct energy audits mandatorily for using their waste heat potential (in buildings for heating and cooling purposes and also in industry, agricultural production, aquaculturing, cold storage and fresh water production).

#### *4.2.2.6 Energy Sector Research and Development Projects Support Program (ENAR)*

**Energy Sector Research and Development Projects Support Program (ENAR)** was developed in order to support, monitor, complete and evaluate the projects that include **technology development and innovation-focused** research, development and improvement in order to convert the scientific and technological information to be established in a way that will serve energy policies, supply security, local energy technologies and industry to products and systems. Amendments made in order to make the By-Law published on ENAR on 8 June 2010 operable were published in By-law Amending ENAR By-law on 21 February 2013

#### *4.2.2.7 Incentives to energy transformation in agriculture sector*

For the modernization of individual irrigation systems of investors, 50% partial grant support was provided to 18,466 projects, and 183,295 ha of land were irrigated with modern methods. New irrigation infrastructure constructed for 30,267 ha and construction for 81,149 ha is continuing. Low-interest loan for the replacement of tractors and harvesters with energy-efficient ones has been given since 2018. For purchases of tractors support payments were made to 5,400 projects and for harvester purchases applications were accepted for 28 projects. Between 2017-2021 consolidation registration procedures are completed for total of 6,022 million ha of land. 50% grant support for investments has been provided to the projects of farmers under the Program for the Support of Rural Development Investments. Support based on electricity generation from renewable energy for agricultural production and greenhouses

using renewable energy sources. The **Sustainable Energy Financing Mechanism for Solar Photovoltaic Systems in Forest Villages in Turkey Project** is a good example for incentives in agriculture sector energy emissions.

The **Modern Irrigation Systems Incentive** has enabled a significant progress in irrigation system supplies for the producers to have in-farm modern pressure irrigation systems by enabling the producers to use low interest rate loans to meet financial needs, develop agricultural production and increase productivity and quality. Approximately 800 Agricultural Engineers working at the Agricultural Credit Cooperatives have taken applied training and prepared numerous projects. Within this framework, financial support of 43.5 million TRY has been provided in the form of loans with No interest rate for 11,419 projects which constitute an area of 9,700 ha, through the Agricultural Credit Cooperatives.

Approximately 600 million kWh/year energy is consumed at an installed power of 500 MW in pumped irrigations put into operation by the General Directorate of State Hydraulic Works. Therefore, it is aimed by DSI to meet 50 MW (60 million kWh/year) of energy consumption until 2023, and 500 MW (600 million kWh/year) in 2030 with Solar Power Plants at pumped irrigations. In accordance with the strategy of "reducing foreign dependence in energy and increasing the ratio of renewable energy resources in energy distribution" in Türkiye's energy policies and the mission of DSI, studies have been carried out on the construction of a Solar Power Plant (SPP) in order to turn the investments made so far into benefits by making the promoted irrigation operational. Pilot field work has started with Adıyaman Samsat Pumped Irrigation.

#### *4.2.2.8 Inspection Regulation*

With the **By-law on Energy Efficiency Inspection** published on Official Gazette of 6 July 2018 with the number 30470, the energy efficiency inspection mechanism has been included in the Energy Efficiency Law numbered 5627.

#### *4.2.2.9 Public Lighting*

Türkiye aims to increase energy efficiency in public lighting, **Procedures and Principles of Using LED luminaires in the General Lighting Facilities** is published and applications has been started in new facilities in 2021.[157]

#### *4.2.2.10 Development of Electricity Storage Capacity*

Legal entities undertaking to establish an electricity storage facility in order to obtain a pre-license for the establishment of an electricity generation facility based on wind or solar energy up to the installed capacity of the electricity storage facility they undertake to establish, or legal entities holding electricity generation licenses based on wind or solar energy can apply to EMRA

[157] MENR, 2021.

for a capacity increase up to the installed capacity of the electricity storage facility they undertake to establish an electricity storage facility from generation facilities that are partially or fully in operation. For applications within this scope, measurement data based on wind or solar energy is not required and these applications are exempt from the competition application for capacity allocation. In applications for pre-license or license to establish an electricity generation facility with storage, the pre-license and license fee is evaluated over the total mechanical installed power of the electricity generation facility. These issues are regulated by EMRA Decisions[158] and the By-law Amending the By-Law on Electricity Market License[159]. It has aimed to increase the wind or solar energy capacity, create new investment opportunities, establish an electricity storage unit, and contribute to the security of supply by reducing the intermittent generation profile and imbalances.

### 4.2.3 BUILDINGS

#### *Overview*

Considering the high GHG emission reduction potential in the buildings, Türkiye gave special importance to increasing energy efficiency in the buildings sector in the **Nationally Determined Contribution**. Constructing new residential buildings and public buildings with high energy efficiency performances has been the focus to reach the goals that are identified in the Nationally Determined Contribution on the buildings sector, which are:

- Constructing new residential buildings and non-residential buildings as energy efficient in accordance with **By-law on the Energy Performance of Buildings**
- Creating **Energy Performance Certificates** for new and existing buildings so as to control energy consumption and greenhouse gas emissions and to reduce energy consumption per square meter
- Reducing the consumption of primary energy sources of new and existing buildings by means of design, technological equipment, building materials, development of channels that promote the use of renewable energy sources (loans, tax reduction, etc.)
- Dissemination of Green Building, passive design, zero-energy house design in order to minimize the energy demand and to ensure local production of energy

Türkiye plans to realize measures on reducing energy intensity of buildings through a set of national policies and actions, particularly **National Energy Efficiency Action Plan (NEEAP)**. These are described in several policy documents and legislation such as **By-Law on Energy Performance of Buildings (BEP)**, 11th Development Plan, National Climate Change Strategy,

[158] Published in the Official Gazettes dated 24 November 2022 and numbered 11412-1 and 11412-2 and published in the Official Gazette dated 25 November 2022 and numbered 32024.

[159] The Official Gazette dated 19 November 2022 and numbered 32018.

National Climate Change Action Plan, Energy Efficiency Strategy Paper and Energy Efficiency Improvement Program.

According to the legislative framework and policies that are mentioned above, Türkiye has the following objectives of GHG emission reduction in the buildings sector:

- All existing and new buildings will have an "Energy Performance Certificate" which indicates the building energy performances of buildings.
- By-Law on Energy Performance of Buildings suggests that all new buildings must be "C Class" for their energy performance.
- As of end of 2022, buildings with a construction area of more than 2,000 $m^2$ have to meet Nearly Zero Energy Building (NZEB) standards which means buildings must have at least B Class energy performance certificate with at least %10 renewable energy contribution of its primary energy consumption.
- Solar thermal collectors for central heating and sanitary hot water will be installed at new hotels, hospitals, dormitories, other Non-residential buildings used for accommodation purposes, as well as sports centers with a usage area of more than 2,000 $m^2$.
- Financing will be provided for increasing energy efficiency / renewable energy applications in buildings.
- Annual energy consumption in buildings and premises of public institutions will be decreased by 10% until 2015 and by 20% until 2023.
- Energy intensities in each service sub-sector shall be decreased. The rates shall be determined in close collaborations with sector stakeholders, but they shall not be less than a 10% of the intensity for each sub-sector in 2012-2022.

Energy efficiency services are being spread throughout the country within the context of the new legislation. Three universities, one trade association and Energy Efficiency Consultancy companies have been authorized as **Energy Service Companies (ESCOs)**. The preliminary audits in building and industry sectors in the last few years revealed a substantial amount of energy efficiency potential. Some of these are financed by the banks.

Türkiye's building codes are based on the By-law on Energy Performance of Buildings dated in 2008 which was amended in 2010, 2011, 2017 and 2022. The By-law introduced a common methodology (BEP-TR) for calculating the energy performance in buildings and set minimum energy performance standards (MEPS) for new buildings and buildings subject to major renovation. BEP-TR currently works under servers of MoEUCC.

Table 21 contains Türkiye's buildings sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

*Table 21 – Buildings sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt CO2 eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Increasing Energy Performance of New Buildings | Buildings | CO2 | Increasing Energy Performance of New Buildings | Regulatory | Implemented | 2008 | MoEUCC | NE |
| 2 - Near Zero Energy Buildings (NZEB) | Buildings | CO2 | Increasing Energy Performance of New Buildings | Regulatory | Adopted | 2022 | MoEUCC | NE |
| 3 - Increasing Energy Performance of Public Buildings and Building Complexes | Buildings | CO2 | Promotion of central heating and utilization of solar power systems<br>15% Energy saving target in Public Buildings<br>Energy Performance Contracts in Public Buildings<br>Annual energy consumption in buildings and premises of public institutions will be decreased by 10% until 2015 and by 20% until 2023. | Regulatory | Implemented | 2008 | MoEUCC, MENR | NE |
| 4 - Promotion of Thermal Insulation Standard (TS 825) | Buildings | CO2 | Increasing energy efficiency of buildings | Regulatory | Implemented | 2008 | MoEUCC | NE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 - Green Certificate Information System (Yes-TR) | Buildings | $CO_2$, $CH_4$ | Reducing environmental impacts of buildings including energy consumption, waste, and others. | Voluntary | Adopted | 2022 | MoEUCC | NE |
| 6 - Higher Financial Incentives for Better EPC Buildings | Buildings | $CO_2$ | Increasing energy efficiency of buildings through financial incentives | Economic, Regulatory | Implemented | 2019 | MoEUCC, MENR | NE |
| 7 - Reducing heating related direct GHG emissions in buildings | Buildings | $CO_2$ | Reducing energy emissions of buildings and air pollution | Infrastructure Development | Implemented | 2006 | MoEUCC<br>MENR | NE |

#### 4.2.3.1 *Increasing Energy Performance of New Buildings*

The By-law on Energy Performance of Buildings introduced an energy performance certificate (EPC) in 2011 in order to give information on primary energy demand and $CO_2$ emissions of new buildings and buildings that have been purchased or are rented.[160] In order to support the EPC system, BEP-TR software was developed. The By-law requires that **new buildings must have at least C class Energy Performance Certificates**. Within this framework, 1,476,447 buildings have received EPC between 2011-2023. 1,365,610 of them are C Class or above.

#### 4.2.3.2 *Near Zero Energy Buildings (NZEBs)*

Türkiye amended the By-law on Energy Performance of Buildings in 2022. The revised By-law introduced the **Nearly Zero Energy Buildings (NZEB)** concept. The NZEB corresponds to a building with at least a B-class EPC and obtains at least 10% of its primary energy from renewable energy sources. Buildings with a total construction area of 2,000 m2 and above must be built as NZEB starting from January 1, 2025. During the transition period between 1 January 2023, and 1 January 2025, NZEB obligation will be required to buildings with a total construction area of 5,000 m2 and above and renewable energy of at least 5% of the building's primary energy need.

#### 4.2.3.3 *Increasing Energy Performance of Public Buildings and Building Complexes*

The By-law on Energy Performance of Buildings made it compulsory to have **central heating** for new buildings having an area of more than 2,000 m2 since 1 April 2010. Household Owners Law (Law No 634) requires at least 50% of flat owners in a building to agree on establishing individual heating systems instead of central heating. The installation of individual metering and control systems for central heating and hot water systems has been mandatory since 4 May 2012.

In 2018, Türkiye allowed energy efficiency efforts in public buildings and facilities through energy service companies. According to this article, public buildings which have a total construction area of over 10,000 m2 or total annual energy consumption of over 250 toe should contract these companies to reduce their energy consumption or expenditures through **energy performance contracts** for at most 15 years. The Presidential Decree on the Procedures and Principles Regarding Energy Performance Contracts in the Public Sector (2020) aims to determine the procedures and principles regarding **energy performance contracts** to be concluded by public administrations within the scope of the government and other public institutions and organizations to reduce their energy consumption or energy costs.[161] As per the

[160] The authority of issuing EPC of the existing buildings is given to the organizations having the independent cons ultancy and engineering certificate as well as EE consultancy companies authorized by the MENR. (OJ dated 28 A pril 2017)

[161] Published in the Official Gazette numbered 31220 on 21 August 2020.

Decree, the relevant Communiqué and its appendixes, including; audit report format, technical specification, contract drafts, and other related documents published in April 2021.

Presidential Decree of 16 August 2019 aims that **public buildings** (with energy managers assigned according to Energy Efficiency Law no. 5627) **should save 15% of energy by 2023**. With this measure, Türkiye achieved a total of 31,855 toe energy savings between 2019-2021.

#### *4.2.3.4 Promotion of Thermal Insulation Standard (TS 825)*

The By-law on Energy Performance of Buildings requires buildings to comply with the Thermal Insulation Standard (TS 825).

#### *4.2.3.5 Yes-TR*

The **By-law on Green Certificate for Buildings and Settlements**[162] was introduced in 2017 to certify buildings and settlements which demonstrate environmentally friendly practices during their construction, design and operation. The Green Certificate is used in order to evaluate environmentally responsible parameters of construction projects, including but not limited to, construction materials, energy efficiency, water efficiency, indoor environmental quality, land use, urban design, social and economic sustainability. The **Green Certificate is currently a voluntary scheme** that encourages the use of best practices, some of which are not mandated by the existing regulations. The By-law was then revised in 2022 to further suit the needs of local conditions and ensure that it is up to date with the current national and international standards.

#### *4.2.3.6 Higher Financial Incentives for Better EPC Buildings*

Credit limits for A and B energy performance class buildings have been increased. For the A code 90% of the value of the household and for the B code 85% of the value of the household loan could be given by the bank different from the uncoded households.[163]

To promote energy efficiency in building sector, after the cabinet meeting held on 5 June 2022, it is announced that credit support for insulation of buildings up to 50,000 TRL per flat with 60-month term will be given by relevant banks.

In addition to industrial facilities, building, agriculture and service sectors are also included in the scope of Efficiency Improving Project Support as per The Law on Making Amendment in same Law which was enforced in December 25, 2021 with the number 7346.

#### *4.2.3.7 Reducing heating related direct GHG emissions in buildings*

11th Development Plan, while requiring a decrease in the use of natural gas in electricity production, continues to strengthen the access to natural gas at buildings with its Article 490.

[162] Official Gazette dated December 23, 2017 and numbered 30279

[163] The Official gazette numbered 30666 in January 2019.

### 4.2.4 TRANSPORT

#### *Overview*

Türkiye's GHG emissions from the transport sector has a significant share and an increasing trend. Therefore, GHG emission reduction policies in the transport sector have a particular importance. Türkiye's transport sector policies are framed with several policy documents including 11th Development Plan, National Transport and Logistics Master Plan, National Climate Change Strategy, National Climate Change Action Plan and National Intelligent Transportation Systems Strategy Document.

The **11th Development Plan** has given priority to transport systems that provide energy efficiency, clean fuel, and the use of environmentally friendly vehicles. The Plan suggests extended use of smart applications in transportation. Improving "Energy Efficiency in Transportation" is one of the important components of the program. In this context, the by-law on increasing energy efficiency in transportation entered into force in 2019. Another important component of the Plan is "Disseminating the use of public transportation, small engine volume and electric and hybrid vehicles, establishing smart bike networks in appropriate residential areas and creating pedestrian paths closed to traffic" and "Disseminating the use of low fuel consumption vehicles in the public sector".

Türkiye's **Transport and Logistics Master Plan 2053 (TLMP)**[164] sets the vision of "*being a global leader and a leading country in its region in transportation and logistics that support environment-oriented, cost-effective, safe, balanced interregional, sustainable mobility, multi-modal transportation, production, and export-oriented economic growth.*" Comprehensive environmental, clean energy and alternative fuel policy constitute the main policy framework that provides input to all modes of transport in evaluating and defining specific policy measures and recommendations selected in the TLMP. One of the six objectives defined in TLMP is "ensuring environmental awareness and increasing energy efficiency in transportation and logistics" to protect natural, cultural and historical assets and the environment within the scope of transportation and logistics investments and activities, to take measures against climate change, to increase energy efficiency, to act within the framework of international measures (EU White Paper, Paris Climate Agreement, European Green Consensus, European Climate Law, etc.) and to develop and maintain green transportation and green logistics investments and practices. Concerning this objective, five targets are defined as follows:

> **Target 1:** Renewable energy production and consumption will be encouraged to increase energy efficiency in the transportation and logistics sector.

[164] MoTI, 2022_a.

**Target 2:** By reducing the dependency on oil in transportation, the level of cost-oriented energy efficiency will be increased and the most appropriate balance between modes will be reached in terms of environmental sensitivity.

**Target 3:** The "Polluter Pays" principle will be applied so that the negative environmental effects are met by those who create this negativity based on fair and transparent criteria.

**Target 4:** In passenger and freight transportation, negative environmental effects will be reduced by focusing on green terminal/building (airport, seaport, dry port, railway, airline and road terminal) projects and applications and by transforming the existing ones within this scope.

**Target 5:** While developing transportation infrastructure, natural, agricultural, cultural assets and areas will be protected.

**Green (Sustainable) Scenario of TLMP** which aims to reduce emissions by decreasing the road share and increasing the share of rail transport in passenger and freight transportation in addition to the public investment program, was chosen as a based scenario in TLMP. The base year of the model is 2019, and the years 2023, 2029, 2035 and 2053 are determined as projection years. According to the Green (Sustainable) Scenario;

- It is planned to construct a total of 8,554 km of railway lines, including 6,425 km of rapid rail lines, 1,474 km of conventional rail lines, 393 km of high-speed rail lines and 262 km of very high-speed rail lines, until 2053.
- The number of provinces with High-Speed Train and High-Speed Train connections will be increased from 8 to 52.
- The share of railways in freight transportation will increase from 5.08% in 2023 to 21.93% in 2053.
- It is predicted that the share of railways in passenger transportation, which was 0.96% in 2023, will also increase to 6.20% in 2053.
- In addition, the annual freight transport ratio of road transport will be reduced from 71.39% (2023) to 57.47% (2053).
- A sustainable, liberalized, economically profitable, high-technology railway sector will be developed, and 35% of the total energy need will be met from renewable energy sources.
- Electricity and alternative energy use will be increased instead of fossil fuels on highways, and appropriate infrastructures will be created for electric vehicles.
- In the maritime projects, it is targeted that the Green Port applications will be expanded, and highly renewable energy resources will be used in our ports.
- Environmentally friendly bio-fuels and/or synthetic fuels will be produced in airline transportation.

- Emission monitoring, reporting, verification infrastructure will be established, and carbon emissions will be strategically managed.

**The National Intelligent Transportation Systems Strategy Document** and **2020-2023 Action Plan** is one of the key policy documents in the transport sector.[165] ITS are developed for the purposes of reducing travel times, increasing traffic safety, using existing road capacities effectively and efficiently, increasing mobility, contributing to the national economy by providing energy efficiency, and reducing the damage to the environment. ITS use information and communication technologies in monitoring, measurement, analysis and control processes performed with versatile data exchange (between user-vehicle-infrastructure-center). ITS vision of Türkiye is determined as «A human and environment-oriented transportation system in Türkiye built with advanced information technologies», and mission of the ITS is determined as «To create a sustainable, productive, safe, efficient, innovative, dynamic, environment-friendly intelligent transport network which creates added value and integrated with all transport modes using latest technology while making use of natural resources». Three Strategic Goals are included in the document in accordance with ITS vision and mission in accordance with climate change:

**Strategic Goal-1:** Development of the ITS Infrastructure
**Strategic Goal-2:** Ensuring Sustainable Smart Mobility
**Strategic Goal-4:** Creating a Livable Environment and Conscious Society

In the Strategy Document and Action Plan, 31 actions and 54 implementation steps are included along with the near-term goals of Türkiye in the field of ITS.

Table 22 contains Türkiye's transport sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

[165] MoTI, 2020. National Intelligent Transportation Systems Strategy Document and 2020-2023 Action Plan was published in the Official Gazette No. 31204 on 5 August 2020, and entered into force with the Presidential Circular No. 2020/9. Its predecessor was **The National Intelligent Transportation Systems Strategy Document (2014-2023)** and its annex **Action Plan (2014-2016),** which is the first in the field of intelligent transportation systems (ITS) in Türkiye.

*Table 22 – Transport sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt CO2 eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Modal shift to public transport | Transport | $CO_2$ | Increasing low-carbon transport modes share in public transport | Infrastructure Development | | | MoTI | NE |
| 2 - Strengthening Railway | Transport | $CO_2$ | Increasing the share of railways in passenger and freight transport | Infrastructure Development | | | MoTI | NE |
| 3 - Blending Ethanol to Gasoline Types | Transport | $CO_2$, $N_2O$, $CH_4$ | Decreasing GHG emissions through increase in combustion efficiency in gasoline burning vehicles | Regulatory | Implemented | 2012 | EMRA, MENR, MoTI, MoEUCC | NE |
| 4 - Blending Biodiesel in Diesel Types | Transport | $CO_2$, $N_2O$, $CH_4$ | Increasing share of biofuels use in diesel vehicles | Regulatory | Implemented | 2017 | EMRA, MENR, MoTI, MoEUCC | NE |
| 5 - Promotion of electric and hybrid vehicles | Transport | $CO_2$ | Promotion of vehicles with alternative fuel types (including electric and hybrid vehicles), through fiscal incentives | Fiscal | Implemented | 2018 | MoTF, MoTI, MoEUCC | NE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6 - Electric Vehicles Fast Charging Stations Support Program | Transport | $CO_2$ | Increasing number of electric vehicles charging stations | Fiscal | Implemented | 2022 | MoIT | NE |
| 7 - Decreasing the emissions from road transport in freight transport | Transport | $CO_2$ | Decreasing Türkiye's transport emissions by converting road transport freight to emission-efficient railway and seaway transport modes. | Infrastructure Development | Adopted | 2022 | MoTI | NE |
| 8 - Regulation on Transferring Cargoes Carried by Road to Sea | Transport | $CO_2$ | Decreasing Türkiye's transport emissions by converting road transport freight to emission-efficient railway and seaway transport modes. | Regulatory | Adopted | 2022 | MoTI | NE |
| 9 - ILBANK & MoEUCC Grant Programme | Transport | $CO_2$ | | Fiscal | | | MoEUCC, ILBANK | NE |
| 10 - Green Port Project | Transport | $CO_2$ | Promoting modern, cost-efficient and environmentally friendly port facilities. | Economic, regulatory, other | Implemented | 2013 | MoTI | NE |
| 11 - Renewal of the Turkish Marine Fleet | Transport | $CO_2$ | Promotion of energy efficient ships through renewal of Coaster fleet | Regulatory | Planned | - | MoTI | NE |
| 12 - Green Airports | Transport | $CO_2$ | Airport Carbon Accreditation Programme | Regulatory, economic | | 2009 | | NE |

#### *4.2.4.1 Modal shift to public transport*

The MoTI carries out projects to increase **public transportation**. It is aimed that railway system projects will provide benefits in socio-cultural, tourism, economic, ecological, and trade areas as well as the need for transportation to Türkiye. For this purpose, the Directorate General of Infrastructure Investments completed seven rail system infrastructure investments in Istanbul, Ankara, and Antalya. An additional 12 rail system projects are under construction in 6 cities.

Türkiye has also issued a **By-law on Electric Scooters**, covering multiple areas in relation to the use of e-scooters in public areas, such as e-scooter applications, authorization of operators, and major safety rules will contribute to the modal shift towards shared mobility. The By-law was prepared by the joint work of the MoTI, MoEUCC, and the Ministry of Interior and entered into force in April 2021. The by-law includes the regulations regarding the shared electric scooter (e-scooter) business activities.

The General Directorate of Highways has completed the construction of a 55.32 km long **bicycle path** in 13 provinces, and the construction of a 38.25 km long bicycle path in 8 provinces continues. In addition, the project works of the 175.75 km long bicycle path in 15 provinces have been completed, and the project studies of the 208.67 km-long bicycle path in 20 projects in 12 provinces are continuing.

The **Mobility Index (SAHİ)** was developed for metropolitan areas, and this index aims to use mobility costs more efficiently for a better quality of life. The Mobility Hubs Design Guide for Turkey was prepared as a guidebook and defines mobility hub typologies and components and guides metropolitan municipalities on how to implement hubs in transport systems.

The **Mobility Vehicles and Technologies Roadmap**, which the Ministry of Industry issued in 2022, includes the roadmap of Türkiye in transition to zero emissions in different transport modes.

The **By-Law on Combined Transport**[166] aimed to establish and expand an environmentally friendly and sustainable transportation system by setting out the principles regarding all elements of **green logistics activities** (such as combined transportation, energy efficiency, greenhouse gas management, and green packaging). In this context, it has been stated that businesses holding a 'Green Logistics Certificate' that continue their combined transportation and green logistics activities will be given additional points in their applications for the UBAK Permit, with various reductions in the Authorization Certificate, Activity Certificate, and Vehicle Card fees that are given by the Ministry of Transport and Infrastructure. In addition, among the enterprises that provide continuity in green logistics activities, those who are found suitable

[166] The Official Gazette dated 27.05.2022 and numbered 31848.

according to the procedures and principles to be prepared and published by the MoTI will be entitled to receive the **Green Logistics Award**.

#### *4.2.4.2 Strengthening Railway*

Türkiye carried out railway construction and renovation, signaling, and electrification works to strengthen **railway transport** in the Country. In rail transport, the total railway length reached 12,803 km, including a 1,213 km fast train railway. With the implementation of Transport and Logistics Master Plan 2053 (TLMP), Türkiye aims to increase the share of railways in freight transport from 5.08% to 20.12% and the percentage of railways in passenger transport from 0.96% to 5.31% by 2035. Türkiye further aims to increase the share of railways in freight transport to 21.93% and the share of railways in passenger transport to 6.20% by 2053. Moreover, Türkiye targets to cover 35% of the total energy need of railways from renewable energy sources. In this context, the Directorate General of Turkish State Railways Energy Management and Climate Change Action Plan (2023-2025), which consists of 9 goals, 20 targets, and 82 actions, with 3 themes: "Green Transportation on the Railroad", "Zero Carbon Future" and "Reliable Energy Supply", was put into effect.

#### *4.2.4.3 Blending Ethanol to Gasoline Types*

**Communique on Blending Ethanol to Gasoline Types** came into force in 2012. The By-law aims decreasing GHG emissions through increase in combustion efficiency in gasoline burning vehicles. This legislation introduced the obligation for licensed distributors to blend at least 3% (v/v) of ethanol from domestic agricultural products/waste into gasoline types imported and supplied from refineries.

#### *4.2.4.4 Blending Biodiesel in Diesel Types*

**Communique on Blending Biodiesel in Diesel Types** came into force in 2017. The By-law aims decreasing GHG emissions through increase in combustion efficiency in diesel vehicles. This legislation introduced the obligation for licensed distributors to blend at least 0.5% (v/v) biodiesel from domestic agricultural products/waste into diesel types imported and supplied from refineries.

#### *4.2.4.5 Promotion of Electric and Hybrid Vehicles*

Türkiye regards the proliferation of electric vehicles as a strategic goal. The spread of electric cars will be a lever for developing the primary industry, supply industry, and technology ecosystem that creates value-added products and services in this newly developing field. **Türkiye's Automobile Initiative Group Industry and Trade Inc. (TOGG)** was established on June 25, 2018, to produce electric cars.

Türkiye revised the tax regulations and reduced Special Consumption Tax (SCT) rates applied on electric and hybrid motor vehicles compared to conventional (internal combustion with high

emission) motor vehicles to promote the purchase of these types of vehicles. Tax regulations to provide these incentives came into force year by year (from 2011 to 2016 gradually) for the aforementioned vehicles.

**Recent developments on taxation of vehicles:**

(1) With the President Decision dated 12.01.2022 and numbered 5096, Special Consumption Tax (SCT) bases of hybrid vehicles with an electric motor power exceeding 50 kW and an engine cylinder volume between 1600 cm³ and 1800 cm³ have been rearranged, and vehicles in the tax brackets subject to this regulation have been moved to a lower bracket and have taxed at a lower rate, hence the calculated SCT amounts of these vehicles have been reduced.

(2) With Article 44 of the Law No. 7417 of 01.07.2022 Amending the Law on Civil Servants and Some Laws and the Decree Law No. 375; in order to encourage only electric motor vehicles in 87.03 G.T.İ.P number, according to electric motor power and base; among the vehicles with 160 kW or less electric motor power, an advantageous taxation is provided as 10% for those of which SCT base (sales price excluding taxes) does not exceed 700,000 TL, 40% for those of which SCT base (sales price excluding taxes) exceeds 700,000 TL; and among the vehicles with an electric motor power over 160 kW 50% for those of which SCT base (sales price excluding taxes) not exceeding 750.000 TL and 60% for those of which SCT base (sales price excluding taxes) exceeds 750.000 TL.

(3) With the President Decision dated 23.11.2022 and numbered 6417, SCT bases of hybrid vehicles with electric motor power exceeding 50 kW and engine cylinder volume not exceeding 1800 cm³, were rearranged, and the taxation of the vehicles in the tax base ranges subject to the regulation from a lower rate group has been ensured, thus the calculated SCT amounts of these vehicles have been reduced.

In this way, it has been ensured that the hybrid and electric vehicles in the tax brackets subject to the regulation are taxed at a lower rate.

**The By-Law on the Disclosure of Consumers About Fuel Economy of New Passenger Car and $CO_2$ Emissions** aims to provide enlightenment of consumers about $CO_2$ emission and fuel economy of new passenger cars offered for sale or rent in the market in order to make consumers informed choices. Therefore, Directorate General for Industry collects and publishes fuel consumptions and emissions of new passenger cars. Within the scope of the By-Law, the market supervision of the cars is done by Directorate General for Safety and Supervision of Industrial Products.

#### *4.2.4.6 Electric Vehicles Fast Charging Stations Support Program*

The MoTI introduced the **Charging Stations Call for Electric Vehicles**, aiming to increase the number of fast charging units in Türkiye, which requires establishing a sufficient number of stations in all provinces of the Country. With this call, it was aimed to accelerate investments by

providing grant support for charging units to be established by the private sector in order to develop the charging infrastructure.

Despite the fact that electric vehicle ownership is currently concentrated in big cities, considering the projection studies, minimum access to charging infrastructure should be homogeneously distributed throughout the Country. For this transformation, a development plan for electric vehicle charging infrastructure for Türkiye was prepared by the MoIT with the active participation of the relevant public institutions, especially the Energy Market Regulatory Authority and the Turkish Standards Institute, and the intense contribution of the private sector. As a result of the studies carried out, a legislative infrastructure has been established that will ensure the development of the ecosystem in an effective and sustainable structure, where they will provide services to all-electric vehicle users without any preconditions, under two national standards and the industry's free market conditions. The MoIT announced the program on 14 April 2022 and introduced it by reaching more than 1,000 investors with the information meetings it held. In total, 206 companies applied to the Technological Product Investment Support Program Charge Stations Call for Electric Vehicles, and 20 investors were entitled to receive firm support. As a result of the evaluations, public support of 137,492,954 TRL was provided to these 20 investor companies for the investment projects they developed with a total budget of approximately 1 billion TRL. The first phase of the process was completed by supporting the charging infrastructure support works. In this way, in the first quarter of 2023, Türkiye will have 1,572 units (3,144 sockets) of fast chargers and infrastructure distributed to all cities of Türkiye. Türkiye aims to continue providing support to more investors, and after the Programme, the Country will have 142 MW more installed fast charging infrastructure.

#### *4.2.4.7 Decreasing the emissions from road transport in freight transport*

Türkiye aims to decrease the annual freight transport ratio of road transport. With the implementation of Transport and Logistics Master Plan 2053 (TLMP), annual freight transport ratio of road transport will decrease from 71.39% to 59.22% by 2035. Moreover, Türkiye aims to decrease GHG emissions from road transport by infrastructure development such as tunnel projects.

#### *4.2.4.8 Regulation on Transferring Cargoes Carried by Road to Sea*

The MoTI has released a regulation that supports the transfer of cargoes from road to seaway on 9 August 2022. The main objective of this regulation is to establish the policies and guidelines for the assistance to be provided to ship owners in order to increase the proportion of maritime transport in combined transportation and to encourage the conversion of cargoes currently transported by road to maritime transport.

#### *4.2.4.9 İLBANK & MoEUCC Grant Programme*

A grant and support was provided to municipalities by the MoEUCC in cooperation with the İLBANK to support the construction of bicycle lanes, green walking trails, environment-friendly streets and noise barriers.

#### *4.2.4.10 Green Ports*

In order to prevent the environmental impacts and adverse effects and eliminate to a certain extent, the "Green Port" Project was developed by the Directorate General of Maritime Affairs, MoTI in 2013. Green Port project which is a voluntarily based project is focused primarily on port operations. ISPS Code Compliance Certificate, TS EN ISO 9001 Quality Management System Certificate, TS EN ISO 14001 Environmental Management System Certificate, TS 18001 occupational Health and Safety Management System Certificate and Auditor's technical report prepared by authorized organization are the main documents that figures out compliance with sectorial criteria.

Certificates are being issued to the ports that fulfil these sectoral criteria. Certificate validity period is three years. In this certificate, modern, eco-friendly and cost-efficient ideas to enhance the competitiveness and to promote Green Ports are presented by taking into account the current situation of the ports, as well as the current legislation regarding the protection of the environment.

The "Green Port" application is expected to increase the environmentally friendly port facilities and as of 2023, while 20 ports received **Green Port Certificate,** the application procedures of 6 more ports are still in progress. Ports are encouraged for development of supply opportunities for alternative fuels, development of onshore powering/cold ironing infrastructure, establishment of renewable energy infrastructure in ports, installation of low/zero emission vehicles, handling equipment and other projects related to other structures.

#### *4.2.4.11 Renewal of the Turkish Marine Fleet*

Türkiye also plans to support the construction of new ships and retrofitting of existing ships for a low-carbon, energy and fuel-efficient maritime fleet. Ships powered by LNG, battery/electrification, methanol, green hydrogen and ammonia will be priority tasks.

The **By-Law on Recreational Craft and Personal Watercraft** entered into force in May 2017, in accordance with the EU Directive 2013/53/EU on Recreational Craft and Personal Watercraft. The By-Law aims to limit carbon, nitrogen oxides and hydrocarbons ratios in the exhaust emissions of the personal watercraft engines.

Türkiye aims to establish **financial support mechanisms** for innovative technologies to be used for environmentally friendly, sustainable and safe transportation on the ships and ports. For the renewal of the merchant marine fleet, Türkiye started a programme designed to support ships

between 1000 GT and 5000 GT. The scope has been expanded to include ships larger than 50 GT. In addition, the number of ships that will benefit from the incentive has been increased from 5 to 10 annually. In addition, the amount of support to be given for conventional ships to be built to replace the scrapped ship has been increased by 50 percent, from 1 time the scrap price per ton to 1.5 times. The amount of support has been boosted 2.5 times the price of scrap per ton if an alternative environmentally friendly energy source, such as LNG or hybrid systems, is installed on the newly constructed ship. For the ships that will convert the main engines of existing ships from fossil fuel to an alternative environmentally friendly energy source, a grant of 25 percent of the conversion cost will be provided. The MoTI submitted the **Maritime Decarbonization and Green Shipping Project** to the EU commission as part of the IPA program. The project has been developed to encourage the use of innovative, and environmentally friendly technologies in ports and ships and create a sustainable environment for further investments in the sector. Basically, the project has three main outputs. The first is to support the transition to a low-carbon, energy and fuel-efficient maritime fleet. The second is to develop the bunker of alternative fuel infrastructure such as LNG, Bio-LNG, Methanol, Hydrogen or Ammonia. The final output of the project is to use the establishment of port electricity infrastructures in port facilities and the use of sustainable energy. With the mechanism to be established, approximately 20 million Euros in grant and 50 million Euros of long-term cost-effective loan support will be provided to maritime sector by the European Bank for Reconstruction and Development (EBRD).

#### *4.2.4.12 Green Airports*

Türkiye's **Nationally Determined Contribution** frames GHG emission reduction policies as "Implementing green port and green airport projects to ensure energy efficiency".

**Green Airport Project** was launched by Directorate General of Civil Aviation and has put into implementation in 2009 and have been improved year by year. In the scope of The Green Airport Project, 170 companies achieved to obtain Green Company Certificate and 6 airports (Uşak, Tokat, Adana, Balıkesir, Siirt and Erzincan Airports) succeeded to have Green Airport Certificate as of 2020. If a company achieves to get a Green Company Certificate, it gains 20% reduction on company license renewal fee. If an airport achieves to get a Green Airport certificate, all the companies have the 50% reduction on company license renewal. A new legislation entitled **Environmental Management Directive at Airports** was developed and sent to the Ministry of Transport and Infrastructure. This legislation will cover all actions taken by the Green Airport Project. Aim of the legislation is to set environmental standard and emission monitoring at all airports in the Türkiye.

Several airports in Türkiye also participated to the **Airport Carbon Accreditation Programme (ACA)** initiated by Airports Council International (ACI). Ankara Esenboğa, Antalya and İzmir Adnan Menderes Airports obtained 3+ level certificate and İstanbul Airport have been certified

at 3rd level of the Programme. In addition, airports managed by General Directorate of State Airports Authority obtained certificate at 1st level within the scope of the programme at Gaziantep, Erzurum, Çanakkale, Sivas Nuri Demirag, Kapadokya, Erzincan Yildirim Akbulut, Adiyaman, Balikesir Kocaseyit, Sinop, Kahramanmaras, Sirnak Serafettin Elçi and Bursa Yenisehir Airports. TAV Gazi Pasa Alanya, TAV Milas-Bodrum and YDA Dalaman Airports achieved also the 1st level of the programme.

### 4.2.5 INDUSTRY, INDUSTRIAL PROCESSES AND PRODUCT USE

#### *Overview*

**The "Green Deal Action Plan" of Türkiye** including a total of 32 objectives and 81 actions under 9 main headings is the main document regarding the policies impacting manufacturing industry of Türkiye in relation to climate change. The Action Plan includes measures for harmonizing with the EU's Green Deal, especially in areas related to trade and industry. Besides Türkiye's policies and measures which will harmonize the EU Green Deal to Türkiye, the EU Green Deal itself directly impacts Turkish industries and their trade to the EU. Also, in line with 2053 net zero emission target, studies to determine sectoral road maps have started in 2022. Executed projects are:

- A Zero Carbon Roadmap for the Steel Sector in the Republic of Türkiye
- A Zero Carbon Roadmap for the Aluminum Sector in the Republic of Türkiye
- A Zero Carbon Roadmap for the Cement Sector in the Republic of Türkiye

The **Industry and Technology Strategy for 2023** was published on 18 September 2019.[167] The strategy aims to reduce the effects of industrial production on the environment.[168] For this purpose, it foresees continuation of supports to technology-intensive modernization of infrastructure and enterprises and new investments based on clean production, especially in organized industrial zones. It is expected that an Industry Registry Information System will be developed to establish an "Economically Valuable Waste Monitoring System" within the scope of the circular economy policies. MoIT and MoEUCC will cooperate in order to use environmental contribution revenues to finance the investments of manufacturers for the development of environmental protection and waste management systems and practices. In addition, the MoEUCC, MoIT, and municipalities will work in coordination with the Ministry of Industry and Technology while determining industrial zones and industrial areas.

[167] MoIT, 2019. The Strategy is a road map in realizing Türkiye's "National Technology, Powerful Industry" vision. T he Strategy has five main components: (i) High Technology and Innovation, (ii) Digital Transformation and Industr y Move, (iii) Entrepreneurship, (iv) Human Capital, and (iv) Infrastructure. The Strategy is expected to support Tür kiye's 2023 targets in the fields of industry and technology.

[168] MoIT, 2019.

**Green Organized Industrial Zones** are an important initiative. "Green solutions are used to address the fundamental infrastructure and superstructure of Organized Industrial Zones (OIZ) as part of the World Bank initiative. The project portfolio includes infrastructure such as water, storm water and sewage pipelines, electricity and natural gas networks, roads etc., wastewater treatment plant, wastewater reclamation and reuse plant, solar power plant (SPP), administrative building, zero waste and biogas plant constructions respectively."

Green Organized Certification System will play a vital role for OIZs to monitor their economic, environmental, social and governmental performance. MoIT evaluates OIZ's performance in two stages in cooperation with TSE. For first stage, MoIT determined 6 pre-criteria and started to evaluate compliance of applications from December, 2022. After this process, TSE will start to score OIZ's performance in 2023 within the framework of economic, environmental, social and governmental indicators and give certificate in four level such as platinum, gold, silver and bronze.

**Energy Efficiency Strategy Paper (2012-2023) (EESP)** and **National Energy Efficiency Action Plan (2017-2023) (NEEAP)** impacts industrial emissions. EESP aims to "reduce energy intensity and energy losses in the industry and services sector". It aims to reduce the amount **energy intensity** of Türkiye in 2023 **by at least 20%** compared to the 2011 level. The Strategy aims to develop the regulatory framework for energy efficiency and increasing the effectiveness of incentives, and increasing the efficiency of incentives over 5000 toe per year. Necessary measures determined as a result of periodic energy audits in energy-consuming companies, determination of energy saving potential and costs, and preparation of action plans for applications are included. NEEAP also has targets regarding the industry sector.

**National Eco-Efficiency Programme,** which has been initiated within the framework of Turkish Industrial Strategy Document and Action Plan (2015-2018), aims to direct Turkish Industry towards more environmentally friendly practices through several activities such as awareness raising on concepts such as eco-efficiency and cleaner production, increasing cooperation among institutions and businesses, capacity building, providing technical and financial support to businesses.

The MENR plans legislative arrangements which would aim to promote renewable power generation and use in the manufacturing industry.

Table 23 contains Türkiye's manufacturing industry and IPPU sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

*Table 23 – Manufacturing industry, industrial process and product use sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Grant Programme for Energy Efficiency Improvement Projects and VAs | Industry / Industrial Processes and Product Use | $CO_2$ | Provision of financial support for industrial enterprises that reduce energy usage %15 to improve energy efficiency in industrial sector | Economic, regulatory | Implemented | 2009 | MENR, MoIT | NE |
| 2 - Promotion of renewable electricity use in industry | Industry / Industrial Processes and Product Use | $CO_2$ | Promoting renewable power generation and use in manufacturing industry | Economic, regulatory | Implemented | 2015 | MENR, MoIT | NE |
| 3 - Promotion of Waste-Derived Fuels | Industry / Industrial Processes and Product Use | $CO_2$, $CH_4$ | Decreasing GHG emissions of manufacturing industries by replacing fosil fuel consumption with waste-derived fuels | Regulatory | | | MoEUCC | NE |
| 4 - Promotion of ISO 50001 | Industry / Industrial Processes and Product Use | $CO_2$ | Increasing energy efficiency at manufacturing industries | Regulatory | | | MENR, MoIT, TSE | NE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 - Supporting Sustainable Energy Project Implementations of SMEs | Industry / Industrial Processes and Product Use | All gases | Provision of support for SMEs that implement sustainable energy projects that reduce GHG emissions | Economic, other | Implemented | 2015 | MENR, MoIT, KOSGEB | NE |
| 6 - Reducing F-Gas Emissions | Industry / Industrial Processes and Product Use | F-gases | Decreasing F-gas emissions | Regulatory | Adopted | - | DCC, MoEUCC | NE |
| 7 - Development of low-carbon technology roadmaps in manufacturing industries | Industry / Industrial Processes and Product Use | All gases | | Research | Adopted | 2022 | MoIT, TUBITAK | NE |

#### *4.2.5.1 Grant Programme for Energy Efficiency Improvement Projects and VAs*

**Grant Programme for Energy Efficiency Improvement Projects and VAs** have been implemented to motivate industrial companies since 2009. Certain amounts have been allocated to the MENR's annual budget for incentivizing industrial establishments. Within the amendment in the Energy Efficiency Law in 2021[169], energy efficiency project supports have been expanded to cover the building, agriculture and service sectors as well as the industrial sector.

The Voluntary Agreements have been implemented to motivate companies to achieve a minimum of 10% decrease in energy intensity over a three-year period. Also rate of the support was increased from 200 thousand TL to 1 m TL and the energy support ratio increased from 20% to 30% as of 2019. In case a company meets the target set by the agreement, then up to 30% instead of 20% of the energy costs can be granted during the first year. The maximum amount is changed to 1 million TL.

Within the scope of Voluntary Agreements (VAs) between 2017-2021, one industrial enterprise has completed a project with a total of TL 3 million investment of which TL 0.2 million has been granted by MENR. Energy savings from this agreement is 934 toe/year and the monetary saving is TL 1.6 million.

Within the grant incentives such as value added tax exemption[170], customs duty exemption, tax reduction, employer's insurance premium support, interest support and investment location allocation are given to investments of manufacturing industry plants that save 15% energy compared to the current situation. Plants benefiting from these incentives invested $25 million for energy efficiency projects and reduced 440 thousand tons of carbon emissions.

#### *4.2.5.2 Promotion of Renewable Electricity Use in Manufacturing Industry*

Since 2015, Türkiye is supporting renewable electricity use in the manufacturing industry.

#### *4.2.5.3 Promotion of Waste-Derived Fuels*

**By-law on Waste Incineration** introduced co-incineration facilities and alternative fuels to the Turkish legislation.[171] Following the commencement of the by-law, usage of waste-derived fuels such as **Refuse Derived Fuels (RDF)** and **Solid Recovered Fuels (SRF)** increased in the manufacturing industry, especially in cement production plants. Some cement plants have waste incineration license which is given by MoEUCC. They use waste as alternative fuels and also raw material. Wastes co-incinerated by license are: waste plastics, used tires, waste oils,

[169] The Law No 7346 published in the Official Gazette No. 31700 of 21 December 2021

[170] Value-added tax exemption is introduced for the construction of facilities and purchases of new machinery and equipment for the manufacturing industry.

[171] Official Gazette dated 6 October 2010 numbered 27721

industrial sludge, tank bottom sludge and sewage sludge, etc. Ratio of secondary fuel to total fuel consumption in cement industry increased from 4.47% in 2017 to 7.97% in 2021. The **Climate Council** that was held in 2022 in Türkiye suggested to further increase the production and usage of waste-derived fuel for emission reduction and foresees the joint work of the relevant ministries, municipalities and industrial facilities for this purpose.

#### *4.2.5.4 Promotion of ISO 50001*

ISO 50001 certification is mandatory for companies that apply for energy efficiency supports. Companies under this scheme are obliged to set up an energy management unit and/or appoint an energy manager.

#### *4.2.5.5 Supporting Sustainable Energy Project Implementations of SMEs*

In promoting the adoption of higher efficiency motors by Small and Medium Sized Enterprises (SMEs) is being implemented under the Ministry of Industry and Technology (MoIT) with financial support of Global Environment Facility (GEF) and in cooperation with UNDP with the **Promoting Energy-Efficient Motors in Small and Medium Sized Enterprises (SMEs) in Turkey Project** (known as TEVMOT Project) which is a 6 year duration between 2017-2023 and aims to promote significant additional investment in industrial energy efficiency in Türkiye by transforming the market for energy-efficient motors used in SMEs.

#### *4.2.5.6 Reducing F-Gases Emissions*

Türkiye was a party to the Protocol and ratified the Kigali Amendment on November 2021 as an Article-5 (A-5, developing) Group 1 country. Türkiye has successfully phased out of hydrochlorofluorocarbons (HCFCs) as Ozone Depleting Substances (ODSs) by January 1, 2025. In addition, phasing down schedules for hydrofluorocarbon (HFC) production and consumption for the next decades has been established. Within this scope, it is aimed to reduce 80% of HFC consumption over the next 30 years. A reduction of HFCs as planned substantially impacts Türkiye's GHG emissions and shows the country's interest in promoting synergies between the Paris Agreement and the Kigali Amendment. On the scope of the Kigali Amendment, The Kigali Implementation Plan, which will be taken as a baseline of national strategy for the phasing down of HFCs, has been prepared by 2024.

Türkiye updated the **By-law on Fluorinated Greenhouse Gases** recently with the aim of harmonizing with the EU regulation on fluorinated greenhouse gases (EC/517/2014) and controlling the release of such F-gases with high global warming potential. The revised By-law includes principles for labeling, databases, leakage checks, reporting, license and quota allocation, and recovery, recycle, reclaim and disposal of these substances. It also covers regulations for the training and certification of individuals and companies interfering with equipment containing these gases. The By-law focuses on evaluating **refrigeration, air conditioning, heat pump, fire protection, electrical switchgear, refrigerated trucks and**

**trailers, aerosols, and solvents** containing fluorinated greenhouse gases. The By-law includes obligations related to HFC production and consumption phase-down schedule from 2024 to 2045, controlling their trade. Türkiye will start to phase-down HFC production and consumption as of 2024. By 2029, Türkiye is planning to reach its first reduction target of 10% of baseline levels calculated for A-5 Group 1 countries in accordance with Kigali Amendment. As of May 2023, a license has been introduced for imports and exports of HFCs, and in 2024, a quota application will begin for the import of HFCs. Türkiye currently implementing four projects to strengthen its capacity on HCFCs and HFCs.

#### *4.2.5.7 Development of Low-Carbon Technology Roadmaps in Manufacturing Industries*

The MoIT and TUBITAK is developing low-carbon technology roadmaps for its manufacturing industries including iron-steel, aluminum, cement, chemicals, plastics and fertilizer sectors as part of the Green Deal Action Plan of Türkiye. Based on the results of these studies, investment support programs will be designed in cooperation by the MoIT and TUBITAK. Sectoral Focus Groups have been established in selected pilot sectors in order to determine the technological needs related to combating/adaptation with climate change and the legal obligations to be brought by the European Green Deal, and to create technological solutions for the identified needs. The work of the established Focus Groups is planned to be completed in 2023. At the end of this study, the technological needs of the sectors regarding green growth will be revealed and R&D and innovation support areas will be created to meet them.

### 4.2.6 AGRICULTURE

#### *Overview*

Türkiye's first **Nationally Determined Contribution** suggests the following measures for reducing GHG emissions in the agriculture sector:

- Fuel savings by land consolidation in agricultural areas
- Rehabilitation of grazing lands
- Controlling the use of fertilizers and implementing modern agricultural practices
- Supporting the minimum tillage methods

Several strategy documents and plans of the Ministry of Agriculture and Forestry (former Ministry of Food, Agriculture and Livestock) underline the threat of climate change's impacts on agricultural production and the security of food supply. Therefore, over the last decade, strategies, policies, and plans in the agriculture sector have included conducting vulnerability assessments on agricultural products, together with financial support schemes for farmers who have economic losses due to the impacts of climate change. Thus, the level of policies and measures regarding reducing GHG emissions from the agricultural sector can be considered as less advanced compared to measures to adapt to the impacts of climate change. However, many

policies and measures that have impacts to increase climate change resilience of the agriculture sector also have GHG emission mitigation impacts. The following policy documents include several measures that target both reduction of GHG emissions and increasing resilience to the impacts of climate change in the agriculture sector:

The **11th Development Plan (2019-2023)** foresees the development of agricultural information systems with digitalization, artificial intelligence and data-based business models and will be made available to all segments and protection, effective use and management of agricultural lands will be ensured.

**National Climate Change Strategy (2010-2023)** suggests limiting GHG emissions and increase resilience to impacts of climate change by using modern agricultural techniques in subjects such as fertilizer use, irrigation, soil cultivation, agricultural spraying, supporting organic agriculture, good agricultural practices, drought-tolerant plant types and certificated seed production, encouraging in-field modern pressured irrigation systems (drip/ sprinkler irrigation systems) and land consolidation in short term. In middle term, NCCS suggests crisis management based on agricultural drought estimation, developing soil and land classification standards and observing applications, protecting and developing meadows and pasture areas, fertilization based on soil analysis, developing techniques for increasing carbon capture in soil, selecting adequate feeding methods in stock farming to reduce methane emissions, manure management and good drainage in rice cultivation, taking precautions for reusing treated wastewaters in agriculture. And finally, in the long term, a decision on establishing a central geographical information system for all land use classes in Türkiye is taken for preparing the National Greenhouse Gas Inventory Report in compliance with IPCC guidelines.

In order to obtain updated and accurate land information, studies on creating a National Soil Database by benefiting from remote sensing and geographical information systems and efficient soil use, primarily by agriculture by making land use planning have been started.

**National Climate Change Action Plan (2011-2023)** envisages mitigating of GHG emissions through the protection of natural resources and minimization of energy consumption in agriculture. The following actions are involved in the Plan:

- Determining and increasing the quantity of carbon stock captured in the soil;
- Disseminating sustainable agriculture techniques including mitigation and adaptation;
- Increasing the effectiveness of soil management;
- Increasing the effectiveness of pasture management;
- Identifying and increasing above ground and below ground biomass
- Identifying the potential GHG emissions limitation in the agriculture sector.
- Slowing down the increase rate of GHG emissions originated from crop and animal production

- Build the information infrastructure that will meet the needs of the agriculture sector in adapting to and combating climate change.

**Strategic Plan (2019-2023) of Ministry of Agriculture and Forestry** suggests R&D studies to be performed to increase the agricultural production efficiency and quality, where "the number of model/suggestion/systems developed to ensure emission measure, monitoring and mitigation" is considered as one of the performance indicators. In addition, two important strategies have been determined in this area. First, it focuses on adapting to the effects of climate change on agriculture and determining agricultural drought studies will be carried out. Latter, greenhouse gas emissions from agricultural activities (plant and animal production) will be determined and projects to be monitored, to reduce emissions, practises will be developed for the retention and increase of the soil organic carbon substance.

**National Energy Efficiency Action Plan 2017-2023** suggests actions to be taken related to increasing energy efficiency in the agriculture sector listed in the section 2.2.5 of the Plan as:

- encouraging the replacement of tractors and harvester with energy efficient ones,
- adapting energy efficient irrigation methods,
- supporting energy efficiency projects in the agriculture,
- encouraging renewable energy sources for agricultural production,
- determination of potential agricultural by-product and waste for the purpose of obtaining biomass,
- supporting energy efficiency in the aquaculture products sector.

There are many various agricultural subsidy instruments offered by the government in order to regulate and create an environmentally friendly investment setting in the agriculture sector. The amount of the financial support is constantly increasing from year to year.

Within the framework of **Good Agricultural Practices (GAP)** legislation and the **GAP Project** following the adoption of the legislation, producers can receive good agricultural practices certificates to institutions that are authorized by the Ministry (which one ???) to register their control and certification process. Good Agricultural Practices are important both for a high-quality and productive agricultural production and food safety. GAP allows traceability, sustainability and food safety in agriculture without harming the human health, animal health and environment. GAP Project will provide the implementation of good agricultural practices in 59 provinces, in fruits (citrus fruits, cherry, hazelnut, fig, grape, olive, plum, melon, peach and apple), vegetables (onion, tomato, pepper, lettuce and cucumber), feed plant and aquaculture (trout). The project will also include training, extension and demonstration activities. In Türkiye, good agricultural practices are generally focused on crop production, however, there are also GAP applications for aquaculture and animal husbandry in recent years. Good Agricultural

Practices are also conducted in "Special Environmental Protection Areas" according to a protocol signed between the MoEUCC and the MoAF[172].

With the **IPARD Program**, support is given to soil cover management and erosion control, biodiversity/bustard population increase, and promotion and implementation of organic farming methods within the scope of agri-environment measures. In this direction, the implementation of the soil cover management and erosion control sub-measure in Beypazarı and the biodiversity-bustard population development sub-measure continue to be implemented in 8 villages of the Polatlı district where bustards are observed.

With the help of **Farmer Registry System**, a database has been created in 2014 which facilitates provision of agricultural supports in a controllable and traceable way, therefore it enables establishing healthy agricultural policies. The System holds information of farmers engaged in agricultural activities, and assets (land, animal, input, etc.) they use during the activities, product design and average yields. Also, with the help of the System agricultural supports are applied, tracked and controlled.

Also, there are other Agricultural Information Systems such as Farmer Informing Service, Türkvet, Organic Agricultural Information System, Underover Registry System, Beekeeping Registry System. Agricultural Information Systems provide all inventories necessary for tracking and controlling agricultural activities and support traceability and accountability.

**Organic agriculture** is also being supported within the framework of Organic Agricultural Law and incentives that are implemented by the Ministry of Agriculture and Forestry (former Ministry of Food, Agriculture and Livestock and Ministry of Forestry and Water Affairs). The Organic Farming Registry System (OTBİS) was implemented in 2005, in order to keep updated information about several statistics such as organic agricultural products, producers and land use. The system is integrated with the Farmer Registry System. Organic agriculture legislation and programmes also provide financial incentives for organic farmers, such as grants and low interest rate loans.

Organic farming is a sustainable farming system with the highest level of traceability and reliability. All national and international standards in organic agriculture require that every stage of production from farm to fork be controlled and certification is mandatory. Reducing the negative effects of the destruction caused by climate change and environmental pollution on biodiversity and the sustainability of ecosystems will be achieved through organic agricultural activities. Türkiye has an important potential in terms of organic agriculture with its ecological conditions and uncontaminated natural resources. In order to evaluate this potential, it is necessary to produce in accordance with international standards and to develop the domestic /

[172] The protocol was signed between former Ministry of Environment and Urbanization and former Ministry of Foo d, Agriculture and Livestock.

foreign market. Compared to 2002, our organic product range reached 263 with an increase of 75%, and our organic production amount reached 1.6 million tons with an increase of 413%.

Within the scope of the **Organic Agriculture Expansion and Control Project,** it is aimed to increase the income level of farmers by producing organic products with high competitiveness in domestic and foreign markets, to ensure a healthy and balanced nutrition of the country's population, to increase the diversity of organic products, to produce organic products in accordance with international standards, to activate the control and certification system, to increase the efficiency of organic products. Important studies are carried out to establish traceability. In this context, a total of 75 projects were carried out in 61 provinces in 2022. In addition, audit, training and R&D studies are also continuing.

Table 24 contains Türkiye's agriculture sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

*Table 24 – Agriculture sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Control of Nitrate Use | Agriculture | $N_2O$ | Protection of Waters Against Pollution Caused by Nitrates from Agricultural Sources | Regulatory | Implemented | 2016 | MoAF | NE |
| 2 - Extending Analysis-Based Fertilizer Use | Agriculture | $N_2O$ | Reducing $N_2O$ emissions through promotion of efficient fertilizer use | Economic | Implemented | 2017 | MoAF | NE |
| 3 - Agriculture-based Specialized Organized Industrial Zones (TDIOSB) | Agriculture | $CO_2$, $N_2O$, $CH_4$ | | Fiscal, Economic | | | MoAF | NE |
| 4 - Land Consolidation | Agriculture | $CO_2$, $N_2O$, $CH_4$ | | Regulatory | | | MoAF | NE |
| 5 – Environmentally Based Agricultural Land Protection Programme (ÇATAK) | Agriculture | $CO_2$, $CH_4$, $N_2O$ | improving soil structure and reducing carbon emissions by taking "Minimum Soil Tillage Agriculture" practices, saving energy and water through efficient irrigation practices | Regulatory, economic, other | Implemented | 2006 | MoAF | NE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6 - Sustainable Use of Agricultural Waste | Agriculture | $N_2O$, $CH_4$ | | Economic | | | MoAF, MENR, MoEUCC | NE |
| 7 - Reducing GHG Emissions from Livestock | Agriculture | $N_2O$, $CH_4$ | | | | | MoAF | NE |
| 8 - Program of Supporting Rural Development Investments | Agriculture | $CO_2$, $CH_4$, $N_2O$ | Reducing GHG emissions promotion of efficient use of irrigation water, energy and fertilizer; helping to protect quality and quantity of the soil; contributing in improvement of quality and productivity and reducing labor need | economic, regulatory, informative, other | Implemented | 2017 | MoAF | NE |

#### 4.2.6.1 Control of Nitrate Use

Türkiye adopted the **By-Law on Protection of Waters Against Pollution Caused by Nitrates from Agricultural Sources**[173] which aims to limit the amount of Nitrate in water. Türkiye started to monitor the amount of nitrate by the **Nitrate Information System (NIBIS)** while the **Nitrate Vulnerable Zones** are established, and the **Nitrate Action Plans (NAPs)** are prepared. It's expected that the by-law will significantly decrease the amount of nitrate used in agriculture and thus contributed to decrease GHG emissions of Türkiye in the agriculture sector.

#### 4.2.6.2 Analysis Based Fertilizer Use

The **By-Law on Chemical Fertilizer Control,**[174] includes technical arrangements in production, import and consumption of chemical fertilizer and are prepared for providing market control in specific standards, in compliance with rules and taking under record. By-Laws enable preventive control of exceeding specific amounts of Greenhouse Gases to be released in case chemical fertilizers are applied by analysis.

The **Programme of Extending Analysis Based Fertilizer Use** provides financial support for farmers in order to have fertilizer and soil analysis services at accredited laboratories, and to have advisory services for adequate use of fertilizers. The Programme is expected to contribute to reduction of $N_2O$ emissions that is caused by agricultural practices.

Within the framework of the **Fertilizer Usage Control Programme**, Agricultural Credit Cooperatives gave information and guidance to technical personnel on determining the fertilizer types, manner, amount, and time of application. Agricultural engineers were given in-service training and were specialized in fertilizer and fertilization and calibration of tools and machinery to be used in fertilization. In this way, producers were prevented from using fertilizers unconsciously. These practices aimed to support reducing N2O emissions from the agriculture sector. Moreover, R&D studies were carried out for the use of controlled chemical fertilizers, and as a result of these studies, organic fertilizers were included in the fertilization program. These actions reduced the use of chemical fertilizers, decreased chemical release to the environment, and contributed to sustainable soil fertility.

#### 4.2.6.3 Agriculture-based Specialized Organized Industrial Zones (TDIOSB)

Türkiye promotes the establishment of Agriculture-based Specialized Organized Industrial Zones (TDIOSB) focused on plant production (greenhouse cultivation) throughout the country. The Ministry of Agriculture and Forestry incentives renewable energy, such as geothermal and solar/wind power, for heating requirements. With the TDIOSB projects supported especially in geothermal fields, environmentally friendly and sustainable food production is ensured by the

[173] Official Gazette dated July 23, 2016 numbered 29779

[174] No 2015/42, which came into force in 2015

cheap energy source and the reduction of costs in production, and the reduction of the use of fossil fuels, which are used extensively in greenhouses and cause environmental pollution. TDIOSBs especially carried out in the geothermal fields, provide significant support to environmentally friendly and sustainable food production. In this context, the sub-component of the **Turkey Climate Intelligent and Competitive Agricultural Growth Project (TUCSAP)** carried out by the Ministry of Agriculture and Forestry with the World Bank is to strengthen climate resistance, efficiency, and efficiency in resource use in the production of horticultural crops of TDIOSBs. It is aimed to establish Greenhouse TDIOSB in an area of 3,036,787 square meters, heated by geothermal resources.

Within the framework of By-Law on Geothermal Resources and Natural Mineral Waters and Governing Regulations of the Law on Geothermal Resources and Natural Mineral Waters greenhouses in 10 provinces performing geothermal green housing practices are under investigation in terms of economic, social and environmental outcomes.

#### *4.2.6.4 Land Consolidation*

Within the framework of legislation regarding "Soil Conservation and Land Use and Changes" it is targeted to ensure enough income for each agricultural land sizes and prevent divisions of lands into small fractions which are unfeasible to operate. Through avoiding splitting of agriculture parcels a reduction in GHG emissions is expected due to effective use of the agricultural lands, water, energy, fertilizers and machinery. Monitoring of GHG emission reduction of this measure is planned to be conducted through monitoring of reduced machinery use. Avoiding parcel division is also expected to cause changes in irrigation methods, reducing water loss and increasing irrigation efficiency.

Also, studies show that in areas in which land consolidation is made, as a result of changes in road lengths and routes, farmers' daily road distances are shortened by an average of 26.68 km (minimum 6.44 km and maximum 70.24 km) in Türkiye (Polat and Manavbaşı, 2012). Reaching to higher yield in the unit area by optimizing the efficiency of nitrogen fertilizer use and using conservative tillage techniques can reduce $N_2O$ and $CO_2$ emissions.

In this context, land consolidation works are carried out on an area of 8.5 million ha by the General Directorate of DSI. As of the end of January 2022, the registered area in Türkiye has been realized as 6.02 million ha. In 2021, consolidation registration works were completed on 1,258,117 ha of land. The 2023 target of the Ministry of Agriculture and Forestry in land consolidation and on-farm services is to complete the consolidation works on an area of 8.5 million ha.

#### *4.2.6.5 Environmentally Based Agricultural Land Protection Programme (ÇATAK)*

One of the best examples is the Environmentally Based Agricultural Land Protection Programme (ÇATAK) to agri-environmental programs. The Programme aims taking necessary

precautions for increasing soil and water quality, sustainability of renewable natural resources, avoiding erosion and decreasing negative effects of agriculture, improving soil structure by taking "Minimum Soil Tillage Agriculture" practices, saving energy and water through efficient irrigation practices, in areas where intensive agricultural activities are performed. The Programme also targets raising awareness of producers on agri-environment and increasing agricultural income of the producers by reducing input costs.

ÇATAK is the first Programme to be specifically targeted at addressing the negative impacts of agricultural practices on the environment. The programme is expected to mitigate $CH_4$ and $CO_2$ emissions through extension of methodologies mentioned above.

The ÇATAK program has some similarities with EU agri-environmental measures in rural development programs. As of 2019, environmentally friendly agricultural practices are performed in 58 cities, and 734,081,405 TRL in total support payment is paid to 188,661 producers covering 721,443 ha area.

#### *4.2.6.6 Sustainable Use of Agricultural Waste*

Türkiye aims for sustainable use of biomass to assist the development of country's economy towards green growth. Türkiye started to utilize livestock animals' manure as a biomass source at new biomass plants which positively impacts the Country's agriculture emissions.

#### *4.2.6.7 Reducing GHG Emissions from Livestock*

Activities conducted within the framework of Pasture Law, Animal Breeding Law, Law on veterinary services, plant health, food and feed, Specialized Organized Industry Zones based on agriculture have direct impact in reduction of methane gas in the stock farming sector.

#### *4.2.6.8 Program of Supporting Rural Development Investments*

Support activities are being carried out in 81 cities within the scope of **Program of Supporting Rural Development Investments** to avoid excessive use of production inputs as irrigation water, energy and fertilizer by extending use of modern irrigation machinery and equipment developed for agricultural activities by producers, helping to protect quality and quantity of the soil and water resources, contributing in improvement of quality and productivity in production and reducing labor need. According to the amount of goods purchasing basis to the grant announced every year for real and legal entity applicants provided to be separately, it is made in the rate of the determined donation support (50% -75%). In 2017 65 million TRY is provided as grant for an arable land of 22,000 ha area; and cumulatively 131,000 Million TRY is provided for an arable land of 131,000 ha area since the beginning of the programme.

As of the end of 2013, productivity in agricultural production has increased and negative effects which extreme irrigations on our soil and water resources shall cause are prevented in approximately 750,000 ha area by providing the utilization of modern irrigation methods.

Also, within the scope of the **Program of Supporting Development Investments,** solar energy is being used as an energy source for agricultural irrigation systems. Initial investment costs of agricultural irrigation systems with solar energy are higher than the diesel systems. Operation and maintenance costs of agricultural irrigation systems are very low and fuel cost is zero.

### 4.2.7 LAND USE, LAND USE CHANGE AND FORESTRY (LULUCF)

#### *Overview*

The roots of Türkiye's forestry sector administration go back to 1839 with the establishment of Directorate of Forestry in. Protection of forest lands entered into the legal framework in 1937 and into the constitution in 1961 which have continued to exist in the constitution of 1982.

Türkiye does not have a determined carbon sink commitment within the framework of UNFCCC processes. However, protection of forests and extension of forest areas have always been a part of Türkiye's strategies and action plans in several ways. Türkiye's forest stock has shown an increasing trend over the last decades. In the direction of global and national demands, the handling of the economic, ecological, social and cultural functions of forests within an ecosystem integrity and management of forests according to sustainable forest management principles is the basic approach of today's forestry approach.

Türkiye's **Nationally Determined Contribution** suggests the following measures for increasing national carbon sink potential through forestry sector as follows:

- Increasing sink areas and preventing land degradation
- Implementing Action Plan on Forestry Rehabilitation and National Afforestation Campaign

Currently, the national legislation on forestry does not have direct reference to increasing carbon sinks in order to fight against climate change. However, both the legislative framework and the policy documents aim at increasing forest lands, improvement of degraded forest lands and enlarging protected areas, which indirectly serve for the increase in carbon sinks of Türkiye.

Within the context of the **National Climate Change Action Plan,** overall policies and targets for forestry sector are defined as follows:

**Target 1:** Increase the amount of carbon sequestered in forests by 15% of the 2007 value by 2020 (14,500 Gg in 2007, 16,700 Gg in 2020)
**Target 2:** Reduce deforestation and forest damage by 20% of the 2007 values by 2020
**Target 3:** Integrate the climate change factor in land use and land use changes management strategies by 2015
**Target 4:** Identify the amount of sequestered carbon in pastures and meadows in 2012, and increase carbon stock 3% by 2020

**Target 5:** Identify the existing carbon stock in wetlands in 2012, and maintain the level until 2020

**Target 6:** Make necessary legal arrangements for combating climate change with regard to land use and forestry by the end of 2013

**Target 7:** Strengthen institutional capacity in institutions involved in land use and forestry on climate change by 2014

The **National Forestry Programme (2004-2023)** has been developed and adopted with the following objectives of protection of forest areas, forest biodiversity and natural habitats, extension and improvement of existing forest areas and providing sustainability of forest ecology while promoting economic social and cultural activities based on forests taking into account social justice. The **National Strategy and Action Plan to Combat Desertification (2019-2030)**[175] also involves several activities and targets that support Türkiye's forest areas:

- Increasing productive forest areas with rehabilitation and afforestation works in degraded forest areas,
- Integrating and monitoring biodiversity and ecosystem services in forest management,
- Making afforestation, multi-purpose afforestation and rehabilitation projects of forests in regions with high desertification sensitivity, taking into account the sustainability principle, with appropriate species, origins and methods,
- Increasing preventive measures in the fight against forest fires, strengthening response capacity,
- Monitoring the health of forest ecosystems and applying preventive measures, primarily natural or suitable for nature, in the fight against diseases and pests; protection of forest wealth and health,
- Implementation of sustainable forest management principles that will reduce the risk of drought, protect water production functions and increase drought resistance,
- Conducting R&D projects on Sustainable Forest Management (SFM) approaches, protection of forests, rehabilitation of degraded areas and development of sustainable use, sharing the project results with the public.

The most updated document for forestry sector planning is the **Strategic Plan of General Directorate of Forestry (2019-2023)**. Within the framework of the plan the following strategic performance indicators are targeted extension of the fight against forest fires and increasing capacities:

- Monitoring the health of forest ecosystems and search for ways to fight with diseases

[175] MoAF, 2019.

- Quality of Wood, seed and fruit efficiency will be improved. Silvicultural maintenance measures for the establishment of healthy forests will be increased.
- Ratio of growing stock per hectare will be increased from 72.9 m3 to 74.5 m3 by 2023.
- Increasing the productive forest area from 12,850,000 ha to 13,250,000 by 2021.
- The total forest land of Türkiye will increase from 28.8% to 30% by 2023.
- Combating erosion to reduce the soil loss and enhance the pasture improvement. The size of soil loss controlled area will be increased from 1,415,000 ha to 1,677,000 ha by 2021.
- Rehabilitated pasture area will be increased from 222,000 ha to 265,000 ha by 2021.
- The forest management plan and inventory of 5,605,000 ha forest land will be made in accordance with multi-purpose use.

All policy documents target effective protection of forests against various factors including fires and harmful diseases, soil conservation, afforestation, rehabilitation studies, extending monitoring practices, extension of sustainable forest management practices, raising awareness among public and development of the institutional capacities of relevant institutions.

On top of above-mentioned policy documents, several Action plans have been adopted for various tree types separately. All action plans target at increasing the productivity of forests and extension of forest lands besides species specific targets.

All these efforts have led to several changes in forest areas and their productivity in Türkiye over the recent decades. Carbon sink potential of Türkiye has shown an increasing trend between 1990 to 2020 with an increase of 114% reaching 57.6 Mt $CO_2$-eq.

Also, there have been efforts to develop a forest carbon standard and certification in Türkiye, in order to integrate to the voluntary carbon market.

At the Climate Council (2022), one of the key issues discussed is management of the forestry sectors. Various policy targets were suggested for LULUCF sector. Among them recommendations on forest are covering issues:

**i.** ensuring to reduce pressures on sink areas and increasing protected areas based on sustainable land management,
**ii.** prevent land degradation, and protect and increase natural carbon sinks,
**iii.** strengthening the existing policies on land degradation neutrality and all ecosystems such as forests, agricultural areas, grazing lands, wetlands,
**iv.** strengthening ecosystem-based forestation,
**v.** enhancing national fire-fighting capacity including the number of equipment and staff.

And within the scope of combating climate change, forest management and forestry policies will be developed in the light of Climate Council decisions.

Table 25 contains Türkiye's LULUCF sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

*Table 25 – LULUCF sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Expanding Forest Areas | Forestry / LULUCF | $N_2O$, $CH_4$ | Extension and improvement of existing forest areas and carbon sink | Regulatory | Implemented | 2004 | MoAF | NE |
| 2 - Effective Protection of Forests | Forestry / LULUCF | $N_2O$, $CH_4$ | Protection of the forests from forest fires and other threats | Regulatory | Implemented | 2004 | MoAF | NE |
| 3 - Protection of Olive Trees and Areas | Forestry / LULUCF | $N_2O$, $CH_4$ | Preserving and improvement of existing olive trea areas as carbon sink | | | | MoAF | NE |

#### 4.2.7.1 *Expanding Forest Areas*

**The 11th Development Plan** targets to increase total forest land of Türkiye from 28.8% to 30% by 2023.

#### 4.2.7.2 *Effective Protection of Forests*

**11th Development Plan** includes completion of the national forest inventory will be completed (Target 415.1); strengthening the capacity to fight against fires, pests and diseases will be improved; afforestation and rehabilitation activities will be accelerated (Target 415.2); promotion of industrial plantations (Target 415.4).

#### 4.2.7.3 *Protection of Olive Trees and Areas*

Supporting olive cultivation with Law on Olive Grove Rehabilitation and Wild Olive Grafting and applying deterrent penalties for cutting down olive trees increase $CO_2$ sink basin.

Table 20 contains Türkiye's energy sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

### 4.2.8 WASTE

#### *Overview*

GHG emissions from the waste sector constituted 3.1% of Türkiye's total GHG emissions, excluding LULUCF in 2020.[176] Türkiye's GHG emissions from the waste sector mainly resulted from municipal waste disposal (landfilling or wild/open dump sites) and municipal or industrial wastewater treatment and discharge systems. Although in Türkiye, the waste sector emissions have a small share compared to other sectors, there are significant efforts to reduce the emissions since waste management is also an issue of environmental protection and public health. The following cross-sectoral Strategies and plans include targets for reducing waste generation.

The **11th Development Plan** targets to increase recovery rate of waste and proportion of municipal population given landfill services. Türkiye aims reducing amounts of both solid waste and wastewater, diverting waste away from landfills, increasing biological recovery of waste which replaces landfilling, capturing or flaring methane from landfills and wastewater, rehabilitation of old dumpsites, better source separation and collection of municipal waste and increasing the use of nitrogen removal technologies in wastewater treatment contribute to GHG emissions from the waste sector.

[176] NIR, 2022.

The **Nationally Determined Contribution** of Türkiye includes plans and policies to be implemented for the waste sector:

- Sending solid wastes to managed landfill sites
- Reuse, recycle and use of other processes to recover secondary raw materials to utilize them as an energy source or to remove wastes;
- Recovering energy from waste by using processes such as material recycling of wastes, bio-drying, bio- methanation, composting, advanced thermal processes or incineration;
- Recovery of methane gas from landfill gas from managed and unmanaged landfill sites;
- Utilization of industrial wastes as an alternative raw material or alternative fuel in other industrial sectors, through industrial symbiosis approach;
- Conducting relevant studies to utilize wastes generated from breeding farms and poultry farms;
- Rehabilitation of unmanaged waste sites and ensuring wastes to be deposited at managed landfill sites

The **National Climate Change Action Plan's (2011-2023)** overall policies and targets for waste sector are defined as follows:

> **Target 1:** Reduce the quantity of biodegradable wastes admitted to landfill sites, taking year 2005 as a basis, by 75% in weight till 2015, by 50% till 2018 and by 35% till 2025
> **Target 2:** Establish integrated solid waste disposal facilities across the country, and dispose 100% of municipal wastes in these facilities, until the end of 2023
> **Target 3:** Finalize Packaging Waste Management Plans
> **Target 4:** Establish the recycling facilities foreseen within the scope of the Solid Waste Master Plan with the EU- aligned Integrated Waste Management approach
> **Target 5:** Termination of uncontrolled disposal of wastes 100% by 2023

The **National Waste Management Action Plan (2016-2023)** was prepared within the framework of the approximation process to the EU Environmental Acquis. In the action plan, the objective of the waste sector is defined as "ensuring effective waste management". Under the plan; by analyzing the present situation of waste management, it is aimed to separate collection, recycling, recovery by different methods and disposal methods of waste according to the types of wastes. At the same time, it was aimed to determine "sustainable waste management strategies" throughout the country by ensuring recycling and recovery and recycling of waste materials into the economy in order to prevent rapid consumption of natural resources. The National Waste Management Action Plan sets goals for local authorities in all 81 provinces towards an integrated waste management system, which will require more recovering, recycling and energy production from waste and accordingly limit the number of sanitary landfills needed as it is aimed at in circular economies. The National Waste Management and Action Plan

presents general plans in the waste management sector for municipal waste as well as packaging waste, medical waste and hazardous waste. This plan, which functions as a roadmap for investments, also includes information regarding the place, time frame and the required capacity for plants to be built, and afterwards a national strategy is developed on the reduction of the biodegradable waste to be disposed of in landfills. Preparation works for a new National Waste Management and Action Plan is conducted to cover the years 2023-2035 by revising the current National Waste Management and Action Plan (2016-2023). By this plan, it is aimed to develop the current plan compatible with zero waste management system project, to increase and mainstream the efficiency of collecting separately at the source, to enhance the recovery rates of the wastes, to determine the recovery and disposal methods on the regional basis and to reveal the capacities of relevant facilities and to establish a sustainable waste management planning for 2023-2035. Regional Waste Management Plans will also be prepared taking into account the waste management system at national level. By the year 2023, it is targeted to recover 35% and to dispose to landfills 65% of the waste generated.

Türkiye add a supplementary clause to the Environmental Law (law no. 2872) on circular economy. The Country also started the preparation of **the National Circular Economy Action Plan**.[177] It's expected that the circular economy approach will help Türkiye to decrease its GHG emissions.

Table 26 contains Türkiye's waste sector policies and measures for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

[177] "Technical Assistance for Assessment of Turkey's Potential on Transition to Circular Economy Project" was initiated. With the project outputs, the transition to a circular economy, which also contributes to more efficient resource and waste management throughout Türkiye, will be encouraged. It is aimed to strengthen Türkiye's institutional and technical capacity in various aspects such as knowledge, strategic documents including relevant legislation, and human resources.

*Table 26 – Waste sector policies and measures*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1- Zero Waste Policy | Waste Management / Waste | $CO_2$, $CH_4$ $NO_2$, F-Gases | Prevention of waste and re-use/recycling/recovery of waste | Regulatory, other | Implemented | 2018 | MoEUCC | NE |
| 2 - Power generation from sanitary landfills | Waste Management / Waste | $CO_2$, $CH_4$ $NO_2$ | Reducing methane emissions from landfills and increasing use of biofuels through Power generation from landfill gas | Regulatory, economic, other | Implemented | 2011 | MoEUCC, MENR and Municipalities | NE |
| 3 - Actions implemented under Wastewater Treatment Action Plan | Waste Management / Waste | $CO_2$, $CH_4$ $NO_2$ | Reducing GHG emissions through reuse of wastewater and promotion of clean technologies for wastewater treatment plants | Regulatory, other | Implemented | 2015 | MoEUCC, MENR and Municipalities | NE |
| 4 - Establishment of deposit return scheme | Waste Management / Waste | $CO_2$, $CH_4$ $NO_2$ | Reducing GHG emissions through recycling of waste which are made from recyclable materials such as plastics and glass | Economic, other | Adopted | 2020 | MoEUCC, TÜÇA | NE |

#### *4.2.8.1 Zero Waste Policy*

The main aim of Türkiye is to decrease the amount of waste generation. For this purpose, Türkiye started the **Zero Waste Project** and adopted the **By-law on Zero Waste**[178] in 2019. Objective of the by Law is to recognize the general rules and principles regarding the establishment, dissemination, development, monitoring, financing, recording and certification of the zero-waste management system. The By-law aims for waste prevention as the main priority and regulates the segregation of the waste at the source and separate collection of recyclable wastes. With the implementation of the By-Law, a reduction at the amount of waste has been sent to landfills will also decrease. Eleven operational guidelines have been prepared by the Ministry to guide the realization of the works related to the establishment, operation and monitoring of a sustainable zero waste management system. Provincial Zero Waste Management System Plans were prepared in 2020 by 81 provinces containing measures for establishing a zero-waste management system within the province.

In 2017 recycling rate was 13%, in 2021 it increased to 27.2 % and it is foreseen to increase 35% by 2023, 60% by 2035. Since 2017 33.8 million tons of recyclable waste brought back into the economy. An economic gain of 62.2 billion TL was achieved from the collected wastes 3.9 million ton $CO_2$ eq. were prevented.

Recycling strategy of Türkiye mostly based on management of packaging material. Because of the mentioned feature of the strategy, the packaging waste has a great influence on both rapid development of the recycling sector in Türkiye and its competitiveness at national and global level. Recycling rate is expected to increase from 13% in 2018 to 35% in 2023 and also it is envisaged to contribute to 'zero waste vision' of the MoEUCC.

Türkiye updated its **By-Law on Control of Packaging Waste** in 2021 and **By-Law on Control of Waste Electrical and Electronic Equipment** in 2022. Revised by-laws increase the separated collection and treatment targets of concerned wastes. The packaging waste by-law also introduced specific quotas concerning recycled material to be used as input during the packages' production process to support recycling to prevent the depletion of virgin/raw material as a circular economy approach. As a result, packaging and packaging waste management; are evaluated as a pioneer for waste and resource management, which has a positive impact on decreasing GHG emissions by promoting sustainable resource management and higher recycling rates. The collection and treatment of e-waste will also reduce Türkiye's F-gas emissions.

In order to prevent all negative effects caused by plastic bags, a legal arrangement has been made for the payment of plastic bags for transportation purposes at the sale points such as

[178] Published on Official Gazette No 30829 on July 12, 2019

markets and stores as of 1 January 2019. Through this policy, between 2019 and 2022 approximately 62.5% reduction in the use of plastic bags was achieved cumulatively and the formation of 760,000 tons of plastic waste was prevented. With this reduction, the import of plastic raw materials necessary for the production of plastic bags in Türkiye has been prevented and approximately 5.24 billion Turkish liras have been saved, as well as approximately 31,500 tons of greenhouse gas emissions have been prevented.

Türkiye also aims to increase its waste recovery rates through increasing waste-derived fuel usage in its manufacturing industry. (See Section 4.2.5.3)

#### *4.2.8.2 Power Generation from Landfills*

Türkiye aims to decrease waste sector GHG emissions through power generation from the waste by collecting and using landfill gas. **YEKDEM mechanism** (see section 4.2.2.1) paved the way for landfill gas collection and electricity generation facilities that have become popular particularly in the last decade. The number of sanitary landfill sites with landfill gas recovery increased from 1 in 2002 to 84 in 2022. Moreover, Türkiye also has methane recovery at one of its unmanaged solid waste sites, where 2.2 kt methane was recovered, which increased the total to 303 kt in 2020.[179] (see Section 2.10)

#### *4.2.8.3 Power Generation from Wastewater Treatment Plants*

**Wastewater Treatment Action Plan (2017-2023),** which has been prepared in accordance with the Environment Law and Strategic Plan of the MoEUCC. The Wastewater Treatment Action Plan aims to strengthen the wastewater treatment capacity of Türkiye. The Plan also promotes reuse of wastewater and cleaner production technologies for wastewater treatment plants which contribute to climate change mitigation. According to the Wastewater Treatment Action Plan (2017-2023), 1422 wastewater treatment facilities are planned to be installed by 2023.

Between 2002 to 2020, number of wastewater biogas facilities with methane recovery increased from 2 to 25. In these 25 sites, 30.9 kt of methane was recovered in 2020.[180] (see Section 2.10)

#### *4.2.8.4 Establishment of Deposit Return Scheme*

Türkiye is setting a nation-wide **deposit refund scheme** for collection and recycle of waste which are made from recyclable materials such as plastics and glass. Türkiye has been established the Türkiye Environmental Agency (TÜÇA) in 2020 and one of the main responsibilities the Agency is the establishment of the deposit system. The impact of the system will be visible in the next reporting cycles to the UNFCCC.

[179] NIR, 2022 p. 412.

[180] NIR, 2022 p. 412.

### 4.2.9 POLICIES AND MEASURES IN ACCORDANCE WITH ARTICLE 2

Table 27 contains Türkiye's policies and measures in accordance with Article 2 for reducing the Country's greenhouse gas emissions. Following the table, each policy/measure is described in the following subsections.

*Table 27 - Policies and measures policies and measures in accordance with article 2*

| PaM | Sector(s) affected | GHG(s) affected | Objective and/or activity affected | Type of instrument | Status | Start year of implementation | Implementing entity or entities | Estimate of mitigation impact *(not cumulative, in kt $CO_2$ eq.)* ***2030*** |
|---|---|---|---|---|---|---|---|---|
| 1 - Collection of maritime transport fuel consumption data | International Travel | $CO_2$ | Collection of fuel consumption data for each type of fuel used in maritime | Regulatory, economic | Implemented | 2016 | MoTI | NE |
| 2 - Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) | International Travel | $CO_2$ | | Regulatory, economic | Implemented | 2018 | Directorate General Of Civil Aviation | NE |
| 3 - 2050 Net-zero Carbon Emission Initiative | International Travel | $CO_2$ | | Regulatory, economic | Adopted | - | Directorate General Of Civil Aviation | NE |

#### *4.2.9.1 Collection of maritime transport fuel consumption data*

Amendments to MARPOL Annex VI on Data collection system for fuel oil consumption of ships, entered into force on 1 March 2018.[181] Under the amendments, ships of 5,000 gross tonnage and above are required to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data including proxies for transport work. Within this framework, Türkiye has been working on the necessary institutional, administrative and technical preparations in order to comply with the Decision. For the data gathering system to be launched on 1 January 2019, official communication has been made in September 2018 to maritime enterprises and classification societies in order to take the necessary actions.

Türkiye is involved in several international cooperation incentives regarding maritime transport. Türkiye is involved in several technical study groups established for the development of maritime lines within the scope of the Organization of the Black Sea Economic Cooperation (BSEC) Secretariat, which is undertaken by the Ministry of Transport and Infrastructure.

#### *4.2.9.2 Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*

The Ministry of Foreign Affairs acts as the focal point and responsible body for implementation of decisions taken by ICAO. Türkiye is among the 44 members of the European Civil Aviation Conference (ECAC) which is the largest civil aviation organization in Europe in charge with working closely and cooperatively with other regional organizations and individual Contracting States of ICAO on a range of civil aviation issues of common interest, including security, safety and environmental fields.

As of July 2018, 68 countries, including Türkiye, representing over 70% of the world air traffic submitted their intention to take responsibility to reduce $CO_2$ emissions from international aviation from the pilot and first phase (i.e. between the years 2021-2027) of the **Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)** scheme voluntarily.

Once fully implemented, CORSIA scheme could keep international $CO_2$ emissions as 2020 levels (carbon neutral growth from 2020). ICAO Standards and Recommended Practice (SARP) documents regarding to implementation of CORSIA scheme approved at ICAO Council on 27 June 2018 and circulated to Member States. Since this date, national airlines have been carrying out emission monitoring, reporting and verification activities. The studies of providing accreditation on the CORSIA scheme, which TÜRKAK started in 2019, yielded results and TÜRKAK has announced accredited a verification body under ISO 14065: 2013 for ICAO CORSIA aviation emissions scheme for the first time on 25 June 2021. The scheme is now open for other potential verification bodies to apply for accreditation.

[181] Adopted by resolution MEPC.278(70).

#### *4.2.9.3 Aviation Sector 2050 Net-zero Carbon Emission Initiative*

Some of the Turkish aircraft operators committed to achieve 2050 net-zero carbon emission initiative established by International Air Transport Association (IATA). Türkiye also participates to several international organizations and initiatives regarding civil aviation such as EUROCONTROL, ECAC, International Civil Aviation Organization (ICAO), North Atlantic Regional Aviation Safety Group and JAA TO.

Several domestic measures are taken in order to reduce GHG emissions of aviation sector. SMART project that aims to modernize the air traffic system targets to provide energy efficiency. Also, several airline companies are taking measures to reduce fuel consumption per passenger via renewal of their fleets with new and modern and energy efficient airplanes. Ways of shortening flight routes, reducing fuel consumption during taxi and cruise are also being investigated.

#### *4.2.9.4 Minimization of Adverse Effects in Accordance with Art.2 of the Kyoto Protocol*

Each Annex I Party shall provide information on how it strives to implement policies and measures under Article 2 of the Kyoto Protocol in such a way to minimize adverse effects, including adverse effects of climate change, effects on international trade, and social environmental and economic impacts on other Parties under Article 4, paragraphs 8 and 9, of the Convention, taking into account Article 3 of the Convention.

In Türkiye, policies developed to tackle climate change are formulated and implemented in a way that minimize the potential adverse impacts on specific sectors of economic activity, industrial sectors or other Parties to the Convention, including the adverse effects on the international trade, social, environmental and economic impacts in developing countries.

Domestic sectoral and national policies, measures and actions that are developed and implemented for GHG emission reduction considers all sectors of economic activity which are related with GHG emissions or with carbon sinks.

#### *4.2.9.5 Minimization of Adverse Impacts in Accordance with Article 3, Paragraph 14 of the Kyoto Protocol*

Türkiye, as a Party included in Annex I with No commitments inscribed in Annex B to the Kyoto Protocol, has No obligation to report on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol.

### 4.2.10 POLICIES AND MEASURES NO LONGER IN PLACE

#### *4.2.10.1 Promotion of Phasing out of Old Vehicles*

Based on the provisional revisions made in year 2016 in the Law on Special Consumption Tax (SCT), No.4760, tax exemption will be applied at the phase of first acquisition in case of

upgrading old commercial vehicles such as taxis, minibuses, service buses, public buses and trucks with newer vehicles which are more energy efficient, until 30 June 2019.

As of 31.12.2019, the implementation of both SCT exemption granted for the update of commercial vehicles regulated by the provisional Article 7 added to the Special Consumption Tax Law with the Article 54 of the Law No. 6745 and incentives regarding the scrapping of the vehicles over a certain age regulated in the provisional Article 1 of the Law No.7103 were ended. There is currently no regulation for scrap incentives.

# 5 PROJECTIONS AND TOTAL EFFECT OF POLICIES AND MEASURES

Türkiye developed its GHG emissions projections during the preparation and revision of its NDC. First, on 30 September 2015, Türkiye submitted its Intended Nationally Determined Contribution (INDC) to UNFCCC. Baseline and mitigation scenarios were established, and these scenarios were shared at the 6th and 7th NCs of the County. Türkiye submitted the same target as the Nationally Determined Contribution (NDC) to the UNFCCC without changing its target and assumptions in 2022.

Second, Türkiye announced raising the targets of this first NDC during COP27. While Türkiye worked on alternative mitigation scenarios for the updated first NDC, as these studies do not fall into the scope of the 8NC. These studies will be elaborated in the next reporting cycle.

Türkiye did not calculate majority of its current policies' emission reduction impacts. Thus, as individual policies' effects are not estimated, these policies' cumulative impacts are not estimated as well. However, these policies are in line with the Country's commitments anticipated at the first NDC, and thus, the projections of the NDC, to an extent, reflect the measures scenario of the current measures and policies. Some of the current policies are additional policies that were not listed at the first NDC, while some of the commitments foreseen at the NDC have not yet been implemented. Thus, it is expected that the current policies of Türkiye will result in an interval around the mitigation target of the first NDC. Moreover, the baseline scenario of the first NDC represents the without-measures scenario of the Country. (Figure 63)

The GHG emission projections of the INDC (and first NDC) by 2030 are based on two scenarios: Business-As-Usual Scenario and Mitigation Scenario. The projections have been prepared based on the works done under the project called "Preparation of Türkiye's Sixth National Communication on Climate Change", which was carried out by the former MoEU and the TÜBİTAK, Marmara Research Center. TIMES-MACRO model has been used for energy related modeling and industrial processes and product use, while for non-energy emissions different national models and studies have been used.

## 5.1 KEY ASSUMPTIONS

The baseline and assumptions used to estimate the projections of greenhouse gas emissions are presented in Table 28. Accordingly, Türkiye achieved 230% increase in GDP between 1990 and 2012. Its population has increased to 75.6 million by more than 30% from 1990 to 2012. Türkiye's energy demand increases by 6-7% each year. According to the projections by MENR, electricity demand in 2030 will reach 580 TWh under the business-as-usual scenario. These assumptions have lost their validity, initially used in the INDC preparation in 2015. Türkiye is updating these

assumptions within the scope of the ongoing preparation of the updated NDC. However, assumptions of the updated NDC will be available for sharing at the 9th NC of Türkiye.

Emission factors used to estimate greenhouse gas emissions are based on 2014 National Inventory Report published by TurkStat, 2006 IPCC Guidelines and collected data provided by various national institutions. Global warming potential on a 100-year timescale used for the calculation of $CO_2$ equivalent emissions is in accordance with the IPCC's Fourth Assessment Report.

*Table 28 – Key Assumptions used in the projections of the first NDC*[182]

| Parameter | 2012 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Population (in thousand) | 75,627 | 78,151 | 82,076 | 85,569 | 88,427 |
| Population growth | 1.38% | 1.07% | 0.93% | 0.75% | 0.60% |

## 5.2 BUSINESS-AS-USUAL SCENARIO (WITHOUT MEASURES)

This scenario projects GHG emissions up to 2030 based on the case of the mitigation measures which have been implemented, adopted or planned since 2012 will not be implemented between 2012 and 2030. GHG emissions for 1990-2020 and projected emissions for 2030 are listed in Table 29 based on the type of greenhouse gases and sectors. $CO_2$ emissions are projected to increase about 187% by 2030 compared to 2012. $CO_2$ emissions, which were 79% of the total emissions in 2012, are projected to be 87% to total emissions in 2030 (excluding LULUCF) due to a gradual increase in energy consumption.

The ratio of $CH_4$ and $N_2O$ emissions to total emissions is 15% and 5% in 2012. The ratio of $CH_4$ emissions to total emissions is forecasted to be 9% in 2030, while the ratio of $N_2O$ emissions to total emissions is estimated 3% 2030. On the other hand, the ratio of fluorinated gases emissions to total emissions is not expected to change much by 2030.

*Table 29 - Emissions by sector based on Business-As-Usual Scenario (Without Measures)*[183]

**GHG emission projections-scenarios (Mt $CO_2$ eq.)**

| | GHG emissions and removals | | | | | | | WoM |
|---|---|---|---|---|---|---|---|---|
| Year | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2030 |
| **By Sector** | | | | | | | | |

[182] Currently being updated as part of the first NDC revision study.

[183] The GHG emission projection figures for year 2030 are based on Türkiye's INDC, which has been submitted on 30 September 2015. The projections have not been updated since then. The base year for the projections is 2012. However, the GHG emission trends for 1990-2020 have been updated based on Türkiye's latest GHG Inventory.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Energy (including transport) | 139,60 | 166,28 | 216,02 | 244,45 | 287,84 | 341,98 | 367,58 | 943,55 |
| *Transport* | *26,97* | *34,11* | *36,46* | *42,04* | *45,39* | *75,80* | *80,68* | *136,51* |
| IPPU | 22,98 | 25,85 | 26,31 | 33,70 | 48,98 | 59,21 | 66,76 | 169,75 |
| Agriculture | 46,05 | 44,08 | 42,33 | 42,44 | 44,41 | 56,13 | 73,16 | 59,28 |
| Forestry / LULUCF | -55,74 | -57,40 | -61,57 | -74,54 | -73,62 | -97,54 | -56,95 | -38,70 |
| Waste | 11,08 | 12,35 | 14,34 | 16,40 | 17,45 | 17,14 | 16,40 | 40,90 |
| **By Gas** | | | | | | | | |
| $CO_2$ emissions (with LULUCF) | 151,66 | 181,48 | 229,86 | 264,77 | 316,04 | 384,33 | 356,19 | 1.018,36 |
| $CO_2$ emissions (without LULUCF) | 95,80 | 123,99 | 168,00 | 190,16 | 242,30 | 286,65 | 413,43 | 1.057,06 |
| $CH_4$ emissions (with LULUCF) | 42,48 | 42,60 | 43,66 | 45,15 | 51,61 | 52,78 | 64,10 | 107,65 |
| $CH_4$ emissions (without LULUCF) | 42,56 | 42,65 | 43,82 | 45,17 | 51,63 | 52,80 | 63,99 | 107,65 |
| $N_2O$ emissions (with LULUCF) | 24,95 | 23,87 | 24,77 | 25,34 | 27,45 | 32,32 | 40,66 | 33,05 |
| $N_2O$ emissions (without LULUCF) | 25,00 | 23,91 | 24,90 | 25,39 | 27,54 | 32,44 | 40,47 | 33,05 |
| HFCs | NO | NO | 0,12 | 1,15 | 3,05 | 4,80 | 5,85 | 13,44 |
| PFCs | 0,63 | 0,61 | 0,60 | 0,56 | 0,46 | 0,16 | 0,04 | NE |
| SF6 | NO | NO | 0,01 | 0,02 | 0,07 | 0,08 | 0,12 | 2,27 |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NE |
| **Total (with / without LULUCF)** | | | | | | | | |
| Total (with LULUCF) | 219,72 | 248,56 | 299,01 | 336,99 | 398,68 | 474,47 | 523,90 | 1.174,78 |
| Total (without LULUCF) | 163,98 | 191,16 | 237,44 | 262,45 | 325,06 | 376,93 | 466,95 | 1.213,48 |

In business-as-usual scenario, emissions from energy consumption are projected to increase about 40.5 Mt $CO_2$-eq. per year for 2020-2030. Greenhouse gas emissions for 1990-2020 and projected emissions up to 2030 for business-as-usual scenario are listed at Table 29 based on the type of greenhouse gas.

## 5.3 MITIGATION SCENARIO (WITH MEASURES)

With measures scenario (WM) includes emissions for 2012-2030, which were developed based on the mitigation policies and measures included in the first NDC, which had been prepared as INDC of Türkiye.[184] Table 30 represents the results of the scenario; however, emissions listed for 1990 to 2020 in the Table are the realized emissions. However, figures for 2030 represent the estimations of the WM scenario for that year. WM scenario is being updated as part of the first NDC revision study, and new estimations will be shared in the 9th NC.

[184] This mitigation scenario represents the results of activities listed in the INDC of Türkiye. Thus, it does not reflect the results of the policies and measures explained in detail in Chapter 4.

*Table 30 - Emissions by sector based on Mitigation Scenario (With Measures)* [185]

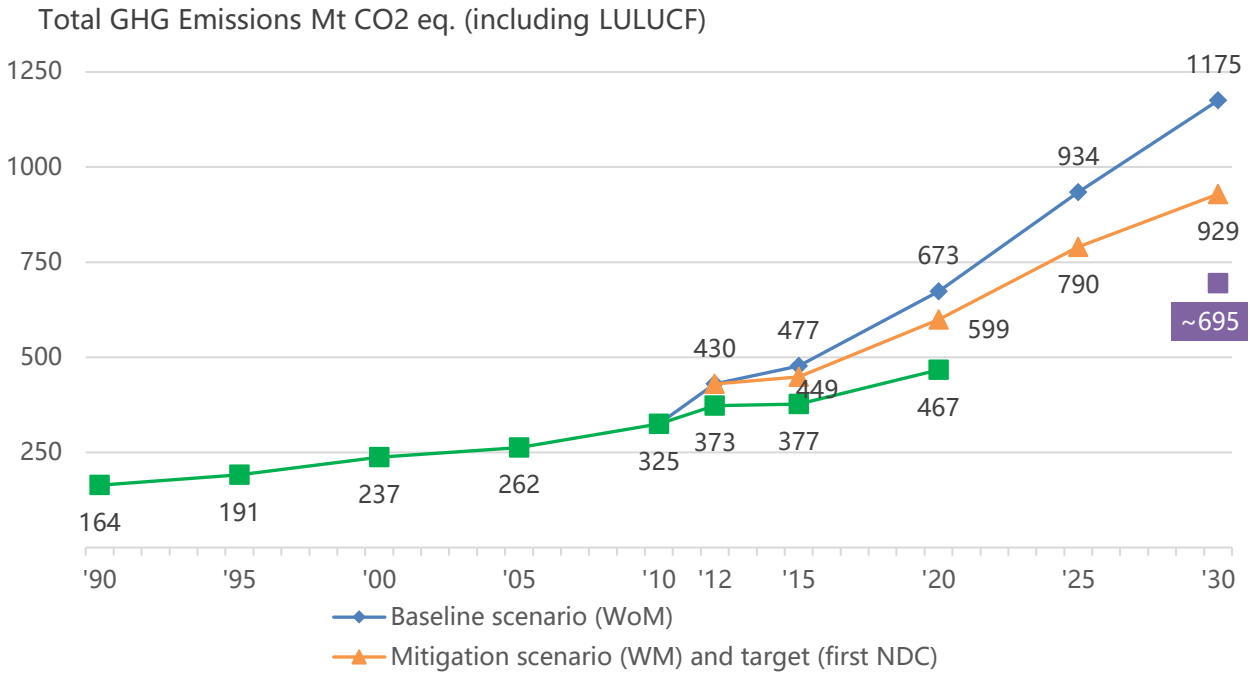
**GHG emission projections-scenarios (Mt $CO_2$ eq.)**

| GHG emissions and removals | | | | | | | | WM |
|---|---|---|---|---|---|---|---|---|
| Year | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2030 |
| **By Sector** | | | | | | | | |
| Energy (including transport) | 139,60 | 166,28 | 216,02 | 244,45 | 287,84 | 341,98 | 367,58 | 738,27 |
| *Transport* | *26,97* | *34,11* | *36,46* | *42,04* | *45,39* | *75,80* | *80,68* | *135,99* |
| IPPU | 22,98 | 25,85 | 26,31 | 33,70 | 48,98 | 59,21 | 66,76 | 169,75 |
| Agriculture | 46,05 | 44,08 | 42,33 | 42,44 | 44,41 | 56,13 | 73,16 | 59,28 |
| Forestry / LULUCF | -55,74 | -57,40 | -61,57 | -74,54 | -73,62 | -97,54 | -56,95 | -69,71 |
| Waste | 11,08 | 12,35 | 14,34 | 16,40 | 17,45 | 17,14 | 16,40 | 31,40 |
| **By Gas** | | | | | | | | |
| $CO_2$ emissions (with LULUCF) | 151,66 | 181,48 | 229,86 | 264,77 | 316,04 | 384,33 | 356,19 | 790,34 |
| $CO_2$ emissions (without LULUCF) | 95,80 | 123,99 | 168,00 | 190,16 | 242,30 | 286,65 | 413,43 | 860,05 |
| $CH_4$ emissions (with LULUCF) | 42,48 | 42,60 | 43,66 | 45,15 | 51,61 | 52,78 | 64,10 | 91,82 |
| $CH_4$ emissions (without LULUCF) | 42,56 | 42,65 | 43,82 | 45,17 | 51,63 | 52,80 | 63,99 | 91,82 |
| $N_2O$ emissions (with LULUCF) | 24,95 | 23,87 | 24,77 | 25,34 | 27,45 | 32,32 | 40,66 | 31,10 |
| $N_2O$ emissions (without LULUCF) | 25,00 | 23,91 | 24,90 | 25,39 | 27,54 | 32,44 | 40,47 | 31,10 |
| HFCs | NO | NO | 0,12 | 1,15 | 3,05 | 4,80 | 5,85 | 13,44 |
| PFCs | 0,63 | 0,61 | 0,60 | 0,56 | 0,46 | 0,16 | 0,04 | NE |
| SF6 | NO | NO | 0,01 | 0,02 | 0,07 | 0,08 | 0,12 | 2,27 |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NE |
| **Total (with / without LULUCF)** | | | | | | | | |
| Total (with LULUCF) | 219,72 | 248,56 | 299,01 | 336,99 | 398,68 | 474,47 | 523,90 | 928,98 |
| Total (without LULUCF) | 163,98 | 191,16 | 237,44 | 262,45 | 325,06 | 376,93 | 466,95 | 998,73 |

The emission reductions to be achieved by policies and plans, which are explained in detail in Chapter 4, compared to the without measures are presented in the Figure 63 below.

[185] The GHG emission projection figures for year 2030 are based on Türkiye's INDC, which has been submitted on 30 September 2015. The projections have not been updated since then. The base year for the projections is 2012. However, the GHG emission trends for 1990-2020 have been updated based on Türkiye's latest GHG Inventory.

*Figure 63 – Türkiye's GHG emission projections in With and Without Measures Scenarios*




The total GHG emissions realized for 2020 (both with and without LULUCF) remained below the estimated baseline (WoM) and mitigation (WM) scenario amounts. (Table 31, Figure 64) The COVID-19 pandemic and economic situation have significantly impacted GHG emissions in recent years. While Türkiye's GDP (constant 2015$) slightly increased, GDP (current price) decreased significantly by 7% in 2018 and 5% in 2019 compared to the previous year. Between 2017 and 2019, Türkiye's GHG emissions decreased by 4%. While Türkiye's total emissions increased by 3% from 2019 to 2020, the increase was limited. For instance, due to the COVID lockdowns and travel restrictions, a reduction in transport sector emissions occurred by 2% during the same period.

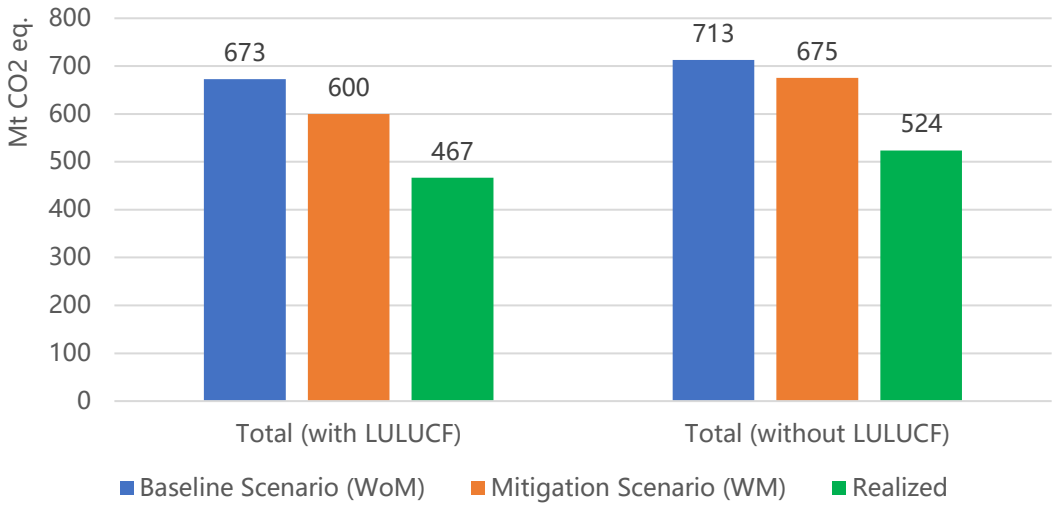
*Table 31 – Comparison of baseline scenario (WoM), mitigation scenario (WM) and realized GHG emissions for 2020*

**GHG emission projections-scenarios (Mt $CO_2$ eq.) (2020)**

| GHG emissions and removals | | | | |
|---|---|---|---|---|
| **Year** | **Baseline Scenario (WoM)** | **Mitigation Scenario (WM)** | **Realized** | **Difference of Realized to WM (%)** |
| **By Sector** | | | | |
| Energy (including transport) | 538,89 | 499,34 | 367,58 | -26% |
| Transport | 101,19 | 101,11 | 80,68 | -20% |
| IPPU | 94,75 | 94,79 | 66,76 | -30% |
| Agriculture | 51,56 | 51,56 | 73,16 | 42% |
| Forestry / LULUCF | -40,19 | -70,04 | -56,95 | -19% |

| | | | | |
|---|---|---|---|---|
| Waste management | 27,90 | 23,61 | 16,40 | -31% |
| **By Gas** | | | | |
| $CO_2$ emissions (with LULUCF) | 561,86 | 494,06 | 356,19 | -28% |
| $CO_2$ emissions (without LULUCF) | 602,05 | 564,09 | 413,43 | -27% |
| $CH_4$ emissions (with LULUCF) | 76,55 | 71,21 | 64,10 | -10% |
| $CH_4$ emissions (without LULUCF) | 76,55 | 76,55 | 63,99 | -16% |
| $N_2O$ emissions (with LULUCF) | 25,72 | 25,72 | 40,66 | 58% |
| $N_2O$ emissions (without LULUCF) | 25,72 | 25,72 | 40,47 | 57% |
| HFCs | 7,50 | 7,50 | 5,85 | -22% |
| PFCs | NE | NE | 0,04 | NE |
| SF6 | 1,27 | 1,27 | 0,12 | -91% |
| $NF_3$ | NO | NO | NO | NO |
| **Total (with / without LULUCF)** | | | | |
| Total (with LULUCF) | 672,90 | 599,77 | 466,96 | -22% |
| Total (without LULUCF) | 713,09 | 675,14 | 523,90 | -22% |

*Figure 64- Comparison of baseline scenario (WoM), mitigation scenario (WM) and realized GHG emissions for 2020*




## 5.4 SUPPLEMENTARITY RELATING TO THE MECHANISMS PURSUANT TO ARTICLES 6, 12 AND 17 OF THE KYOTO PROTOCOL

Türkiye, as a Party included in Annex I with no commitments inscribed in Annex B to the Kyoto Protocol, has no obligation to report on supplementary relating to the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol.

# 6 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION

This chapter provides a comprehensive overview of observed and expected impacts of climate change in Türkiye, an assessment of extreme hazards, and a review of sectoral vulnerability and risk. It also reviews the vulnerability and risk of various sectors to climate change, and discusses the legal regulations, policies, and strategies in place for conducting adaptation studies. The final section outlines specific adaptation actions that are being taken.

Türkiye has published its **Climate Change Adaptation Strategy and Action Plan (2011-2023)** in 2012. In line with changing needs, Türkiye is updating this Climate Change Adaptation Strategy and Action Plan by conducting comprehensive impact, risk and vulnerability assessments in prior sectors. In recent years, Türkiye has experienced extreme weather events and related disasters. As a result of the extreme floods that occurred in the Black Sea region, Türkiye has intensified its efforts on regional climate change adaptation studies and announced the **Black Sea Region Climate Change Action Plan** in 2019 in order to increase urbanization resistance to climate change as an emergency action plan. This subject has been defined as a target in the **Türkiye's 11th Development Plan (2019-2023)**. Following its accession to the Paris Agreement, the **Directorate of Climate Change** was established, and a **Department of Adaptation to Climate Change and Local Policies** was set up under the presidency to address the issue of climate change.[186]

The Climate Council was also instrumental on development of adaptation policies and actions. The **Climate Change Adaptation Commission** was one of the commissions of the Council and several decisions were taken regarding the adaptation.

## 6.1 IMPACT ASSESSMENT

### 6.1.1 Observed Impacts

The Turkish State Meteorological Service (TSMS) has compiled a set of climatological observations indicating that precipitation decreases while temperatures rise during the warmer months. According to TSMS, the long-term annual mean temperature in Türkiye for the 1991-2020 reference period (new normal period), is 13.9°C, which is an increase from the 13.5°C recorded for the 1981-2010 period the 13.2°C recorded for the 1971-2000 period (TSMS a, 2022). Additionally, Türkiye has seen positive temperature anomalies from the average temperature,

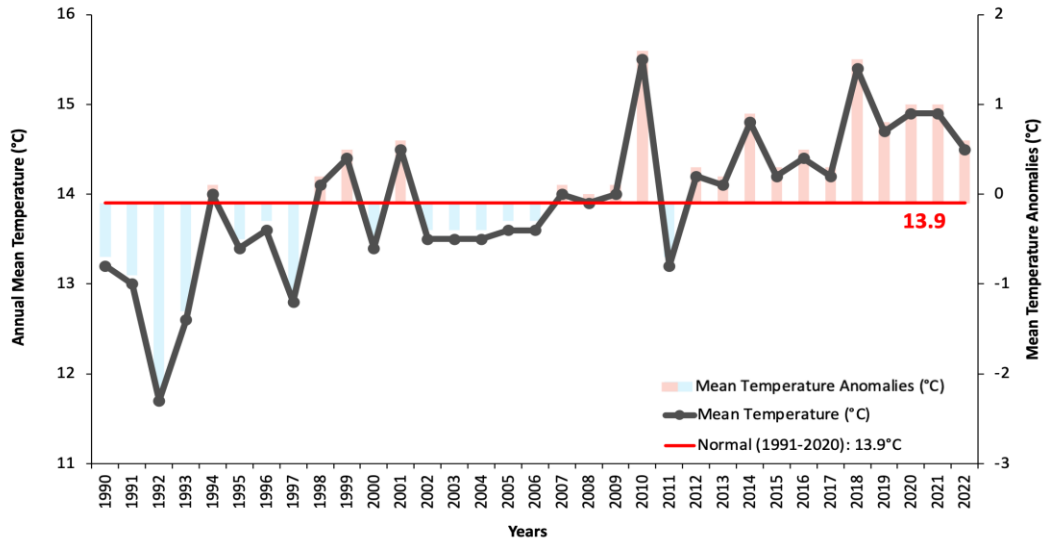
[186] The Department is responsible for a range of duties and authorities, including identifying national, local, and sectoral adaptation needs through studies, preparing legislation and guidelines for climate change policies, coordinating climate action plans, conducting impact and risk assessments, raising awareness on climate change adaptation.

since 1990 with the exception of 1992, 1997 and 2011. The year 2010 was particularly noteworthy, as it saw the highest temperature anomalies on record, with temperatures 1.6°C above the average In 2022, Türkiye experienced its seventh warmest year on record. The 1991-2020 reference period indicates that the average temperature in Türkiye has increased by 0.6°C°C, considering the new mean temperature of 13.9°C. In 2022, monthly mean temperatures were above normal except in January, March, and May. Overall, temperature differences from the average were positive in winter, summer and autumn seasons.

Figure 65, Table 32. TSMS, 2022). These findings by the TSMS align with the Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC).

In 2022, Türkiye experienced its seventh warmest year on record. The 1991-2020 reference period indicates that the average temperature in Türkiye has increased by 0.6°C°C, considering the new mean temperature of 13.9°C. In 2022, monthly mean temperatures were above normal except in January, March, and May. Overall, temperature differences from the average were positive in winter, summer and autumn seasons.

*Figure 65 - Annual Mean Temperature of Türkiye*




In recent decades, Türkiye has also seen some of the warmest seasons on record. For example, both the winter and summer of 2010 were the warmest on record, and the hottest spring on record occurred in 2018. The hottest fall on record took place in 2020, as shown in Table 32, which provides an overview of seasonal and annual temperature trends in Türkiye.

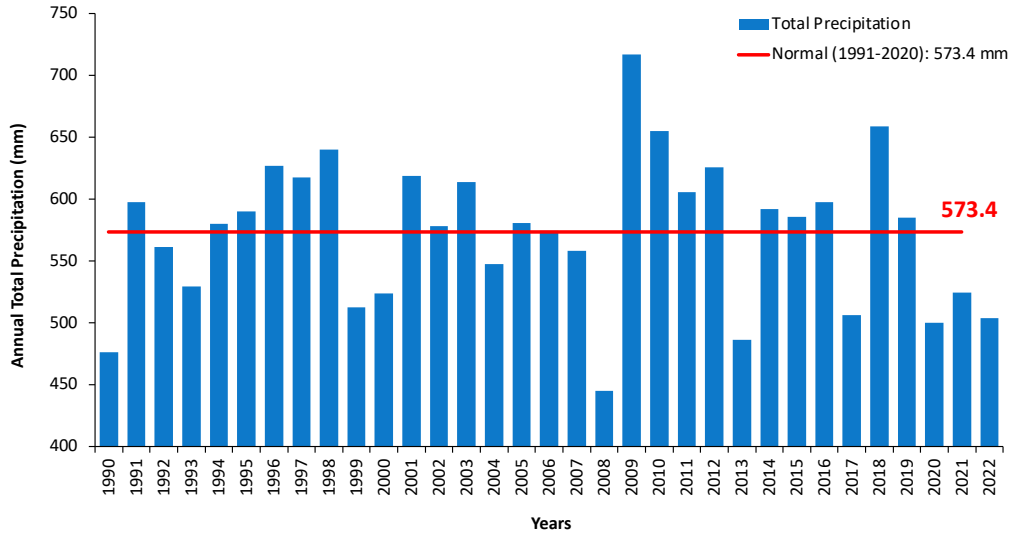
*Table 32 - Ranking of the Seasonal and Annual Warmest Decades*

| ***Winter*** | ***Spring*** | ***Summer*** | ***Autumn*** | ***Average*** |
|---|---|---|---|---|

| Year | Temperatur | Anomaly | Year | Temperatur | Anomaly | Year | Temperatur | Anomaly | Year | Temperatur | Anomaly | Year | Temperatur | Anomaly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2010** | 6.8 | 2.9 | **2018** | 14.9 | 2.5 | **2010** | 25.1 | 1.1 | **2020** | 17.4 | 2.1 | **2010** | 15.5 | 1.6 |
| **2014** | 6.4 | 2.5 | **1989** | 14.0 | 1.6 | **2012** | 24.9 | 0.9 | **2012** | 16.8 | 1.5 | **2018** | 15.4 | 1.5 |
| **2018** | 6.0 | 2.1 | **2008** | 13.8 | 1.4 | **2007** | 24.8 | 0.8 | **2010** | 16.7 | 1.4 | **2021** | 14.9 | 1.0 |
| **2021** | 5.9 | 2.0 | **2016** | 13.7 | 1.3 | **2016** | 24.8 | 0.8 | **2019** | 16.7 | 1.4 | **2020** | 14.9 | 1.0 |
| **1999** | 5.5 | 1.6 | **2013** | 13.7 | 1.3 | **2021** | 24.7 | 0.7 | **2015** | 16.7 | 1.4 | **2014** | 14.8 | 0.9 |
| **2009** | 5.4 | 1.5 | **2014** | 13.6 | 1.2 | **2017** | 24.7 | 0.7 | **2022** | 16.5 | 1.2 | **2019** | 14.7 | 0.8 |
| **2019** | 5.2 | 1.3 | **2001** | 13.6 | 1.2 | **2022** | 24.6 | 0.6 | **2018** | 16.3 | 1.0 | **2022** | 14.5 | 0.6 |
| **1981** | 5.2 | 1.3 | **2010** | 13.4 | 1.0 | **2001** | 24.6 | 0.6 | **1994** | 16.0 | 0.7 | **2001** | 14.5 | 0.6 |
| **1996** | 5.2 | 1.3 | **2021** | 13.2 | 0.8 | **2018** | 24.6 | 0.6 | **1998** | 16.0 | 0.7 | **2016** | 14.4 | 0.5 |
| **2020** | 5.1 | 1.2 | **1994** | 13.1 | 0.7 | **2006** | 24.5 | 0.5 | **2021** | 15.8 | 0.5 | **1999** | 14.4 | 0.5 |
| **2022** | 4.5 | 0.6 | **2022** | 11.8 | -0.6 | **2008** | 24.5 | 0.5 | **2017** | 15.7 | 0.4 | **2012** | 14.2 | 0.3 |

The annual areal total precipitation in Türkiye between 1991 and 2020 was 573.4 mm, as measured by TSMS (TSMS_b, 2022). There is no significant increase or decrease in the annual total precipitation averages across Türkiye, as indicated by the precipitation time series in Table 32. However, when reviewing long-term precipitation averages in Türkiye, it is observed that dry and wet periods follow one another. For the examined period, the year 2008 (445 mm) was one of the driest on record while the wettest year was 2009 (717 mm). In Figure 66, blue colored columns show the amount of precipitation, while the red horizontal line shows the long-term average for Türkiye.

*Figure 66 - Annual Total Precipitation in Türkiye*




### 6.1.2 Expected Impacts

#### *6.1.2.1 Climate Change Modelling Background*

As presented in the 7th NC, the high-resolution regional climate projections for Türkiye were downscaled by the Turkish State Meteorological Service (TSMS) and the General Directorate of Water Management (GDWM). Both institutions used the outputs of three global climate models under RCP4.5 and RCP8.5 scenarios selected from the CMIP5 archive, which was presented by the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Furthermore, the institutions plan to produce new regional climate models with higher resolution for Türkiye, utilizing the latest global climate models from the CMIP6 archive that were developed as part of the IPCC's Sixth Assessment Report.

From the regional climate projections studies that have been carried out so far, the Turkish State Meteorological Service (TSMS) has downscaled the HadGEM2-ES, MPI-ESM-MR, and GFDL-ESM2M global climate models to a resolution of 50 km using the RegCM regional climate model, and then further downscaled to 20 km. Meanwhile, the General Directorate of Water Management (GDWM) downscaled the HadGEM2-ES, MPI-ESM-MR, and CNRM-CM5.1 global climate models to 50 km and then to 10 km (Table 33).

*Table 33 - Regional Climate Projections of Türkiye*

| Projects | Global Climate Models | Regional Climate Model | Resolutions of GCMs | Resolutions of RCMs | Emission Scenarios | Reference Period | Projection Periods |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **GDWM** | HadGEM2-ES | RegCM4.3 | 112,5 km | Outer Domain: 50 km<br>Inner Domain: 10 km | RCP4.5 and RCP8.5 | 1971-2000 | 2015-2100 |
| | MPI-ESM-MR | | 210 km | | | | |
| | CNRM-CM5.1 | | 155 km | | | | |
| **TSMS** | HadGEM2-ES | | 112,5 km | Total Domain: 50 and 20 km | | | 2013-2099 |
| | MPI-ESM-MR | | 210 km | | | | |
| | GFDL-ESM2M | | 220 km | | | | |

Within the scope of the "Enhancing Adaptation Action in Türkiye (Iklime Uyum) Project", the performance of regional climate models in simulating the Turkish climate was evaluated. The monthly average temperature and total precipitation values produced by the models for the reference period of 1971-2000 were calculated and compared with meteorological observational data. Subsequently, the results of 2021-2100 projection period under the RCP4.5 and RCP8.5 emission scenarios were compared with 1971-2000 reference period and the changes were evaluated annually.

As part of the Iklime Uyum Project, the performance of the models in the reference period was evaluated using high-resolution WorldClim2.1 data. This was done by examining model biases, correlations, and errors, and selecting the regional climate model that best represents Türkiye's climate for use in the climate change impact assessments. The evaluation showed that, as with many downscaling studies, the temperature and precipitation variables improved in accuracy as the resolution increased, but also the biases of the models increased, and they produced colder and wetter simulations, particularly in regions with higher elevations.

According to the analyses performed, the MPI-ESM-MR model with a 10 km resolution was deemed the most accurate representation of the Turkish climate among the models downscaled by the institutions. It was selected for use in climate change impact assessments. The bias correction analysis was performed using the Quantile Mapping Tricubic method, which is a commonly used method for extreme hazards studies. The impact analysis was conducted by

dividing the 2021-2100 projection period into four 20-year periods (2021-2040, 2041-2060, 2061-2080, and 2081-2100) and evaluating them under both RCP4.5 and RCP8.5 scenarios.

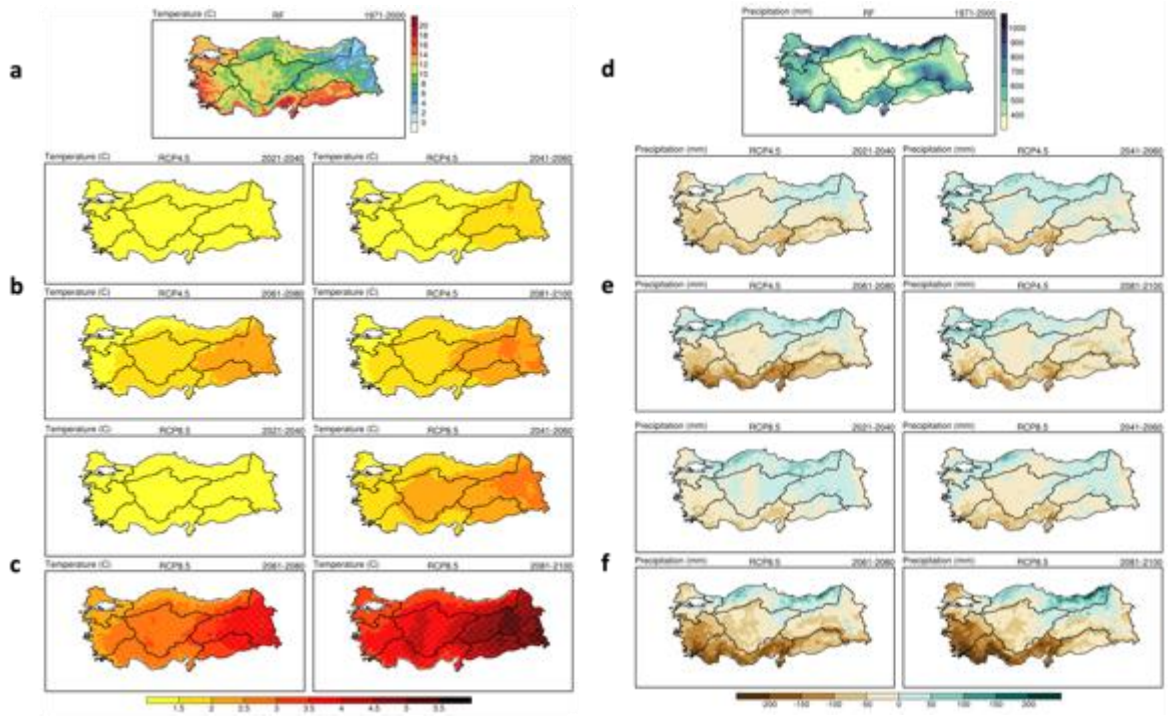
#### *6.1.2.2 Expected Changes in Türkiye*

The change from the 2021-2100 projection period to the 1971-2000 reference period was analyzed using the bias-corrected MPI-MR-ESM with 10 km resolution under the RCP4.5 optimistic scenario and the RCP8.5 pessimistic scenario under the Iklime Uyum Project.

In the reference period, the average temperature in the coastal areas of the Aegean and Mediterranean Regions and the Southeastern Anatolia Region ranges from 14°C to 19°C, whereas it is approximately 12°C in the Marmara Region. Towards the eastern part of the country, the average temperature decreases to 2°C, particularly in the higher elevations of the East Anatolia Region. The highest average temperature values were recorded in the east of the Mediterranean Region, reaching up to 20°C (Figure 67-a). In the projections of temperature changes, both the RCP4.5 and RCP8.5 scenarios predict temperatures to be higher than the reference period. The RCP4.5 scenario anticipates an increase in average temperature values by around 2.5°C in the eastern part of the country, and at least 1°C in the rest of the country by the end of the century (Figure 67-b). The RCP8.5 scenario predicts that the average temperature throughout Türkiye will increase by approximately 2.5°C until the 2060s, with this increase surpassing 5°C by the end of the century. According to the RCP8.5 pessimistic scenario in the 2081-2100 period, it is estimated that there will be a warming of at least 3°C in the Marmara Region and over 5°C in the Eastern Anatolia Region in Türkiye (Figure 67-c).

The regions of Central Anatolia and southern Southeastern Anatolia have the lowest precipitation levels during the reference period, with an average total precipitation of less than 400 mm. On the other hand, the Southern Aegean Region, the Western and Eastern coasts of the Mediterranean, the high elevations in Eastern Anatolia, and the Western Black Sea receive precipitation levels ranging from 600 to 800 mm. In the Eastern Black Sea Region, which receives the highest precipitation in Türkiye, the average annual total precipitation is more than 1000 mm, as shown in (Figure 67d). In the future, it is projected that the northern regions of Türkiye will experience an increase in total precipitation, while the southern regions, including the Aegean and Mediterranean, will experience a sharp decrease. Despite the similar distribution patterns of total precipitation changes for both emission scenarios, the magnitude of change is substantial. The RCP4.5 scenario projects an average increase of 50 mm in the Marmara and Black Sea Regions, and a decrease of 200 mm in the Mediterranean Region during the 2061-2080 period (Figure 67-e). On the other hand, the RCP8.5 scenario predicts fluctuations of precipitation between -100 to +100 mm until the 2060s, with the Black Sea Region projected to have an increase of 150 mm compared to the reference period and the Mediterranean Region projected to have a decrease of 300 mm by the end of the century (Figure 67-f).

*Figure 67 - Average Temperature (a) and Total Precipitation (d) in the Reference Period with Changes in RCP4.5 Scenario (b,e) and RCP8.5 Scenario (c,f)*[187]




### *6.1.2.3 Extreme Hazard Assessment in Türkiye*

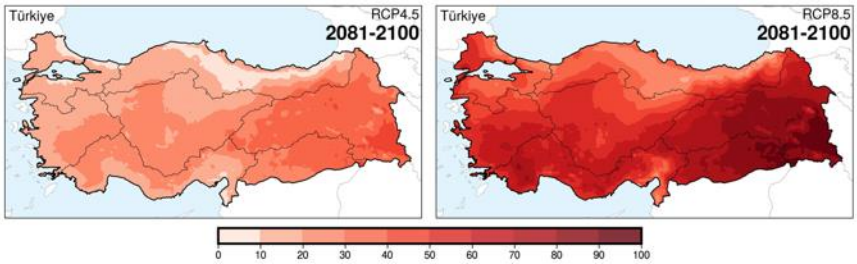
The Iklime Uyum Project is the first and comprehensive multi-hazard assessment related to climate change in Türkiye, identifying the regions and sectors that will be most affected during the 21st century. By using bias-corrected MPI-MR-ESM with 10 km simulations, the project analyzed the vulnerability and risks associated with various climate hazards, including heat waves, cold waves, droughts, forest fires, heavy precipitation, and extreme winds. The reference period for these indices was determined and their 20-year changes and distributions were evaluated in the projection period based on this reference period.

The Heat Wave Frequency Index (HWF) has been calculated to assess the heat wave hazard as presented in Figure 68. Both emission scenarios suggest that heat waves will become more frequent in the last 20-year period of the 21st century, in line with rising temperatures. The RCP8.5 scenario projects the greatest increase, with a five-fold increase in heat wave frequency in the last 20 years of the century compared to the first 20 years. The RCP4.5 scenario projects a more modest increase, with a 10-day increase in the Marmara and Black Sea Regions during the 2021-2040 period, and a maximum increase of 50 days in the 2081-2100 period. The RCP8.5 scenario predicts the greatest increase in heat wave frequency, with at least 90 more days of

[187] Source: İklime Uyum Project, 2020

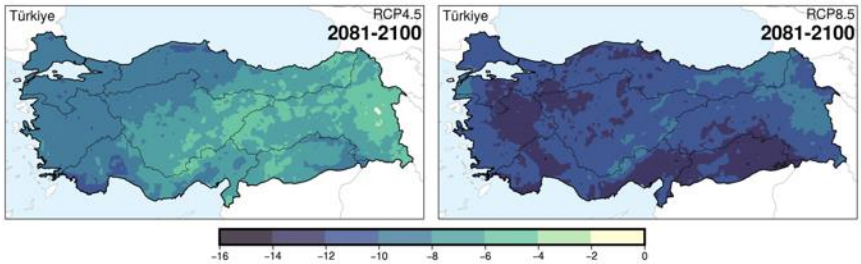
heat waves, particularly in the Eastern Anatolia Region, in the 2081-2100 period compared to the reference period.

*Figure 68 - Change in Heat Wave Frequency*[188]




The frequency of cold waves has been quantified using the Cold Wave Frequency Index (CWF) as shown in Figure 69. Both projected emission scenarios suggest that the frequency of cold waves will decrease in the future, with the reduction becoming more pronounced from east to west in Türkiye. The RCP4.5 scenario predicts that the number of days with cold waves in western Türkiye will decrease by 8 days in the 2081-2100 period, towards the end of the century. The RCP8.5 scenario, on the other hand, projects the greatest decrease in the number of cold wave days to occur in the 2081-2100 period, and this time over a larger area of the country. It is estimated that the number of days with cold waves, particularly in the Southeastern Anatolia, Mediterranean and inner Aegean Regions, will decrease by around 16 days compared to the reference period.

*Figure 69 - Change in Cold Wave Frequency*[189]



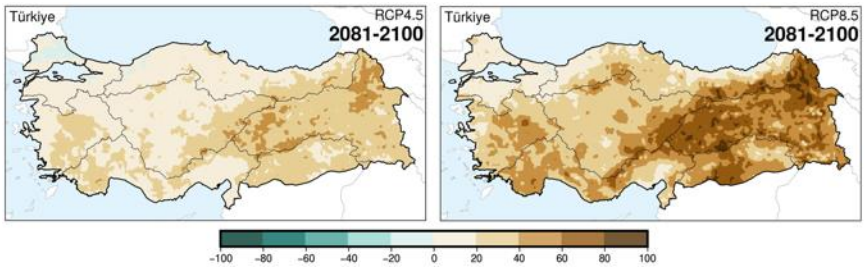

The 3-month Standardized Precipitation Evapotranspiration Index (SPEI3) was performed to assess the meteorological drought hazard (Figure 70). The SPEI index is a comprehensive drought index that considers both changes in precipitation and temperature. The analysis of the results indicates that arid conditions will become more prevalent in the future, compared to the reference period, under both emission scenarios. Towards the end of the century, it is expected that the drought will become more severe, particularly in the RCP8.5 scenario. By the 2060s, it

[188] Source: İklime Uyum Project, 2022

[189] Source: İklime Uyum Project, 2022

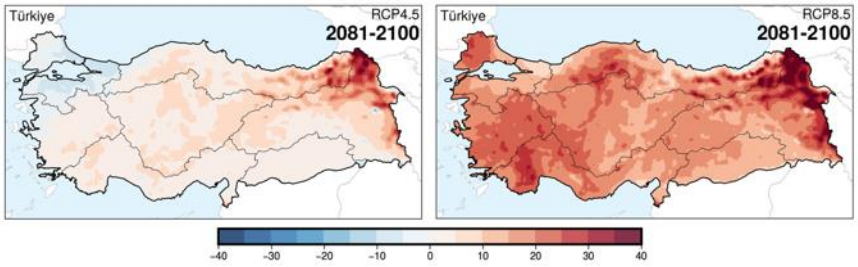
is projected that the increase in meteorological drought intensity will surpass 80% in the eastern and southeastern regions of Türkiye, particularly in the RCP8.5 scenario.

*Figure 70 - Change in Meteorological Drought Intensity*[190]




The Canadian Fire Weather Index (FWI) was calculated to assess the forest fire hazard (Figure 71). The results indicate that changes in fire-prone atmospheric conditions in Türkiye will be significant in the future, particularly in 2061-2080 and 2081-2100 periods of the RCP8.5 scenario, with an increase of 20-40% across the country. In contrast, the RCP4.5 scenario predicts a change of around +/- 20% across the country, but with a 40% increase in fire-prone weather conditions in the northeast of Türkiye during the 2081-2100 period.

*Figure 71 - Change in Fire Weather Severity*[191]

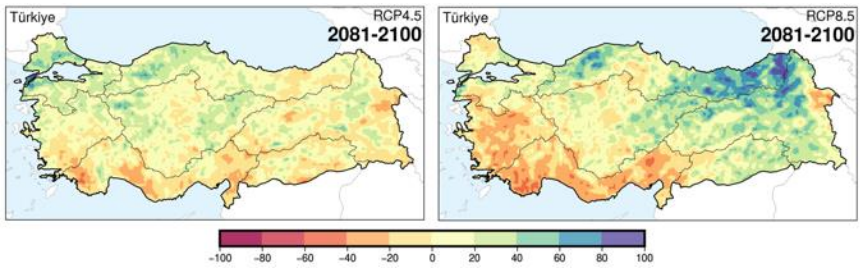



The heavy precipitation hazard was assessed using the R95P index, which represents the total amount of precipitation during the 95th percentiles of very wet days (Figure 72). Both scenarios predict an increase in the amount of heavy precipitation in northern Türkiye and a decrease in the south. The RCP4.5 scenario projects the greatest decrease in heavy precipitation in the Mediterranean Region in the 2061-2080 period, while the RCP8.5 scenario predicts the largest decrease, reaching 40%, in the 2081-2100 period. On the other hand, the highest increase in heavy precipitation is expected in the Eastern Black Sea Region and northern Eastern Anatolia, with the increase potentially reaching 100% in the last period of the century, according to the RCP8.5 scenario.

[190] Source: İklime Uyum Project, 2022

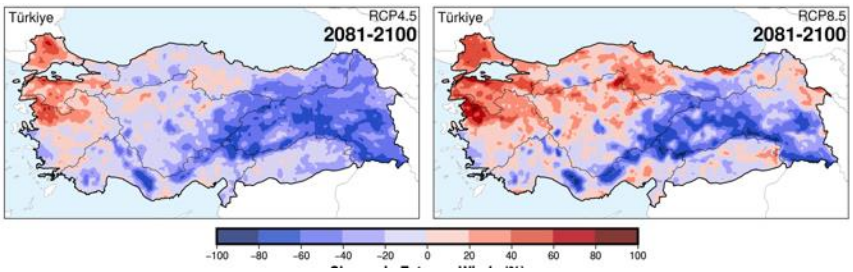
[191] Source: İklime Uyum Project, 2022

*Figure 72 - Change in Heavy Precipitation Amounts*[192]




The 98th percentiles of daily maximum wind speeds (W98) were calculated to assess the extreme wind hazard as shown in Figure 73. The simulations show an increase in the number of days with extreme winds in the Marmara, West and Central Black Sea, and North Aegean regions for both RCP4.5 and RCP8.5 scenarios. Conversely, it is estimated that a decrease in the number of extreme wind days will occur in the Mediterranean and Eastern Anatolia regions. The magnitude of these changes is expected to intensify by the 2060s for both scenarios. The RCP4.5 scenario predicts that by the end of the century, the increase in the number of days with extreme winds in the Marmara and North Aegean regions will reach 80%, while the decrease in Eastern Anatolia will be as high as 80%. The RCP8.5 scenario predicts an even greater increase, reaching almost 100%. The greatest increase in the number of days with extreme winds is anticipated to be seen in the Aegean Region for both scenarios.

*Figure 73 - Change in Extreme Wind Frequency*[193]




The first comprehensive multi-hazard analysis and multi-sector risk assessment has been conducted for Türkiye, to determine the changes in the frequency of extreme hazards that occur in return periods of 2, 10, 20, 50, and 100 years. The objective of this study was to identify areas that potentially vulnerable to the impacts of climate change. The methodology used in this analysis was first introduced by of Forzieri et al[194]. in 2016, who applied this approach to Europe. The study evaluated the frequency of extreme climate events at both the national level and four

[192] Source: İklime Uyum Project, 2022

[193] Source: İklime Uyum Project, 2022

[194] Forzieri, G., Feyen, L., Russo, S. et al. Multi-hazard assessment in Europe under climate change. Climatic Change 137, 105–119 (2016). https://doi.org/10.1007/s10584-016-1661-x

selected pilot province, with the results compared to the reference period. The projected outcomes of the climate hazards in Türkiye by the end of the 21st century are as follows:

- The heat waves show a progressive increase in frequency throughout Türkiye. A current heat wave event that occurs every 2 years is expected to be seen every year from now. Particularly, the RCP8.5 scenario predicts that the 100-year heat wave events during the reference period may occur every 2 to 3 years by 2050 and almost every year by 2100.
- As the frequency of heat waves increases across Türkiye, the frequency of cold waves is expected to decrease. According to the RCP8.5 scenario, the 2-year cold wave events of the reference period could occur every 4 to 10 years by the 2050s, and as infrequently as every 21 years by the 2070s.
- The drought will become more severe, and conditions will tend to become drier, particularly in the south and southeast of Türkiye by the end of the 21st century. According to both scenarios, droughts, which occur every 2 years in the reference period accross the country, are expected to occur almost every year in the future. Droughts, which occur every 10 years in the reference period, are expected to occur every 4 years from the 2030s, indicating that droughts will become almost permanent.
- Considering the weather conditions that are most conducive to forest fires in Türkiye, the RCP8.5 scenario predicts an increase in the frequency of forest fire conditions, particularly in the southern region. It is anticipated that forest fire conditions that currently occur every 2 years throughout Türkiye during the reference period will occur almost annually by the end of this century. Additionally, fire weather conditions that are seen every 10 years during the reference period are expected to happen every 5 to 6 years in the future.
- Heavy precipitation predictions show higher spatial and temporal variability. By the end of the century, heavy precipitation events may happen less frequently in the south of Türkiye, while more frequent events are expected in the north. According to the RCP8.5 scenario, heavy precipitation events that occur every 10 years in the reference period are expected to occur every 6 years towards the end of the century, and events that occur every 50 years are expected to occur every 25 years. However, due to regional differences in precipitation distribution throughout Türkiye, the frequency of heavy precipitation events will also vary regionally.
- While changes in extreme winds remain uncertain in the future period, a decreasing trend in frequency is expected by the end of the century in Türkiye. Both RCP scenarios predict a decrease in the frequency of extreme wind events in the future compared to the reference period. According to the RCP8.5 scenario, extreme wind events that occur every 2 years in the reference period are expected to occur every 6 years towards the end

of the century, and events that occur every 10 years are expected to occur every 18 years by 2050.

Climate change is causing an increase in the frequency, severity, and intensity of natural disasters, which have a negative impact on society, ecosystems, and sectors. As a result, society and various sectors are becoming increasingly vulnerable to extreme weather events. It's crucial to assess the sectoral vulnerabilities and risks and determine adaptation measures at the national level to mitigate the effects of these disasters.

## 6.2 VULNERABILITY AND RISK ASSESSMENT

Social and economic losses caused by weather and climate-related extreme events and disasters have been increasing in many parts of the world, including Türkiye, with significant regional and inter-annual variability. The nature, intensity and impact power of extreme weather and climate events and disasters closely depend on economic, social, geographical, demographic, cultural, institutional, and governance (e.g., adaptation) factors, environmental and ecological factors, as well as exposure and vulnerability levels varying at spatial and temporal scales.

A large part of Türkiye is located in the subtropical Mediterranean climate zone with dry summers. Türkiye is a country with a medium to high risk of climate change and future climate risks. In this context, there is a need for studies on the issues of climate monitoring, climate change vulnerability and risk assessments as well as adaptation measures to reduce the adverse impacts of climate change.

The first comprehensive climate change vulnerability and risk assessment of Türkiye was prepared in 2022 as part of the **"Enhancing Adaptation Action in Türkiye Project" (Iklime Uyum Project)**, with the MoEUCC as the beneficiary institution. The assessment was conducted at the national scale and in four pilot municipalities under 10 sectors, which are water resources management, agriculture, livestock and fisheries, ecosystem and biodiversity services, public health, urban, tourism and cultural heritage, energy, industry, transportation and communication, social development, with the cross-cutting disaster risk reduction sector. With the **Climate Promise Project**, which was completed in 2021 and whose beneficiary institution was the MoEUCC, sectoral risk analyses were conducted for seven geographical regions of Türkiye as part of the preparation of regional action plans, and a catalog of nature-based solutions was compiled to strengthen climate change adaptation and mitigation. Within the scope of the **Climate Change Disaster Management Project**, for which the Disaster and Emergency Management Presidency (AFAD), whose work began in 2020, is the beneficiary institution, multi layered hazard maps were prepared and vulnerability analyses were conducted on a national scale for the disaster sector in Türkiye.

In the vulnerability and risk assessment conducted for Türkiye as part of the İklime Uyum Project, drought, heavy precipitation, and heat wave hazards that have the most impact on the

country's sectors were analyzed. In the risk analysis, the sectoral indicators were calculated based on the conditions of the 1990-2019 current period. For the 2021-2100 future period risk analysis, the climate change risks of the sectors were determined according to the RCP4.5 and RCP8.5 scenarios, using current period sectoral indicators and climate projections.

The following sections present the results of vulnerability and risk assessments conducted for each sector, based on the selected climate hazards for the current and future periods.

### 6.2.1 Water Resources Management

The water resources sector in Türkiye is highly vulnerable to the impacts of climate change, which can also affect other sectors. To adapt to these changes, comprehensive measures must be put in place. In this context, the use of water resources in Türkiye, particularly in the agricultural sector, has been thoroughly analyzed to assess vulnerability and risk. The study identified the risks to water resources in Türkiye from drought and heavy precipitation climate hazards and evaluated the results for the current and future periods.

According to the study, the risk of drought in water resources is high or very high in the Western Marmara region, the southern provinces of the Central Anatolia region, the Eastern Mediterranean provinces, Southeastern Anatolia, and most of Eastern Anatolia during the current period. In the Aegean coastal provinces, the risk of drought is typically moderate. When the risk scenarios based on current sector indicators and future climate projections are analyzed, it is expected that the risk of drought in the Eastern Mediterranean, Southeastern, and Eastern Anatolian regions will remain similar.

When the results of the study assessing the risk of heavy precipitation in the water resources sector are analyzed, it is determined that the risk is extremely high for the current period in the Eastern Mediterranean region and the western and eastern Black Sea coastal provinces. There is also a significant risk of heavy precipitation in water resources along the coasts of the Northeastern Marmara, Mediterranean, and Aegean, as well as the western provinces of Southeastern Anatolia. The risk of heavy precipitation is moderate in the Central Black Sea region and low in the interior part of the country. After the 2060s, the risk of heavy precipitation is expected to reach extremely high levels, particularly in the northern Marmara region.

### 6.2.2 Agriculture

Türkiye is one of the most vulnerable countries to the impacts of climate change on agricultural and related food sectors due to its geographical location. The increase in frequency and intensity of climate hazards such as drought, heavy precipitation, and windstorms, as well as the average changes in climate parameters, have a direct impact on agriculture and the livestock sector. In accordance with research conducted on the scale of Türkiye, the country's drought risk was studied, and the results were analyzed for the current and future periods.

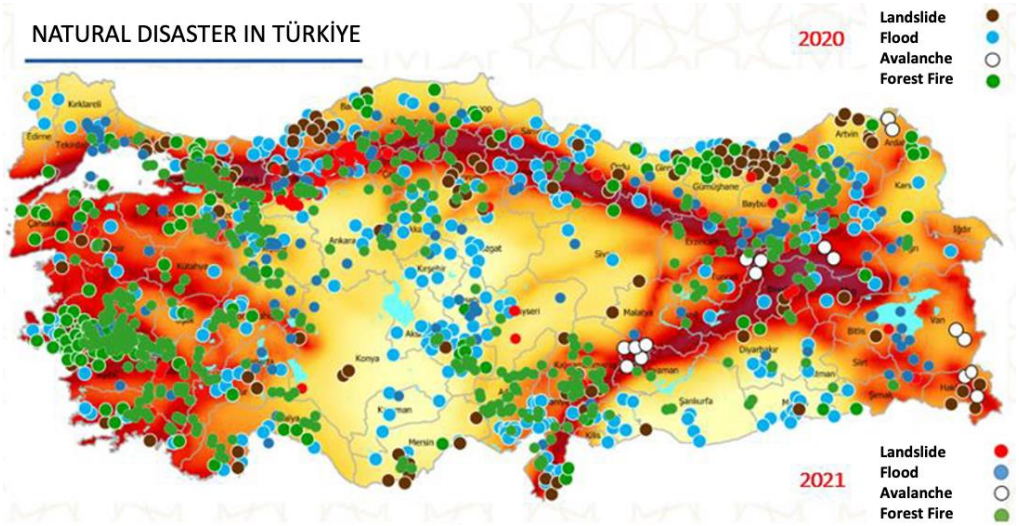
According to the findings of the studies, the western and eastern parts of the Central Anatolia Region, the provinces in the east of Eastern Anatolia, and a few provinces on the Eastern Mediterranean coasts have been identified as having a high or very high drought risk for crop yields during the current period. The risk of drought is at its lowest level in the provinces of Eastern Marmara and Central Black Sea, while it is low along the coasts of the Aegean and medium in the remaining regions. It is anticipated that the drought risk in the agricultural sector will gradually increase, particularly in the eastern Aegean Region.

Analysis of the current drought risk in the livestock sector shows that there is a high level of risk in areas where livestock is concentrated, such as Eastern and Southeastern Anatolia, Central Anatolia, and the Mediterranean coasts. It is expected that the drought risk will spread to almost the whole southern half of the country in the future.

### 6.2.3 Disaster Risk Reduction

Türkiye is highly vulnerable to various natural hazards due to its territory, natural and geophysical characteristics, including geology, topography, and climate. Of the 70 types of global natural hazards, most occur in Türkiye. Earthquakes and climate-related hazards (floods, mudflows, droughts, storms, wildfires, precipitation-triggered landslides, and erosions) have the largest share, followed by rockfalls and avalanches. In the last two years, major flood disaster events have occurred in the Western (Sinop, Bartin and Kastamonu) and Eastern Black Sea (Giresun, Rize and Artvin) Region and wildfires in the Southern Aegean (Muğla) and Mediterranean (Antalya) Region. The spatial distribution of natural disasters of Türkiye in 2020 and 2021 is given the Figure 74. (AFAD, 2022)[195]

*Figure 74 - Disaster Profile in Türkiye*




[195] AFAD, 2022. Mid-Term Review of the Sendai Framework: National Report of Türkiye. p.6

Türkiye is considered one of the most disaster-prone countries in Europe and the direct damages from disasters could amount to 3% of the national GDP or more than 3% when indirect losses are considered.[196] In 2019, a total of 935 extreme events (36% heavy precipitation/floods, 27% windstorms, 18% hail, including earthquakes) resulted in an annual average loss of 0.2% of GDP, compared to the OECD average loss of 0.09%.[197] Floods occur in all provinces of Türkiye, but in recent years the flood hazard has increased significantly, resulting in frequent flooding with greater magnitude, particularly in the most exposed areas such as the Kızılırmak, Yeşilırmak, Fırat, and Eastern Black Sea Basins. The most at-flood-risk provinces that experience with the greatest number of flood events since 1950 are Erzurum, Van, Bitlis (Eastern Anatolia) and Sivas (Central Anatolia). The worst affected province is Erzurum with 440 reported flood events followed by Sivas with 319, Van with 265, and Bitlis with 247 flood events. [198] During the period of 1970-2021, 43 major flooding events caused 758 human losses, affected 1,805 million people, and caused damages of 2.8 billion USD. [199]

In Türkiye, landslides are frequently occurred in the Eastern Black Sea region, specifically in the provinces of Trabzon and Rize and their surrounding areas, as well as in Erzurum and Giresun. Trabzon was most affected by landslides with a total of 1,673 recorded landslide events between 1950 and 2019 followed by Rize with 1,319, Erzurum with 939 and Giresun with 915 landslides in total.[200] Forest fires have become more frequent in recent years, caused both by prolonged heatwaves and temperature extremes, as well as human behavior. Approximately 60% of the forest land of Türkiye is exposed to forest fire hazards, with some provinces such as Antalya and Muğla experiencing disaster events more frequently with greater magnitude, particularly impacting local communities and ecosystems. [201] Additionally, in recent years, there has been an increase in other climate-related hazards such as heatwaves, windstorms, and heavy precipitation leading to coastal flooding. In Türkiye, storms occur particularly in the North Aegean (Balıkesir) and Western (Izmir) and Central Anatolia (Konya and Kayseri), Eastern Anatolia (Kars and Elazığ) Regions. [202]

### 6.2.4 Biodiversity and Ecosystem Services

Biodiversity and ecosystem services are comprised of multiple subcomponents, and the impact of climate change on each ecosystem service varies. As part of Türkiye's vulnerability and risk assessment at the national level, drought risk for species diversity, carbon storage, and wetland ecosystem services was analyzed for the current and future time periods.

---

[196] World Bank Group, 2022. *TÜRKIYE. Country Climate and Development Report*. p.23.
[197] World Bank Group, 2022. *TÜRKIYE. Country Climate and Development Report*. p.23.
[198] AFAD, 2020. 2019 Overview of Disaster Management and Natural Disasters Statistics. p.93.
[199] Risk and Resilience Portal, 2022: https://rrp.unescap.org/country-profile/TUR#paragraph-id--24424
[200] AFAD, 2020. 2019 Overview of Disaster Management and Natural Disasters Statistics. p.90.
[201] AFAD, 2022. *Mid-Term Review of the Sendai Framework: National Report of Türkiye*. p.11.
[202] AFAD, 2022. *Mid-Term Review of the Sendai Framework: National Report of Türkiye*. p.12.

According to studies indicating that all species inhabiting terrestrial ecosystems and inland waters will be negatively affected by the risk of drought, species diversity in the Eastern Mediterranean, the south of the Central Anatolia Region, the west of Southeastern Anatolia, and the northern provinces of Eastern Anatolia have a very high risk of drought during the current period. Drought threatens species diversity along the coastlines of West Marmara, the South Aegean-Mediterranean, and east of Central Anatolia. In future periods, it is anticipated that the risk in the southern part of the country will be high to extremely high.

Taking into account the current drought risk associated with the carbon storage ecosystem service, it is estimated that the drought risk is extremely high, particularly in the eastern Black Sea, western Marmara, and western Mediterranean. In the coastal provinces of the Northern and Southern Aegean and the Eastern Mediterranean, the risk is very high. Despite the fact that the risk of drought is lower in the north of the country than in the south, it is considered that carbon storage has a medium-to-high degree of risk in the provinces of this region due to the greater forest resources and wood production. It is expected that the drought risk of the carbon storage ecosystem service will expand and reach high-very high levels in the Western Black Sea provinces in the future.

Analyzing the current drought risk of wetland areas shows that Central Anatolia, East Anatolia, and Southeastern Anatolia have the highest and very highest risk levels. It is expected that the risk, particularly in the Eastern Anatolia Region, will increase and reach extremely high levels during the next few years. In the Northwest Marmara, where there is a high drought risk in the current period, it is anticipated that the risk will gradually decrease in the future. Consequently, risks such as a decrease in the ecosystem services provided by wetland ecosystems, the loss of biodiversity, and an increase in reed fires may occur in provinces with a high drought risk, depending on the risk status of wetland ecosystems.

### 6.2.5 Coastal Areas

The coastal areas of Türkiye are under pressure from population density and extensive migration. Climate change is expected to have a significant impact on coastal areas and result in an increase in sea water temperature, level, and acidification, and a decrease in oxygen concentration. Climate change affects marine ecosystems (decrease of seagrass, coral, phytoplankton, etc., which are important oxygen sources for our seas, migration of invasive species, negatively affecting the reproduction of species, etc.). Coastal cities and tourist areas are particularly vulnerable. The need for water in these areas is often met through underground reserves, but excessive use can lead to saltwater intrusion and negatively affect water resources used for agriculture. Sea level changes are important indicators of global climate change and are being monitored by the Turkish National Sea Level Monitoring Network (TUDES) which was also mentioned in Chapter 8. Additionally, the Coastal Vulnerability Index (CVI) analysis is being applied to all coastal and delta regions in Türkiye to assess the risk of sea level rise and related

disasters. Adana, Çanakkale, Samsun, Balıkesir, and Aydın are among the regions determined to be at the highest risk of land loss. Studies continue for potential land loss in Türkiye due to sea level rise. These studies estimate land losses that can be expected in Türkiye in terms of sea level increase scenarios. The results of the study show that the places to be affected the most by climate change on the coast are the delta areas. With the help of the CVI analysis, the areas that are most affected by sea level increases and disasters are determined, and the necessary precautions are taken to minimize the negative effects of these scenarios.

### 6.2.6 Public Health

When the effects of climate change on health are examined, the following cases show an increase. It is well known that infectious and vector-borne diseases are on the rise, and it is predicted that the number and spread of vectors such as mosquitoes and pathogenic microorganisms (malaria, dengue fever, yellow fever, and lyme disease) will increase virulence. Increases in zoonotic diseases like rabies, TB, HIV/AIDS, and measles are expected. Air pollution and heat stress, heatwaves and coldwaves are expected to cause an increase in respiratory tract infections, allergic diseases, obesity, chronic heart, diabetes, and hypertension diseases, as well as depression and mental health deterioration.

Conditions such as food poisoning, acute gastroenteritis, and contamination are expected to increase in areas where food safety cannot be ensured; in areas where water security cannot be ensured, it is expected to increase the spread of water-borne infections, the incidence of diseases such as cholera, typhoid fever, paratyphoid, viral gastroenteritis, food contamination, and deaths related to them.

Climate-related migration is likely to have negative health consequences for both displaced and host populations, particularly in cases of forced migration. However, when immigration and other forms of mobility are used as adaptation strategies, health risks are reduced and, in some cases, health gains are realized.

As a result, in order to mitigate the effects of climate change on human health, it is critical to be prepared for climate hazards such as heavy precipitation, extreme temperatures, as well as natural disasters (heat waves, and cold waves, floods, forest fires, etc). Strengthening early warning response systems is critical for increasing capacity to mitigate the effects of climate change on health, monitoring syndromic surveillance, prioritizing, vulnerability and risk assessment, risk communication, and increasing inter-agency cooperation and coordination, as well as increasing preparedness and capacity.

The impact of heatwaves on public health in Türkiye has been analyzed, along with vulnerability and risk assessment. Based on analyses evaluating population density and health management capacity, the Eastern Mediterranean, Southeast, and Southern regions of Eastern Anatolia have the largest heatwave risk for the health sector during the current period. The risk is high in the

hinterland of the Aegean and the southern regions of Central Anatolia, and it decreases toward the north. In the future, the southern part of the country is expected to see high-to-extremely high risks of heatwaves. In the adaptation plans, the necessity of strengthening the health system capacity of the Southeastern and Eastern Anatolian provinces and giving priority to the socio-economic development of the region emerges.

### 6.2.7 Urban Areas

When the cities of Türkiye are examined, the population change rates in the eastern and western cities are going in opposite directions. The shifting population size has a significant impact on urban areas. The increasing population in cities causes expansion in residential areas. In recent years, the expansion of residential areas has increased vulnerability to climate hazards that are becoming more severe and frequent as a result of climate change. Cities with steep topography and those developing in flood-prone locations are all vulnerable to heavy precipitation. Cities in the Black Sea Region, in particular, stand out due to their expansions seen in high-risk locations. The recent disasters have resulted in substantial loss of life and damage in the region's cities, which are at great risk of flooding. Coastal cities in the Mediterranean and Aegean regions, on the other hand, can experience significant losses in the face of heavy precipitation and windstorms. Furthermore, heatwaves represent a severe threat in the cities with few natural areas, no air corridors, hidden water lines, and dense populations. Because of their widespread urban forms, high densities, and growth patterns, metropolitan cities stand out in terms of this risk. For these reasons, the risks posed by climate hazards such as heavy precipitation and heat waves, which are common in the cities of Türkiye, were assessed as part of the vulnerability and risk analyses.

According to the findings of the current period, the heavy precipitation risk in the urban sector is high or very high in the Black Sea, Aegean, Mediterranean, and Southeastern Anatolia, as well as in the south of Eastern Anatolia. Cities located east of the Western Black Sea, in the Eastern Mediterranean, and in the north are the most hazardous. When the heavy precipitation risk is assessed for the future, almost all coastal cities, except for the Marmara Region and the Southeast Region, are expected to be at a high or very high risk.

The heatwave risk in urban areas has been found to be extremely high in the current period, particularly in cities located in the southern half of the country. Towards the north of the country, it is seen that the risk level in cities generally decreases. Cities in the Southeastern Anatolia Region are expected to have a very high level of risk, while other cities in the country's southern region are expected to have a high level of risk. As in the current period, the risk of heat waves is expected to be lower in the north than in the south.

### 6.2.8 Tourism and Cultural Heritage

The tourism sector in Türkiye has been evaluated based on tourist satisfaction, and the impacts of climate hazards on tourist satisfaction and, therefore, the number of tourists and tourism income have been examined. As a result of climate change, it is anticipated that tourist-serving components such as lodging, transportation, dining, and drinking would be most affected. In the vulnerability and risk assessment conducted in this context, the economic and social indicators of the value chain that assure visitor satisfaction are identified, and the potential losses in areas such as the number of tourists, tourism revenue, and employment rate are analyzed as risks.

The cultural heritage sector in Türkiye has been evaluated based on the vulnerability of cultural assets with an upper scale range in terms of hazards (climate drivers), exposure, sensitivity, and adaptive capability of cultural assets. It was not feasible to offer a full risk analysis due to the limitations e.g. short time available to evaluate climate impact on cultural assets and a lack of data. As a result, the scope of this report is narrowed to variables with high informative potential, as well as their features and general indicators for monitoring the effects of climatic hazards on cultural assets.

In the current period, the heatwave risk was determined to be extremely high, particularly in the southern Aegean and Mediterranean coasts of the country, the south of the Central Anatolian Region, the Eastern Mediterranean Region, and the western provinces of the Southeast. Nonetheless, the risk is high in the coastal and interior parts of the Aegean, the Southwest Marmara, the capital of Türkiye, as well as surrounding provinces, and the northern part of the Southeast. It has been found that the risk of heat waves is lowest in the northern and northeastern regions of the country. In the future period, it is anticipated that the risk will spread to the north and northeast of Central Anatolia, but in a similar pattern to the current period.

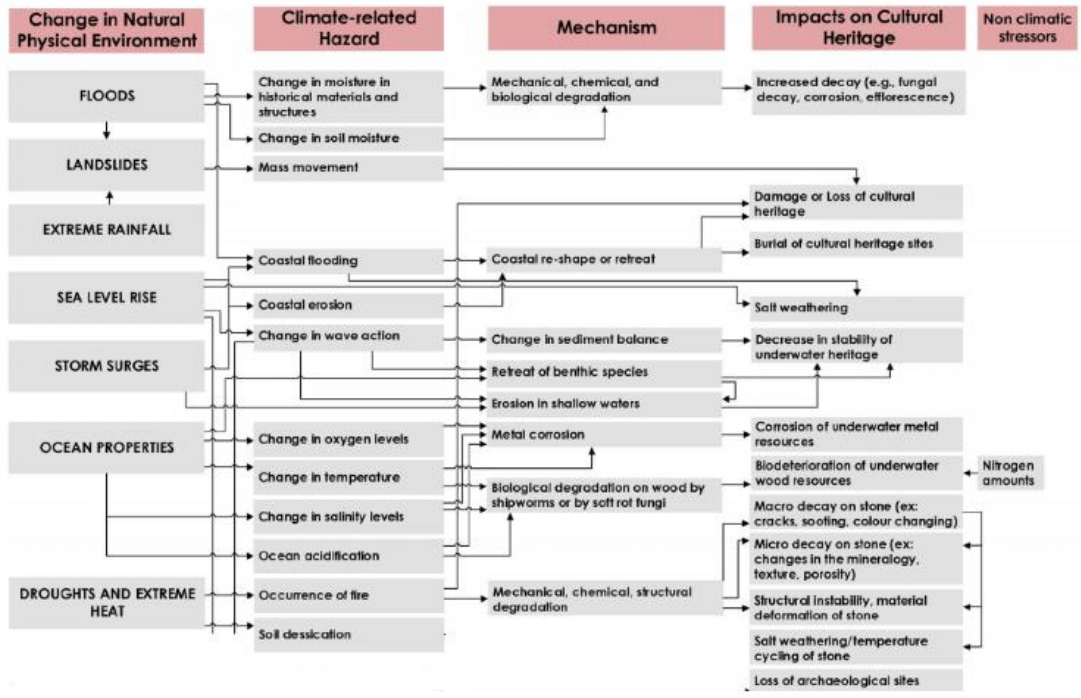
The likelihood of wildfires is increased due to coexistence of drought and extreme heat events. Despite the fact that the fires in the Aegean and Mediterranean in 2021 damaged our natural heritage sites, cultural heritage sites did not suffer substantial damages. However, cultural values and natural values are inseperable in tourism percpective because they collectively influence the destination preference of visitors and tourists. Climate hazards related to temperature continues to put cultural heritage sites at jeopardy in terms of building degradation due to soot accumulation, cracking, or fragmentation on the surface by thermal expansion and contraction (thermoclastism). Eventually, extreme heat events and increased fluctuations (severity & intensity) lead to exacerbated degradation processes in stones at both the macro (cracking, discolouration of stones containing iron) and micro scales (mineralogical and textural changes).

The likelihood and amplitude of floods triggered by drought and unexpected heavy rains caused by climate change, as well as changes in groundwater, represent a substantial risk to cultural

monuments, particularly in sloping terrain and near the coast. Following the earthquake catastrophe in 2023, flood events occurred in Turkiye's south and southeast provinces where considerable number of multi-layered cultural heritage sites are exist. These occurrences have the potential to significantly exacerbate moisture-induced degradation in historical materials and structures. Flooding at museums and archives may result in the permanent loss of artifacts made of organic materials e.g. wood, bone, archival documents etc. It has the potential to cause significant harm to historic monuments as well as irreversible damages in scientific evidence in ongoing archaeological excavation sites. The historic regions that comprise archaeological and traditional architectural building groups comprising unfired earthen building materials such as adobe would surely be the most endangered sites by the floods.

Türkiye's provinces represent every stage of human history and all monotheistic religions coexisting for centuries without conflict. Each region has significant heritage values, including artistic and aesthetic value, age value, archaeological research value, symbolic value, technical value, authenticity value, continuity value, documentary value, economic value, environmental value, existence/being value, functional value, historical value, impression value, informative value, mythical value, location value, memorial value, political value, and rarity value. These values must be preserved in line with international conventions and agreements, such as the Venice Charter, Burra Charter, Athens Charter, and Nara Document. Therefore, preserving cultural assets is critical to promote the appreciation of common cultural values, identity, inclusiveness and tolerance to support the overall sustainable development. The risk of loss in abovementioned heritage values also put tourism volume and revenue of Türkiye to reduced diversity in touristic activities and visiting areas.

*Figure 75 - Changes in the natural physical environment affecting cultural heritage (Sesana, et al., 2021)*[203]




### 6.2.9 Energy

Climate change is anticipated to impact the energy sector in three ways: energy resources, energy infrastructure, and energy demand. Within the scope of the vulnerability and risk analyses for the energy sector in Türkiye, the risk of heat waves and drought has been assessed. The change in average temperatures impacts energy supply and consumption. While heat waves cause peak electricity demand, they can also cause damage to electricity transmission and distribution lines.

Based on the climate change scenarios, it is estimated that there will be changes in many parameters such as precipitation, temperature, vegetation, and humidity. Changes in these parameters may also lead to changes in the design parameters of power plants, and as a result, risks such as loss of efficiency, access to water resources, and an increase in costs may occur. Studies have determined that climate change poses a serious risk for energy security, and these risks create a negative environment for both investors and financial institutions in the energy market. In order to compensate for the efficiency and operational losses that may occur due to changes in temperature and humidity, additional investments will be needed to commission. Climate change leads to increased energy demand for cooling, so vulnerability and risk maps for

[203] Sesana, E., Gagnon, A. S., Ciantelli, C., Cassar, J., & Hughes, J. J. (2021). Climate change impacts on cultural heritage: A literature review. Wiley Interdisciplinary Reviews: Climate Change, 12(4), e710. : https://wires.onlinelibrary.wiley.com/doi/full/10.1002/wcc.710

energy generation and transmission infrastructure are needed to be determined. A national inventory of critical energy infrastructure, including information on climate change vulnerability, consequences of asset loss, and dependencies with other critical assets, will be determined. Identifying sites in water-stressed areas, assessing their water footprint, and locally confirming the water stress will result in a reduction in their water footprint.

According to the analysis of heat wave risk conducted in this context, the risk is extremely high in the southern provinces of the country during the current period. The risk is especially high in the Mediterranean Region, the southern provinces of Central Anatolia, including the capital city of Türkiye, and the Aegean coast. The risk is low in the northern half of the country. It is anticipated that the heat wave risk will be increased in the future, particularly in the eastern portion of Central Anatolia and the provinces of Southeastern and Eastern Anatolia.

Drought or water scarcity also has a negative impact on energy resources, particularly hydroelectric power plants that rely on waterpower. In the Eastern and Southeastern Anatolia lines, where hydroelectric power plants are located along Türkiye's largest rivers, the current drought risk in the energy sector has been determined to be extremely high. Moreover, the risk is extremely high in the Eastern Mediterranean and Southwestern Marmara; high and moderate in the Mediterranean, Central Anatolia, and Aegean regions, respectively. It is also expected that the future period's risk will follow a similar pattern to the present period.

Türkiye has currently no nuclear power plant (NPP) in operation. The construction activities for Akkuyu NPP, located by the Mediterranean Sea, continue. A second NPP is planned to be built in Sinop by the Black Sea. All required vulnerability and risk assessment studies of NPPs due to climate change are carried out in accordance with national legislation and the International Atomic Energy Agency's (IAEA) documentation and recommendations. For instance, during the siting activities of Akkuyu NPP, comprehensive coastal flooding investigations were carried out, including tsunamis, seiches, storm surges, tides, waves, and sea level rise due to global warming. The extreme meteorological hazards at Akkuyu NPP Site, including storms, heavy precipitation (impacting hydrological events), extreme temperatures (air and water), lightning, and small tornadoes and waterspouts, were also investigated.

### 6.2.10 Industry

Extreme weather events, which are occurring more frequently and with greater intensity as a result of climate change, have a significant impact on the industrial sector in Türkiye. It is crucial to identify the negative effects of climate hazards, such as drought, heavy precipitation, and heat wave, on the sector and to strengthen its adaptability. Climate change will have a negative impact on industries that rely on agriculture and water resources for production. In addition, it is estimated that climate change may cause changes in heating and cooling energy demand and energy supply as a result of changes in average temperatures, as well as short-term job losses

due to extreme weather events. Accordingly, a vulnerability and risk analysis were conducted for the industrial sector in Türkiye based on the drought and heavy precipitation hazards.

Following the analyses conducted, the heavy precipitation hazard in the industry sector during the current period is particularly high in Organized Industrial Zones and locations with a large number of industry workers. Consequently, it was identified in high and extremely high-risk levels in the provinces around the Black Sea, Aegean Sea, and Mediterranean Sea. The heavy precipitation risk is also increased in the western Mediterranean and its hinterlands, as well as in the eastern regions of Central Anatolia. Considering the risk of heavy precipitation for the industrial sector in the future, a pattern similar to the current period is predicted.

In the west of Central Anatolia, Northern Central Aegean, the Eastern Mediterranean, and Southeastern Anatolia, the industrial sector in Türkiye faces a very high risk of drought during the current period, according to the vulnerability and risk assessment. However, drought risk is significantly lower in northern regions. The future period will also show a similar trend to the current period, the risk is predicted to increase in the center of the Aegean Region.

### 6.2.11 Transportation and Communication

Damages and disruptions in transportation and communication infrastructure and activities caused by climate hazards and exacerbated by climate change have the consequence of affecting all economic and social activities, education, health, and emergency services. In order to adapt to these negative consequences, vulnerability and risk analysis for the transportation and communication sectors in Türkiye were primarily studied with the heavy precipitation and heat waves hazards.

In the vulnerability and risk analyses of the transportation sector, the risk of heavy precipitation was determined to be high and very high along the central and eastern Black Sea, Aegean, and Mediterranean coasts, the south of central Anatolia, and the east of southeast Anatolia. While the risk in the future will show a similar pattern to the current period, it is expected to reach a high level in Southeastern Anatolia. It has been assessed that the risk of a heat wave in the transportation sector during the current period is high and very high in the western and southern regions of the country. When the future heat wave risk is examined, it is expected that it will diminish in the northwest and shift to the southern half of the country.

When the heavy precipitation risk in the communication sector is examined for the current period, it is determined that the risk is high and very high in the coastal provinces of the central and eastern Black Sea, the Aegean, and the Mediterranean. In the future, it is anticipated that the risk would increase by one level in the North Aegean and West Mediterranean provinces. According to the heat wave risk in the communication sector, the risk is high in the Aegean, Eastern Mediterranean, and Southeastern Anatolia regions during the current period, while it is low in the north-eastern region of the country. Southeast Anatolia is expected to reach a very

high-risk level in the future period, while the South Aegean will maintain its high and very high-risk levels.

Climate change has a range of potential impacts, including sea-level rise. This will have significant and far-reaching consequences for many coastal and developing states, which are particularly vulnerable to the effects of rising sea levels. Maritime transport is responsible for more than 80% of the world's trade capacity and is of huge importance to developing countries, accounting for around 60% of goods loaded and unloaded globally. Due to their location, ports are particularly exposed to a variety of natural disasters that make them vulnerable to the effects of climate hazards such as rising sea levels, storm surges, waves, and winds, fluvial and pluvial flooding, and tectonic events. Considering the critical role of ports in the global trading system and their potential exposure to climate-related damage, enhancing their climate resilience is a matter of strategic socio-economic importance for the global economy and society (UNCTAD, 2020a). Improving ports' climate resilience is also key to enabling Turkish coastal areas and islands to explore and harness the full potential and benefits of the blue economy for sustainable development. Türkiye's ports are crucial for external trade, food and energy security, and tourism – often a major driver of economic growth and development, as well as in the context of Disaster Risk Reduction. Ports also provide vital socio-economic linkages and are key to regional connectivity. Regulations and projects for marine energy efficiency, decarbonization and renewable energy resources are expected to provide significant side benefits in terms of climate change mitigation and adaptation, as well as reducing reliance on energy imports and related expenditures.

## 6.3 ADAPTATION MEASURES

### 6.3.1 Domestic Adaptation Policies and Strategies

In terms of international responsibilities, Türkiye continues to fulfill its international commitments as a party to the **UNFCCC**, the **Kyoto Protocol**, and the **Paris Agreement**.

Türkiye has made progress in climate change adaptation studies, since submitting its **7th NC** to the UNFCCC Secretariat in 2018. This progress has been made at the national level, in local administrations, and in different sectors.

Türkiye has published its **Climate Change Adaptation Strategy and Action Plan (2011-2023)** in 2012. In line with changing needs, Türkiye is updating this Climate Change Adaptation Strategy and Action Plan by conducting comprehensive impact, risk and vulnerability assessments in prior sectors. In recent years, Türkiye has experienced extreme weather events and related disasters. As a result of the extreme floods that occurred in the Black Sea region, Türkiye has intensified its efforts on regional climate change adaptation studies and announced the **Black Sea Region Climate Change Action Plan** in 2019 in order to increase urbanization resistance to climate change as an emergency action plan. This subject has been defined as a

target in the **Türkiye's 11th Development Plan (2019-2023)**. In this regard, Türkiye prepared Regional Climate Change Action Plans in 2020 for all seven geographical regions in order to identify the regional action needs and solutions. MoEUCC has set a target of preparing **Local Climate Change Action Plans** in 30 Metropolitan Municipalities by 2023. In this regard, the Ministry is preparing legal and technical infrastructure, building the capacity of all stakeholders, and mainly supporting the local governments through various projects.

Türkiye organized a **Climate Council** between 21-25 February 2022 in Konya to discuss all aspects of climate change which deeply affects Türkiye and the world, to establish special working groups on climate change, to contribute to setting medium and long-term strategic targets, to receive opinions and suggestions of stakeholders and finally to draft recommendations. The Climate Change Adaptation Commission and the Local Authorities Commission were two commissions of the Council and several decisions were taken regarding the adaptation. Proposals of Council put forward to develop policy proposals for the draft Climate Law and other legislation, as well as to determine the sectors' strategic targets and primary actions of institutions. In this context, the **Climate Law**, which will form the legal framework for combating climate change in Türkiye, including adaptation to climate change, is being prepared in accordance with the long-term goals of Türkiye.

Considering the existing regulations in terms of climate change adaptation; the relevant legislation and institutional regulations address climate change either considerably directly or indirectly. From the point of view of climate change adaptation, the primary legislation containing direct provisions is the **Environmental Law** and the **Law on Soil Conservation and Land Use**. While the **Energy Efficiency Law** and the **Law on Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy** directly address climate change, they contain provisions on emission reduction and indirectly refer to climate change adaptation. On the other hand, numerous laws concerning various sectoral areas that are in effect contain direct and indirect provisions supporting adaptation to climate change.

Some of the regulations which were considered to have an important place in policy planning for climate change adaptation, prominent on the basis of the Environmental Law, and the enforcement for which the MoEUCC is responsible may be exemplified as follows: legislation on air, water, soil, chemicals, and waste management, **Regulation on Making Spatial Plans**, and **Strategic Environmental Assessment (SEA) Regulation.**

The planning processes and the strategic environmental assessment process are implemented concurrently in almost all sectors across the country. Accordingly, the plans (strategies, development programmes, management plans, regional plans, master plans, action plans, spatial plans, etc.) in preparation have begun to take the SEA scope into consideration.

By-law on Strategic Environmental Assessment (SEA) entered into force with its publication in 4 April 2017. This By-law comprises administrative and technical procedures and principles regarding applying, having applied, monitoring and providing training Strategic Environmental Assessment for plans and programmes which are prepared in the field of agriculture, forestry, fishery, energy, industry, transport, waste management, water management, telecommunications, tourism spatial planning and which sets framework for the projects and activities defined in Annex I and II of the By-Law on Environmental Impact Assessment in force.

The new by-law on EIA entered into force with its publication in 2022. With the new by-law on EIA, it is now mandatory to prepare a Greenhouse Gas Reduction Plan and to evaluate the impacts of climate change under the "**Sustainability Plan**" within EIA reports.

In addition to UNFCCC, a range of international and international/regional treaties to which Türkiye is a party are directly and indirectly related to climate change adaptation. Today, the implementation of international treaties on nature conservation is considered in conjunction with the elements of climate change response; empowering changes are also taken on climate change response at the international level within the framework of such agreements. Such treaties to which Türkiye is a party are the United Nations Convention to Combat Desertification, United Nations Convention on Biological Diversity, Convention on Wetlands of International Importance especially as Waterfowl Habitat, Convention on the Protection of the Black Sea against Pollution (Bucharest Convention), European Landscape Convention (Florence Convention), Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention), and Antarctic Treaty - Protocol on Environmental Protection to the Antarctic Treaty.

### 6.3.2 Information, Capacity Building and Education

The **"Enhancing Adaptation Action in Türkiye" (Iklime Uyum Project)** project is being conducted between 2019 and 2025 with a focus on national, local, and capacity building objectives. In the scope of this comprehensive project; "Türkiye's Climate Change Adaptation Strategy and Action Plan" is being updated, the vulnerability and risk assessments and climate change adaptation action plans are being prepared for four pilot cities, guidelines are being prepared for cities with different typologies, workshops and trainings are being held with the participation of all stakeholders, "Climate Change Platform" which will gather all data and provide a network for all stakeholders is being established within the scope of technical components.

The **"Training for the Institutional Capacity Building on Climate Change Adaptation" (Iklimi Duy Project)** was completed between 2020 and 2021. Within the scope of this project, it was aimed to strengthen the capacities of the institutions that are members of the Climate Change and Air Management Coordination Board (CCAMCB) which is former structure of Climate

Change and Adaptation Coordination Board (CCACB). Four training modules were developed and personnel from the Municipalities and the CCAMCB Member Organizations were trained. In addition, an Education Portal was published as part of the project.

**"Enhancing Required Joint Efforts on Climate Action Project" (IklimIN Project)** was completed in 2020 after being initiated in 2017. Within the scope of this project, a comprehensive training programme was implemented to provide technical assistance on capacity building and raising awareness of climate change among the target groups through effective communication measures and the immediacy of joint climate action in order to manage and monitor the **"Capacity Building in the Field of Climate Change in Türkiye Grant Scheme"**.

Since 2009, the educational activities of The Union of Municipalities of Türkiye (TBB) have been carried out under the corporate identity of "Municipal Academy"; trainings are provided for appointed and elected managers and personnel of municipalities, subsidiaries, and their affiliates; and symposiums, congresses, workshops and various events are organized.

The main purpose of the Municipality Academy's training activities is to correctly identify the municipalities' training needs and to ensure that these emerging needs are met through the most appropriate training method. The Municipality Academy provides extensive training on climate change, environment, and energy issues. Approximately 100,000 municipal personnel benefit annually from these activities.

### 6.3.3 Implementations and Actions

Türkiye is in the process of updating its Climate Change Adaptation Strategy and Action Plan by conducting comprehensive climate change impacts, vulnerability, and risk assessments and developing national adaptation measures for various sectors. This process involves analyzing the potential impacts of climate change on various sectors, such as water resources, agriculture, biodiversity and ecosystem services, public health, urban, tourism and cultural heritage, energy, industry, transportation, and communication, as well as identifying the vulnerabilities and risks associated with these impacts. Based on these assessments, Türkiye is developing a range of adaptation measures to reduce the negative impacts of climate change and improve the resilience of these sectors to future climate-related risks. These measures could include building new infrastructure, enhancing existing systems and practices, promoting research and development, and implementing policies and regulations to support adaptation efforts.

The following sections outline the studies and adaptation measures, plans and strategic targets undertaken by relevant institutions to increase the capacity to adapt to climate change in specific sectors.

#### *6.3.3.1 Water Resources Management*

Türkiye, located in the Mediterranean Basin, is facing significant challenges related to the impacts of climate change on its water resources. The country is particularly vulnerable to climate change, with irregular precipitation regimes and rising temperatures putting pressure on already scarce water supplies and affect the quality of water for various uses. To protect water resources in terms of quality and quantity and to ensure fair water sharing, river basin management plans and sectoral water allocation plans are made and followed for 25 river basins in the country. In order to address these challenges, it is necessary to prioritize and implement a variety of adaptation measures and water management practices by developing projects.

Below are the climate change adaptation projects in the water resources management, conducted by the Ministry of Agriculture and Forestry, the General Directorate of Water Management (GDWM), the General Directorate of State Hydraulic Works (DSI), the Turkish Water Institute (SUEN), the MoEUCC and TUBITAK-MAM.

One of these projects is the **"Climate Change Impact on Water Resources Project"** which aimed to identify the impacts of climate change on surface water and groundwater in Türkiye on the basis of river basins and determine the adaptation activities. As mentioned in the 7th NC, the project was launched in 2013 by the Ministry of Agriculture and Forestry, General Directorate of Water Management (GDWM), Department of Flood and Drought Management, to address the problems of population growth, lack of appropriate resource availability, overutilization, declines in groundwater reserves and pollution. The projection period of the studies carried out for 25 river basins covers the years between 2015 and 2100. The project includes several key components such as climate change projections, hydrologic and hydraulic modeling, and sectoral vulnerability analysis. The studies were carried out by running a regional climate model using data sets of 3 global climate models under RCP4.5 and RCP8.5 emission scenarios. Climate projections under these scenarios were transferred to the National Water Information System (TRNWIS), which was developed by DGWM in 2017 and is commonly used by the decision-makers as a decision support system, to visualize the outcomes of the projections. The outcomes were used to determine the surface flow data in the basin, amounts of surface water and groundwater potential and the potential changes in hydrometeorological parameters caused by climate change. Sector-specific vulnerability analysis (drinking water, agriculture, industry, ecosystem main sectors) were also carried out in 3 pilot river basins. The project resulted in recommendations for adaptation activities and a "Climate Water Database" was created to store all the data produced during the project which is accessible through the TRNWIS (Turkish National Water Information System) application.

Another project is the "**Assessment of Climate Change Impacts on Snowmelt and Streamflow Project**" which is a comprehensive study designed to assess the impacts of climate change on snow cover and streamflow in the Upper Euphrates Basin in Türkiye, conducted by the GDWM.

The Euphrates Basin, where mainly covers the majority of the Eastern and Southeastern Anatolia, is a key water resource for the region, with a significant portion of the annual runoff coming from snowmelt. However, climate change is expected to lead to a reduction in snow cover, which could have adverse impacts on water resources. The aim of the project is to understand these impacts and develop strategies for addressing them. Within the project, snow observation data were collected, naturalized daily streamflow was estimated, snow characterization was determined, and satellite images were used to generate snow depletion curves. The MPI-ESM-MR climate model with 10 km resolution was used to project changes in snow-covered areas, snow-water equivalent, and runoff caused by snowmelt, projections of snowmelt-induced peak discharge timing and shifts and amount of low-flow period flow and their temporal projections under RCP4.5 and RCP8.5 scenarios. This information was used to understand the impacts of climate change on snowmelt and streamflow and to develop projections for the period from 2020 to 2100. Overall, the project aims to provide valuable insights into the impacts of climate change on water resources in the Euphrates Basin and to help inform the development of adaptation measures that can help to mitigate these impacts.

**"Adaptation to Climate Change in Water Resources Project"** is another project being conducted by the GDWM that began in 2021 and is expected to be completed by the end of 2023. This project aims to conduct cost-benefit, technical feasibility, and sustainability analyses of rainwater harvesting and greywater reuse. These techniques can help to reduce the demand on freshwater resources and ensure a more reliable supply of water. The project will also develop applicable water pricing scenarios and measures and recommendations to reduce water usage, taking into account the impacts of climate change. The study area for the project is 30 provinces with metropolitan municipality organization in Türkiye. By addressing the impacts of climate change on water resources through the adaptation measures, it is possible to ensure a reliable and sustainable supply of water for the region.

The GDWM prepares **"Drought Management Plans"** for basins in order to minimize the negative effects from potential drought risks. These plans aim to identify precautions that can be taken in the event of water shortages, as well as measures that can be taken before, during, and after a drought to quickly resolve drought problems. The Drought Management Plans are being prepared specifically to individual basins. The goal is to complete the Drought Management Plans of 25 basins in Türkiye by the end of 2023. The follow-up of the implementation of the measures included in the completed Drought Management Plans is monitored every 6-month. In addition, the outputs of this project is planned to be included in TRNWIS for effective management and decision-making purposes.

In order to protect and achieve good water status in all surface and groundwater bodies and to ensure sustainable use of water resources, Türkiye is preparing **"River Basin Management Plans"** in accordance with the EU Water Framework Directive. With River Basin Management

Plans, it was aimed to perform the categorization and classification of basin-based water bodies, reveal the characteristics of the basin, determine the pressures and impacts on water resources, carry out monitoring studies and determine the status of surface and groundwater bodies, set environmental objectives, and prepare a program of measures to achieve good water status for all water bodies in the basin. As of 2021, River Basin Management Plans have been prepared and came into force in 11 river basins (Meriç Ergene, Susurluk, Akarçay, Konya, Gediz, Küçük Menderes, Kuzey Ege, Burdur, Batı Akdeniz, Yeşilırmak, Akarçay). Preparation of River Basin Management Plan studies is ongoing in 7 basins (Sakarya, Marmara, Doğu Akdeniz, Antalya, Batı Karadeniz, Doğu Karadeniz, Kızılırmak) and will be completed for all 25 river basins in Türkiye. The outputs of the completed River Basin Management Plans can be monitored in TRNWIS by decision-makers. As the other River Basin Management Plans are completed, the outputs of these management plans will be transferred to TRNWIS for effective, comprehensive and catchment-scale management of water resources.

Besides increasing storage capacity through the construction of traditional dams and ponds, Türkiye is also exploring the use of underground dams as a nature-based adaptation approach to water resource management. According to the **"Groundwater Artificial Recharge and Underground Dams Action Plan"** prepared by the Ministry of Agriculture and Forestry, 100 underground dams will be built by 2023 in many cities across the Türkiye such as İzmir, Aydın, Mardin, Ankara, Konya, Çankırı, Malatya, Elazığ, Edirne, Tekirdağ, Bartın and Balıkesir. These underground dams will store approximately 50 million $m^3$ of water, which can be used for drinking water or irrigation. If all this water is used for drinking water, it will provide 750,000 people with access to clean drinking water. If it is used for irrigation, it will irrigate 8,000 hectares of land and result in an increase of 60,000,000 TL in annual net income. The use of underground dams will not only contribute to the water reserve of Türkiye, but also provide a reliable source of water for drinking and irrigation, resulting in increased net income for the region.

To address the increasing demand for water and the drought risks, the "**Action Plan for Domestic and Industrial Water Supply of 81 Provincial Centers (2008-2012)**" was revised in 2020 to evaluate all needs until 2055. This allowed for the identification and prioritization of provinces that may experience water shortages in the coming years for future studies. In order to effectively manage water resources and ensure a reliable supply of clean water for various uses, it is important to adopt principles of conservation, reuse, and recycling. This can involve using water efficiently, reusing water in different processes, and purifying and recycling water. According to the Regulation on the Control of Water Losses in Drinking Water Supply and Distribution Systems, metropolitan and provincial municipalities must reduce their water losses to a maximum of 30% by 2023 and to a maximum of 25% by 2028. Other municipalities are required to reduce their water losses to a maximum of 35% by 2023, to a maximum of 30% by 2028, and to a maximum of 25% by 2033. The average loss rate in Türkiye currently stands at

35%, but efforts are being made to reduce this rate in line with these targets. By reducing water losses, it is possible to achieve a reduction in water production costs of 20%-40%, making water more affordable for users and providing resources for infrastructure investments. The DSI has already completed 370 drinking water facilities that have supplied 4.9 billion $m^3$ of drinking, domestic, and industrial water. When the other plants currently under construction, planning, or in the project phase are completed, an additional 2.6 billion $m^3$/year of drinking water will be provided by the DSI. This will bring the total supplied drinking, domestic, and industrial water to a level of 7.5 $m^3$/year per capita per year.

One strategy for addressing the challenges of decreasing water resources in Türkiye is the reuse of treated wastewater. **Wastewater reuse** is becoming increasingly important in Türkiye as the country's surface and underground water resources are decreasing due to increasing water demand from population growth, drought, and excessive use of water in industry and agriculture. The MoEUCC has set a goal of increasing the reuse rate of treated wastewater to 4% by the end of 2022, 5% in 2023, and 15% until 2030. As of the first half of 2022, the target has already been exceeded, with the reuse rate of treated wastewater reaching 4.75%. Treated wastewater is being reused in a variety of applications, including irrigation, industrial use, groundwater recharge, recreational uses, and domestic and industrial applications. By reducing water use and reusing treated wastewater, Türkiye is working to protect its water resources in line with the principles of the circular economy. In addition, while 46% of the sewage sludge that was produced in the year 2021 was used as soil conditioner for improving the soil characteristics within the scope of circular economy, Türkiye aims to increase this ratio to 98% until 2030.

In effort to effectively manage water resources and ensure a reliable supply of clean water for irrigation, Türkiye has implemented various strategies and projects. These include the development of efficient irrigation systems, such as the use of piped water distribution networks and closed irrigation networks, as well as the installation of flow meters to track and manage water usage. These efforts have already resulted in significant water savings, with an average of 18% in tubular irrigation networks and 38% in irrigation facilities that charge on the basis of volume. According to the studies carried out in Türkiye, the land area that can be irrigated technically and economically is 8.5 million hectares, and 6.4 million hectares of this area have been opened for irrigation. The irrigation projects in the investment program are reviewed, and the possible open irrigation systems are transformed into closed irrigation networks to save water and improve the overall efficiency of water use in agriculture. Türkiye is also working to encourage farmers to adopt these efficient irrigation methods and to provide necessary facilities to support the transition. The **"Effective Use of Water in Agriculture Program"** continues to study and implement strategies to **save water in irrigation**.

In addition to these efforts, Türkiye is also working to reuse treated wastewater in agricultural irrigation. With the increasing population and developing industry, the need for clean water is

increasing rapidly, while clean and accessible water resources are decreasing. As a result, it is important to recover wastewater through the principles of circular economy and integrated water resource management. By the end of 2021, 24 Wastewater Facilities had been built in Türkiye, treating and reusing 322,659 m³ of wastewater for agricultural irrigation. Overall, 7 billion $m^3$ of wastewater is treated annually in the existing Wastewater Treatment Plants in Türkiye, with approximately 2 billion $m^3$ of this treated wastewater being able to be used for agricultural irrigation after it has been disinfected and meets irrigation criteria. According to the "**Evaluation of Reuse Alternatives for Used Water Project"** carried out by the GDWM between 2017-2019, 5.6 billion $m^3$/year of wastewater treatment plant effluent with a capacity of 2,000 $m^3$/day or more has a reuse potential in Türkiye. After prioritization, it was determined that 3.3 billion $m^3$/year of this amount can be recovered, and 2 billion $m^3$/year can be used for agricultural irrigation. It is estimated that this recovery potential of 2 billion $m^3$/year can be applied as 630 million $m^3$/year, considering the average irrigation period of approximately 5 months in Türkiye. Through the transformation of Wastewater Treatment Plants with projects completed by DSİ and those still ongoing into investments, approximately 1,000,000 $m^3$ of wastewater will be treated daily and 200,000 decares of agricultural land will be irrigated. **Wetland Management Plans** have been prepared by the **General Directorate of Nature Conservation and National Parks (GDNCNP)** since 1999 within the scope of the wise use of wetlands principle of the Ramsar Convention. The plans include a participatory approach to solve the problems of wetlands and activities that gives various responsibilities to all interest group. Until today, 50 National wetlands biodiversity projects have been carried out and 75 wetland management plans were prepared and put into practice in the wetlands of Türkiye by the GDNCNP. Some of the plans, 'research of climate projections in wetland specific' has been determined as the target. And a climate change risk assessment was carried out within the scope of the "Büyük Menderes Basin Landscape Atlas Project".

Another project that has been implemented in Türkiye by the SUEN is called **"Benchmarking of Water and Sewerage Administrations in Turkey"**. This project aims to evaluate the performance of water and sewerage administrations in the country and identify areas for improvement based on the study results. These findings are then shared with the administrations along with necessary strategic recommendations.

Nitrate pollution from agricultural sources can have significant negative impacts on water resources, including contamination of drinking water and eutrophication of surface waters. In order to control and manage nitrate pollution originating from agricultural sources, the Nitrate Directive (No.91/676/EEC) was implemented by EU member states in 1991. This directive was then transferred to national legislation in Türkiye with the "**Regulation on the Protection of Water Against Agricultural Nitrate Pollution,"** which came into effect in 2004 and was revised in 2016. In addition, a "**Communiqué on the Code of Good Agricultural Practices for the**

**Prevention of Nitrate Pollution Caused by Agricultural Activities in Water"** was published in 2017 to raise awareness about the issue. Nitrate pollution is currently being monitored at 4,849 stations comprising of 2,531 surface water and 2,318 groundwater stations in Türkiye. The results of these monitoring studies are recorded in real-time in the web-based Nitrate Information System and used to identify nitrate-sensitive areas. Nitrate Action Plans, which outline strategies and measures to reduce nitrate pollution in these areas, have been prepared and are set to be implemented in 2023. In addition to these efforts, awareness-raising activities are also conducted to educate the public about the impacts of nitrate pollution and the importance of good agricultural practices for preventing it.

In order to monitor and evaluate the chemical and ecological status of Türkiye's seas, the **Integrated Marine Pollution Monitoring Program (DEN-İZ)** Program has been implemented by the MoEUCC, with coordination from TÜBITAK-MAM and participation from various institutions, organizations, and universities operating in the marine field. It is a multi-stakeholder program that aims to implement the requirements of the Barcelona and Bucharest Maritime Conventions, the EU Water Framework Directive (2000/60/EC), and the Marine Strategy Framework Directive (2008/56/EC). Marine monitoring data from the program is reported to MEDPOL, the Black Sea Commission Secretariat, the EEA, and national institutions and local authorities. The program aims to ensure compliance with national and international legislation on marine pollution prevention and to evaluate the effectiveness of such measures. It involves in situ oceanographic cruises and monitoring of various parameters such as physicochemical parameters in water column, pollutant parameters in sediment and biota, phytoplankton, zooplankton, macrozoobenthos, seagrass, fish, and macroalgae. The program also includes monitoring of marine macro and micro litter, radioactivity, satellite-based observations, and eutrophication. The current DEN-İZ program, which covers the period 2020-2022, consists of 423 monitoring stations. The program is funded by the national budget and is intended to meet the requirements of international conventions and European Union legislation. It is planned to conduct a study on the "Examination of the Impact of Climate Change on Our Seas" by the end of 2022, using data from nine years of regular sea monitoring. Preparatory work for the DEN-İZ program for the period 2023-2025 has also begun, with new strategies expected to be added to the program based on the country's needs and budget constraints. These strategies will focus on monitoring coral reefs and collagens for climate change studies, monitoring microplastics in biota as part of a zero-pollution policy, developing an Open Sea Monitoring Program, and evaluating monitoring components with the IMAP NEAT assessment tool. The DEN-İZ Monitoring Program will provide information about global, regional, and local climate-related changes, including extremes and adaptation, to the Ministry's operational departments. New monitoring strategies will be added to the program as needed in each monitoring period.

Erosion is a problem that impacts humanity's ability to efficiently and sustainably utilize soil and water resources. Türkiye, with its particular geography, climate, topography, geology, and soil properties, is particularly prone to intense soil erosion, which leads to various environmental issues. In order to protect against the impacts of erosion and sediment on soil and water resources, settlements, agricultural lands and downstream facilities, the General Directorate of DSI carries out **Flood and Sediment Control Studies**. These studies involve the construction of various types of structures, including classic (closed) check dams, open check dams, ground sills, and flood rakes, which are designed to hold sediment materials and prevent bed scours in the upper basins. These efforts are integrated with broader flood control activities in order to address the issue of erosion and sediment in a holistic manner.

#### *6.3.3.2 Agriculture*

The agriculture sector plays a critical role in the economic and social well-being of Türkiye. Below are studies on adaptation to climate change, as well as various applications such as combating agricultural drought, implementing EbA, adopting good agricultural practices, promoting organic agriculture and cleaning of abandoned fishing gears by the Ministry of Agriculture and Forestry, General Directorate of Agricultural Reform, the Agriculture and Rural Development Support Institution, the General Directorate of Fisheries and Aquaculture, Food and Agriculture Organization (FAO). Detailed information on the legal regulations and applications for adaptation to climate change in agriculture sector is given in Section 4.

At both the global and national levels, numerous studies are conducted to reduce the effects of drought, which are becoming more and more noticeable today, and to ensure the sustainability of agricultural food production. The **"Agricultural Drought Combat Strategy and Action Plan (2023-2027)"** is a project that aims to reduce the impact of drought on the agricultural sector in Türkiye. The plan is developed and implemented by the Ministry of Agriculture and Forestry, General Directorate of Agricultural Reform with the participation of relevant institutions and organizations and is renewed every five years. The main objectives of the plan are to increase public awareness of the risk of water scarcity, develop environmentally sustainable agricultural water use planning, and establish an institutional structure with sufficient capacity to combat drought while including all stakeholders in this process. The plan is intended to be implemented in a holistic and comprehensive manner, considering the economic, social, and societal impacts of drought. It is also intended to involve all members of society, including non-governmental organizations, and all relevant public institutions and organizations in the fight against drought. The Agricultural Drought Combat Strategy and Action Plan is closely linked with other initiatives and projects aimed at combating other disasters that affect the agriculture sector.

In addition to combating agricultural drought, the Agriculture and Rural Development Support Institution (TKDK) implemented the "**Instrument for Pre-Accesion Assistance Rural Development (IPARD) Programme"**. The IPARD program aims to improve the performance of

agricultural enterprises in the production of primary agricultural products and contribute to food security by increasing the competitiveness of enterprises through investments in physical assets. It also aims to reduce greenhouse gas emissions by complying with EU standards on environmental protection and animal welfare and supports investments in renewable energy sources such as biogas and solar energy. The program's measures on agriculture, environment, climate, and organic agriculture aim to address climate change by promoting the adoption of good agricultural practices and organic agriculture and reducing the impact of climate change on water use, water quality, biodiversity, and ecology in the agricultural sector. The program also supports the implementation of local development strategies and the LEADER approach, which promotes local participation and partnerships in the development of sustainable strategies for rural areas. The diversification of farm activities and business development measure aims to diversify rural economic activities and increase economic sustainability in competitive markets, as well as increase the use of renewable energy sources in rural areas to reduce costs.

In order to protect and reimbursed the losses of the producers against the various risks that may affect their crops, livestock, etc. the **"Agricultural Insurance Law"** with a number 5363 was implemented in Türkiye in 2005. The Agricultural Insurance Pool (TARSIM) is an important tool for the protection of the agricultural sector, which plays a strategic role and function in the economy. The TARSIM basic data from 2006 to 2022 was shown by below table.

*Table 34 - TARSIM Basic Data (x1000 TRY)*

| | (Total) 2006-2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|
| **Sum Insured** | 70.731.055 | 23.080.720 | 30.303.347 | 42.217.541 | 55.166.348 | 83.146.049 | 124.396.971 | 296.149.927 |
| **Total Premium** | 3.589.151 | 1.299.986 | 1.628.553 | 2.050.635 | 2.447.064 | 3.198.743 | 4.678.459 | 9.005.954 |
| **Indemnity** | 2.336.494 | 801.631 | 791.423 | 1.000.813 | 1.155.983 | 1.313.526 | 2.436.610 | 3.162.663 |
| **Policy Number (Piece)** | 5.851 | 1.444 | 1.598 | 1.756 | 2.087 | 2.235 | 2.517 | 3.077 |

In addition to providing protection and reimbursement for losses through the use of insurance, implementing the ecosystem-based adaptation projects can also help to increase the resilience of the agriculture sector to the impacts of climate change. One such project that has been conducted in cooperation with the Ministry of Agriculture and Forestry and the Food and Agriculture Organization (FAO), is the **"Agricultural Practices for Ecosystem-Based Adaptation (EbA) to Climate Change in Steppe Ecosystems (ETU) Project."** The overall goal

of the project, which is identified as GCP/TUR/063/EC, is to increase the resilience of societies and steppe ecosystems to the impacts of climate change. The first objective of the project is to increase national capacity and awareness in preparation for the adoption of medium and long-term climate change ecosystem-based adaptation strategy. The **"Strategy Document for Ecosystem-Based Adaptation (EbA) to Climate Change for Anatolian Steppe Ecosystems (2022-2036)"** has been approved by the government of Türkiye through Presidential Circular numbered 2022/8 and dated June 7, 2022.The EbA Strategic Document sets the framework for implementing an EbA approach in steppe ecosystems in order to adapt to climate change in agriculture sector. The goal of the EbA Strategic Document is to "facilitate and promote to the use of best EbA practices at the steppe ecosystem level for adaptation to climate change by establishing governmental, sectoral, inter-sectoral and local governance system to help further support of ecosystem service provision."

One such project that has been conducted in cooperation with the Ministry of Agriculture and Forestry / General Directorate of Agricultural Reform and the Food and Agriculture Organization (FAO), is the **"Enhancement of Agro-Ecological Management System Through Promoting Ecosystem-Oriented Food Production Project"** which is identified as (GCP/TUR/069/GFF). The overall objective of the project is to facilitate introduction of a holistic approach taking into account of interactions between environment, nature, climate change and agricultural practices for more sustainable and efficient management of agro-ecosystems focusing on Bolu province through this project, Turkey will be able to help make a difference by its strengthening national policies and capacities to address these interconnected challenges. Project has been approved by the Ministry of Agriculture and Forestry in 12.12.2022 and it has three main outcomes those are strengthening the policies and strategic plans for promotion of the agro-ecosystem approach, promoting agroecological practices, applying integrated agroecosystem and sustainable land management practices in Bolu province and promoting the best practices and disseminating the learned lessons.

Land Use Plans with a scale of 1/25000 were prepared by the General Directorate of Agricultural Reform, based on the border of 81 provinces and 922 districts, within the scope of Article 10 of the Law No. 5403, and land control work was completed by the Provincial Directorates of Agriculture and Forestry. With the Land Use Plans which approval process is ongoing; It is aimed to determine the agricultural areas to be protected, to determine the land use status of the great plains, to show alternative areas that can be evaluated for non-agricultural use, thus reducing the non-agricultural pressure on agricultural lands, and to increase the quality of statistical information about agricultural areas.

Within the scope of the "**Turkey Climate Smart and Competitive Agricultural Growth Project (TUCSAP)"** signed with the World Bank, 1/5000 Scale Land Use Plans work will be carried out in 81 provinces.

Fertile agricultural lands have been given the status of "Great Plain Protection Area" with the 14th article of the Law No. 5403. The number of Great Plains, which was taken under protection, was increased from 429 to 440 by declaring a total of 11 new Great Plains (121.178.38 ha) distributed in the provinces of Tunceli, Ağrı, Erzurum, Afyon, Amasya and Sivas. Great Plain studies continue in Afyon, Tokat, Amasya, Batman, Kayseri, K.Maraş, Sakarya, Samsun, Edirne and Van provinces. The area covered by 440 Great Plains, whose borders are drawn within the total agricultural land assets of our country, has reached a total of 9,339,305.31 ha. In addition, revision studies were announced in 2 plains in Muş and Tunceli provinces.

**"The Ocean Cleaning of Abandoned Fishing Gear Project"** is an initiative led by the Ministry of Agriculture and Forestry, the General Directorate of Fisheries and Aquaculture of Türkiye. The project targets to clean up abandoned, lost, and otherwise discarded fishing gear contaminating the waters around Türkiye. Public resources have been directed towards the project entitled "*Cleaning Up Abandoned Fishing Gear*" for the first time, which was conceived in 2014. In total, 103 million areas were scanned, 727.540 m2 of fishing net, and 34.731 other fishing gear were removed, some of which were recycled. The project aims to prevent uncontrolled fishing gear, which causes biological and economic losses, by using the media to alert people to remove derelict fishing gear, aid in identifying risk areas and inform fishermen about the seriousness of the situation.

In addition, the "Protection and Development of Fisheries Resources with Artificial Reefs" is carried out by the MoAF in order to create new habitats for aquatic diversity to protect and improve existing habitats. Within the scope of the project, artificial reef projects with the largest volume in the Mediterranean countries were implemented in the North Aegean Sea and the Sea of Marmara. In the Mediterranean, an artificial reef project was implemented in three different locations in 2022. It is aimed to protect, develop and sustain our marine ecosystems with a total of 8328 artificial reef placed in our country's territorial waters. In the regions where artificial reef studies were completed, monitoring studies were carried out on the socio-economic development of local fishermen, species diversity, population sizes, changes in the productivity of fishing gear, ichthyoplankton (fish egg) diversity, abundance and distribution, and it was determined that the biodiversity and biomass in the reef regions increased.

#### *6.3.3.3 Disaster Risk Reduction*

Below are the disaster risk reduction studies, conducted by the Disaster and Emergency Management Presidency (AFAD), the Turkish State Meteorological Service (TSMS), the General Directorate of State Hydraulic Works (DSI) and the General Directorate of Water Management (GDWM).

Disaster and Emergency Management Presidency (AFAD), established in 2009, focuses on integrated disaster management to coordinate efforts and work with other institutions. Its

legislation prioritizes risk reduction, preparedness and damage reduction in pre-disaster phase. Since its establishment, AFAD has implemented various plans and arrangements to increase intervention capacity and introduce pre-disaster risk and damage reduction policies. The **"Integrated Disaster Management System"** approach distributes responsibilities among institutions and organizations, shifting from crisis management to risk management and disaster management to disaster risk governance. The goal is to prevent interruptions in sustainable development by minimizing loss of life and property during disasters, aligning with international frameworks such as the Hyogo and Sendai Framework. Türkiye's national disaster risk reduction, response, and recovery plans, which are aimed at being carried out in cooperation with other institutions concerned with intervening in disasters, show the country's determination to effectively govern disaster risk throughout the country. The basic elements of Türkiye's disaster management system are established in **the "Türkiye Disaster Response Plan (TAMP)"** which went into effect in 2014 and has been updated as of 2022, in the **"Türkiye Disaster Risk Reduction Plan (TARAP)"**, which went into effect in 2022, and in the **"Türkiye's Post-Disaster Recovery Plan (TASİP)"** which is currently under preparation and intended to go into effect in 2023. These plans, developed on a national scale, outline the tasks that need to be performed before, during and after a disaster, together with the responsible institutions and organizations, allocating duties and responsibilities in a clear and transparent manner. At the local level, **"Provincial Disaster Risk Reduction Plans (IRAP)"** which outline risk reduction activities to be conducted in operational terms and act on them in accordance with given priorities, and local level disaster response plans are being implemented.

Türkiye has made a commitment to achieving the priorities and goals outlined in the **"Sendai Framework"** for Disaster Risk Reduction and has prepared and implemented several plans at the national level to reduce disaster risks. As of 2017, the fundamental plan and strategy documents that constitute Türkiye's roadmap to reduce disaster risks are briefly listed below:

- Provincial Disaster Risk Reduction Plan (İRAP) Preparation Guideline (2020)
- Eleventh Development Plan (2019-2023)
- Paris Agreement (2015)
- Sendai Disaster Risk Reduction Framework (2015-2030)
- Sustainable Development Goals (2015-2030)
- The Green Deal Action Plan (2021)
- Türkiye Disaster Risk Reduction Plan (TARAP) (2022)

In 2015, AFAD has developed the **"Disaster Management and Decision Support System (AYDES)"** is a web-based application that utilizes Geographical Information Systems and decision support mechanisms to effectively manage resources during disasters and

emergencies. It also serves the informatics infrastructure of the Türkiye Disaster Response Plan (TAMP). In 2017 AFAD has launched the **"Disaster Risk Reduction System (ARAS)"** Project to analyze disaster hazards and risks and create accurate maps. The goal is to conduct risk assessments using statistical analyses once risks are identified. The project includes mapping inventories, susceptibilities and hazards, and producing risk maps for landslides, rockfalls and avalanches. ARAS uses web-based geographical information technologies and is flexible allowing for updates and data analysis. The susceptibility maps have been made available for use by all institutions through TUCBS (Turkey National Geographical Information Systems). It is an important example of using digital platforms and technologies to determine disaster risks. AFAD recently developed the **"Turkey Disaster Risk Reduction Plan (TARAP)"** in 2022 which aims to reduce disaster risks by maximizing efficient use of resources and creating resilient societies and safe living spaces. The TARAP is based on the priorities of the Sendai Framework.

Türkiye has made progress in reducing disaster risk and impacts since implementing the Sendai Framework in 2015. In the years between 2015 and 2022, various institutions in Türkiye have taken steps to reduce disaster risks and mitigate the impacts of hazards. These efforts have included the provision of geographical data support and mapping to better understand and plan for disaster risks, strengthening building stocks to reduce risk, raising awareness about safe businesses and risk reduction, and establishing disaster management centers, and defining and addressing risk in projects by the General Directorate of Mineral Research and Exploration. The TARAP and IRAP plans also helped achieve coordination and prioritize efforts at both the national and local levels. Additionally, AFAD and the Turkish Red Crescent have also provided training on disaster risk reduction and awareness and have focused on educating young people on how to protect themselves from existing risks in their areas. Overall, these actions have led to a reduction in disaster risk and a decrease in the impacts of hazards in Türkiye.

In an effort to reduce vulnerability to natural disasters, institutions in Türkiye have implemented a number of measures. These include the production of susceptibility, hazard and risk maps for landslides, rockfalls, and avalanches by the Disaster Risk Analysis System, flood, drought, heatwave and forest fires, etc. by the TSMS, GDWM. Training and awareness-raising activities have also been carried out, as well as projects focused on reducing structural and non-structural hazards. Additionally, efforts have been made to improve transportation safety by monitoring meteorological conditions in real-time and implementing measures to reduce risks on railway lines. To augment coping capacity, disaster and disaster protection awareness training has been provided to all sections of society and a disaster-prepared society policy has been adopted. The national development plans also take into account basic disaster risks and their impact on sustainable development.

The Turkish State Meteorological Service (TSMS) aims to assist in minimizing problems, reducing economic losses, and mitigating injuries and deaths caused by severe meteorological

events such as heavy precipitations and floods, extreme winds and storms, heavy snowfalls, snowmelt and avalanche hazards, heat and cold waves, ice and frost, agricultural frosts, fog, and dust transportations by providing the impact-based meteorological early warnings to relevant institutions and organizations, media and broadcasting organizations, and citizens. This helps to ensure that necessary measures are taken in a timely manner by relevant and authorized institutions to protect people and properties in the event of a natural disaster. In 2021, 539 meteorological early warnings and assessments related to such severe meteorological events were published by the TSMS Analysis and Forecasting Center.

**"The Flash Flood Guidance System (FFGS)"** is an important system to reduce the damage that may occur in the areas exposed to flash floods, increase regional capacities, and give real-time and high-accuracy flash flood warnings developed by TSMS under the umbrella of the WMO. The Black Sea and Middle East Flash Flood Guidance System (BSMEFFGS) and South East Europe Flash Flood Guidance System (SEEFFGS), of which Türkiye is the regional center, were established within the body of the TSMS in 2013 and 2016. These systems provide services and products to the Meteorology and Hydrology Services of 19-member countries. The model is run with three different numerical weather prediction (NWP) models and is used operationally to prepare flash flood early warnings six hours ahead of time (Turkish State Meteorological Service-d, 2022).

The General Directorate of DSI in Türkiye also operates a comprehensive hydrometeorological observation network to improve its understanding of flood dynamics and improve its flood forecasting capabilities. This network includes 1315 flow observation stations on rivers, 531 dam and lake observation stations, 56 meteorology stations, 260 snow stations, and 155 sediment measurement stations. The data collected by this network is used to inform decision-making and implement early warning systems, such as the "**Early Warning System (TEUS)"** currently being established in the Black Sea Region, which is particularly prone to floods and their associated social and economic impacts. The General Directorate of DSI also utilizes the "**TAMBIS (Flood, Failure and Response Spatial Information System)"** application to identify flood events and their locations quickly and accurately, and to receive notices, photographs, and information from the public through SMS and email. These efforts are aimed at reducing loss of life and property before, during, and after flood events, and are supported by the DSI's construction machinery park, which includes various types of equipment such as excavators, dozers, loaders, graders, trucks, and trailer tractors.

In December 2017, the **"Flood Forecasting and Early Warning Center (TATUM)"** was established under the General Directorate of Water Management (GDWM). Comprised of personnel from the GDWM, DSI and TSMS, TATUM has been working on the **"Establishment of Flood Forecasting and Early Warning System in Pilot Sub-Basins Project (TATUS)"** since July 2021. The system aims to create an interface where all required data for flood forecasting

can be viewed, analyzed and reported across the country on a sub-basin level. It will also be able to calculate real-time estimated flow rates of rivers in 15 selected pilot sub-basins, and display flood inundation and hazard maps for early warning using the water inundation areas with different flood return periods. The system will also be able to generate real-time flood spread maps based on estimated and/or determined flow rates. Using meteorological data from the TSMS and the forecast data specified by the user, the system will establish a hydrological model and precipitation-flow relationship, calculate estimated flows, and calibrate these estimates with Stream Gauge Stations (SGS) operated by DSI in the pilot sub-basins. Once the project is complete, it is planned that the system will be implemented nationwide. A web-based application software called the **"Flood Prediction and Early Warning System (TATUS)"** will be developed to display the inputs and outputs of the system in real-time.

The DSI has developed the **"Flood Action Plan (2014-2018)"** to minimize flood damage and effectively implement intervention and improvement activities. The GDWM has also begun working on the preparation of flood management plans based on basins, and has already completed **"Flood Risk Management Plans"** for 23 basins. Work on preparing management plans for the remaining 2 basins is ongoing, with the goal of having flood management plans in place for all 25 basins in Türkiye by 2023.

The risk of forest fires is particularly high when the air temperature is above 40°C and the relative humidity is below 20%, conditions that can occasionally be experienced in some forested areas in Türkiye. In an effort to reduce the forest fires risk, TSMS has developed the **"Forest Fires and Meteorology Early Warning System (MEUS)".** This system uses various meteorological data, including forecast data from the European Centre for Medium-Range Weather Forecasts (ECMWF), to create risk maps that are updated continuously and shared with the General Directorate of Forestry. These maps provide three days of advance notice of Forest Fire Risk Potential in Türkiye, helping to protect communities and ecosystems from their impacts.

Climate change is driving to warmer temperatures, which can result in earlier snowmelt and increase in the risk of avalanches in the spring. Drought conditions, which are becoming more frequent and severe due to climate change, can also weaken vegetation on slopes and make them more susceptible to landslides and avalanches. To address the avalanche risks, a software program was developed by the **"Identification of Potential Avalanche Release Zones Project"** for 81 provinces in Türkiye to identify Potential Avalanche Release Zones as a measure to reduce damage from avalanches, including loss of life and property. In addition, the Steel Barrier Design Program has been developed for use in debris flow barrier projects in wild streams to mitigate the increasing risk of flood events.

#### *6.3.3.4 Biodiversity and Ecosystem Services*

Below are the climate change adaptation studies in biodiversity and ecosystem services sector, conducted by the MoEUCC and the Ministry of Agriculture and Forestry, the General Directorate of Combating Desertification and Erosion, the Ministry of Agriculture and Forestry (GDWM, OGM, TAGEM, DSI).

The **"National Biological Diversity Strategy and Action Plan (NBSAP)"** was developed by Türkiye following its participation in the United Nations Convention on Biological Diversity in 1996, and it was prepared as part of Türkiye's responsibilities under the 6th Article of the Convention. The NBSAP was updated in 2008 to cover the period from 2008-2017, and it included six thematic working areas related to different types of ecosystems: agricultural biological diversity, forest biological diversity, steppe biological diversity, mountain biological diversity, inner waters biological diversity, and shore-sea biological diversity. This update to the NBSAP was made accordance with the regulations of European Union in the scope of nature protection sector. Climate change is recognized as a strategic issue in the NBSAP, and it is specified that the impacts on biological diversity will be considered when determining and monitoring the impacts of climate change. The NBSAP has been updated again in 2018 to align with the Aichi Targets and recent action plans based on the country's national policies. As part of Türkiye's efforts to minimize the impacts of climate change on biodiversity, it has taken a position in support of nature-based solutions and an ecosystem-based approach in the Post-2020 Global Biodiversity Framework negotiations Türkiye will update its NBSAP according to the **Kunming-Montreal Global Biodiversity Framework**, to ensure the effective implementation of the Convention on Biological Diversity, Türkiye has Kunming-Montreal Global Biodiversity Framework, also established the National Biodiversity Coordination Council. To protect Türkiye's ecosystems, natural resources, and biological diversity, the MoEUCC and the MoAF have collaborated on a number of projects, including research on protected areas and projects related to the conservation and sustainable management of various types of ecosystems.

In addition to the efforts described above, Türkiye has also carried out various other projects to protect its biodiversity and ecosystem services. These include the Pilot Study on Valuation of Sultansazligi National Park, **the National Biodiversity Inventory and Monitoring Project, the Project on Registration of Traditional Knowledge Associated with Biodiversity,** and **the Technical Assistance for Strengthening the National Nature Protection System for Implementation of Natura 2000 Requirements**. In addition, the **Project on Preparation, Implementation and Monitoring of Species Action Plans for Endangered Species in Turkey** within the Concept of a New Methodology is still ongoing. Türkiye has also implemented projects to address the threat of invasive alien species, including the GEF VI Project on **Addressing Invasive Alien Species Threats at Key Marine Biodiversity Areas and the**

**Conservation, Sustainable Management of Türkiye's Steppe Ecosystem Project and Addressing of Invasive Alien Species Threats in Terrestrial Areas and Inland Waters in Türkiye**. Overall, these efforts are aimed at ensuring the sustainability of Türkiye's natural ecosystems and the ecosystem services they provide, and at mitigating the impacts of climate change on biodiversity.

Türkiye has implemented a number of measures to manage and protect its lakes and wetlands, including the **"Wetland Management Plans Preparation Project"** and the **"Lakes and Wetlands Action Plan"**. The Wetland Management Plans Preparation Project, which ran from 2011-2017, involved the development of management plans for all wetlands of international significance in accordance with the Protection of Wetlands By-directives Law and the "Ramsar Convention - Guidelines on Wetland Management Planning." By 2019, 100 species action plans had been completed and these species were being regularly monitored.

**"The Lakes and Wetlands Action Plan (2017-2023)"**, which was coordinated by the General Directorate of Water Management, aims to preserve lakes and wetlands in an integrated manner by considering the balance between protection and use. The "Circular on Lakes and Wetlands Action Plan" numbered 2017/1 was put into effect to ensure that the Action Plan would be implemented in a sensitive and disciplined manner by the responsible Ministries, institutions and organizations. As part of the Action Plan, it is aimed to study 303 lakes and wetlands in 25 basins. The action steps outlined in the plan include:

- Taking Inventory of Natural Lakes,
- Determination of Bathymetry of Natural Lakes,
- Determination of the Water Budget of Natural Lakes,
- Determination of Pressure and Impact Components and the Assimilation Capacity for Pollutant Parameters,
- Monitoring of Natural Lakes and Determination of Water Quality,
- Improvement of Water Quality and Quantity of Natural Lakes.

Erosion is a major environmental problem that can have significant impacts on humanity's ability to use soil and water resources efficiently and sustainably. Türkiye, with its particular geography, climate, topography, geology, and soil properties, is particularly prone to soil erosion, which can lead to various environmental issues. To address these issues, the General Directorate of Combating Desertification and Erosion has implemented various strategies, including the use of the "**Revised Universal Soil Loss Equation (RUSLE)"** to estimate soil erosion and the development of the "**Dynamic Erosion Model and Monitoring System (DEMMS)"** software to monitor and evaluate water erosion. Soil erosion with RUSLE model estimating that very intensive soil loss occurs in 60.27% of the country, with 19.13% classified as

low, 7.93% as moderate, 5.97% as severe, and 6.7% as very severe. According to data obtained from DEMMS, an average of 8.24 tons of soil is displaced per hectare in Türkiye each year due to water erosion, with a total of 642 million tons of soil displaced annually. Water erosion is most severe in agricultural areas, accounting for 38.71% of total soil displacement, followed by forests (4.17%), pasture areas (53.66%) and other areas (3.46%) in Türkiye. The mail factors contributing to soil erosion in Türkiye include topography (47.55%), vegetation (34.82%), precipitation (14.26%), and soil type (3.36%).

Agricultural lands are particularly vulnerable to soil erosion due to improper land use and destruction of land cover that keeps the soil with its roots and stems (forests, heathlands, pastures, etc.), as well as a lack of preservation techniques on sloping agricultural lands and the cultivation of unsuitable lands. In order to address the issue of soil erosion in Türkiye, the responsibility for combating erosion in agricultural areas, forest and pasture lands, and reservoir basins is under the responsibility of the Ministry of Agriculture and Forestry (OGM, TAGEM, DSI), MoEUCC (General Directorate of Combating Desertification and Erosion) and other relevant public institutions and organizations. In addition to the efforts of the government and public institutions, city private management and municipalities also have a role in combating erosion in the framework of their duties and responsibilities. Non-Governmental Organizations such as Protecting Natural Possessions Foundation (TEMA) also contribute to the efforts to combat erosion by carrying out various projects and initiatives. General Directorate of Combating Desertification and Erosion has the responsibility of developing national strategies and action plans to address soil erosion and desertification, with the goal of reducing the impacts of climate change and promoting sustainable natural resource management. These efforts are crucial in ensuring the long-term sustainability of Türkiye's soil and water resources, which are vital for agriculture and other sectors.

The **"National Strategy and Action Plan for Combating Desertification (2015-2023)"** is an important strategy document that outlines the actions and activities necessary to prevent desertification and land degradation in Türkiye, was approved in 2015 and entered into force. In 2019, the implementation period of the Current Action Plan (2014-2018) was completed. The **"National Strategy and Action Plan to Combat Desertification (2019-2030)"** has been prepared in consideration of the United Nations Convention to Combat Desertification's (UNCCD) new strategy document (2018-2030) and the National Land Degradation Neutrality (LDN) targets. The National Strategy and Action Plan for Combating Desertification (2019-2030) includes the planned actions and activities to prevent desertification and land degradation in Türkiye.

The General Directorate of Combating Desertification and Erosion carries out bilateral cooperation activities with primarily African countries as well as several Central Asian and European countries in the fields of combating desertification drought, land degradation, floods

and erosion. By the General Directorate of Combating Desertification and Erosion (ÇEM), international trainings are being held between the years 2011 and 2021 in countries affected by desertification in Central Asia, Balkans, Caucasus, and Africa with an aim to exchange knowledge and to help increase their technical capacity on the combating desertification, land degradation neutrality, drought, and climate change. (ÇEM, 2022).

The **"Contributing to Land Degradation Neutrality (LDN) Target Setting by Demonstrating the LDN Approach in the Upper Sakarya Basin for Scaling up at National Level Project"** was launched by the ÇEM in 2019 to develop a model for LDN target-setting, planning, and implementation in the Upper Sakarya Basin, which will be scaled up to the national level in line with Agenda 2030 and SDG Target 15.3. The project has developed a "LDN Decision Support System (DSS)" that is a database of georeferenced information on different dimensions relevant to achieving LDN. The DSS is an open-source web-based system that integrates and coordinates activities for the prevention and reduction of land degradation, remediation of partially degraded land, and rehabilitation of degraded land. The DSS approach aims to inform decision-makers about the current LDN status, support decision-makers to analyze the advantages and synergies between different land uses and practices, prioritize intervention areas for avoiding land degradation, and ultimately contribute to target setting/reversing the targets on LDN.

#### *6.3.3.5 Coastal Areas*

Coastal areas in Türkiye are home to a diverse array of ecosystems and habitats, including sandy beaches, salt marshes, rocky cliffs, and mangrove forests. These ecosystems provide a range of significant ecological, economic, and social benefits, including serving as a habitat for various plant and animal species, providing recreational opportunities, and protecting against natural disasters such as storms and floods.

In adapting to climate change and reducing its effects, it is essential to determine priorities and create policies according to these priorities, develop the best methodologies, take measures, and act together by ensuring cooperation on a global and regional scale.

Türkiye needs to adequately address environmental and climate-related challenges facing the coastal areas and their cumulative impacts to ensure the social well-being of current and future generations in the region.

Within the scope of the international agreements and regulations, including Regional Sea Conventions like the Barcelona Convention, in line with the Paris Agreement and the European Green Deal and sustainable development goals (especially SDG 13, SDG 11, SDG 12, SDG 14), to increase the resilience of the Mediterranean to climate change, land degradation, integrated coastal management, marine and coastal biodiversity, etc. ecosystem-based approach, nature-based solutions, circular economy, reduction of land-based pollution; an intensive study has been planned on the adoption of practices on the subject.

Coastal areas in Türkiye are home to a diverse array of ecosystems and habitats, including sandy beaches, salt marshes, rocky cliffs, and mangrove forests. These ecosystems provide a range of important ecological, economic, and social benefits, including serving as a habitat for a variety of plant and animal species, providing recreational opportunities, and protecting against natural disasters such as storms and floods.

Coastal areas in Türkiye are also at risk from climate change, in addition to other human activities such as urbanization, tourism development, and pollution. To protect and conserve these valuable ecosystems, Türkiye has implemented a number of strategies and actions, including the establishment of marine protected areas and the implementation of coastal zone management plans. Some of the specific studies and projects related to adaptation to climate change that have been carried out in the coastal regions of Türkiye include the "Determination and Classification of Sea and Coastal Waters Project (2011-2014)", the "Management of Urban Sewage on the Coasts of Turkey Project", and the preparation of the "Integrated Coastal Zone Plans" to guide the management and conservation of its coastal areas, as mentioned in the 7th National Statement.

The MoEUCC is responsible for the management and planning of the integrated coastal areas in Türkiye, as stated in the Presidential Decree dated 10 July 2018 and numbered 1. Integrated Coastal Zone Plans completed for approximately 93% of Türkiye's coastal zones by 2022. On the other hand, Türkiye's Mediterranean coasts were also monitored and natural and other coastal areas that have been degraded because of natural and man-made structures that may have significant environmental consequences on coastal areas in relation to climate change were identified. Coastal areas degraded by man-made structures will be monitored for a period of 6 years as of 2022. The aim of the monitoring is not only obtain basic monitoring data, but also to open the issue of how to integrate this data into integrated coastal zone plans and thus to take another important step in the realization of sustainability and economic development by protecting the ecological structure of coastal areas. In the next step, based on the results of the monitoring data obtained and by using the data of the integrated coastal area plans approved, "good environmental status" (UNEP/MAP (2013) will be determined for the Mediterranean coasts of Türkiye.

Protecting migratory marine species and habitats under climate change will require innovative and dynamic **Area-Based Management Tools (ABMTs)**. The boundaries shift across space and time, which could help safeguard marine life and build ecosystem resilience by protecting dynamic habitats and migratory marine species in a changing ocean. When adequately developed, **Marine Spatial Planning (MSP)** could have significant economic, social, and environmental benefits.

**Marine Protected Areas (MPAs)** are one of the widely implemented area-based management approach commonly intended to conserve, preserve, or restore biodiversity and habitats, protect species, or manage resources, especially fisheries.

#### *6.3.3.6 Public Health*

Türkiye has implemented a number of long-term strategies and actions, including the development of the "National Program and Action Plan for Mitigating the Negative Impacts of Climate Change on Health" by the Ministry of Health in 2015. The aim of this program is to protect to population from the adverse health effects caused by climate change in Türkiye and to take necessary health precautions for disaster situations. The objectives of the program include:

- Reducing the effects of extreme weather events (such as heavy precipitation, extreme temperatures, and air pollution) and resulting natural disasters (floods, fires, etc.) on human health,
- Strengthening the corporate infrastructure for tracking diseases that are seen and/or increasing in Türkiye as a result of climate change and increasing cooperation within and between institutions,
- Ensuring water and food security and preventing water and foodborne diseases,
- Conducting necessary studies to ensure that vulnerable groups are not affected by the adverse effects of climate change,
- Reducing the negative contributions of health institutions to climate change,
- Raising public awareness for more effective protection against the adverse health effects of climate change,
- Conducting monitoring and evaluation activities.

#### *6.3.3.7 Urban Areas*

Urban areas in Türkiye are particularly vulnerable to the impacts of climate change due to their high population densities and complex systems. In order to address these challenges, Türkiye has implemented a number of strategies and actions, including the development of the **"New Urban Agenda"**, which aims to support building resilience and reducing greenhouse gas emissions from all relevant sectors, as well as promoting global, national, and local climate action, including adaptation and mitigation of climate change. It also supports the efforts of cities and human settlements, their residents, and all local stakeholders as important implementers. Supporting the long-term adaptation planning process, as well as city-level impact, risk and vulnerability assessments, is the aim in order to inform adaptation plans,

policies, programmes, and actions that increase the resilience of urban residents, including by using ecosystem-based adaptation.

Below are the climate change adaptation projects in the urban areas, conducted by the Ministry of Environment, Urbanization and Climate Change and United Nations Development Programme (UNDP) Türkiye.

To further address the challenges of climate change in urban areas, Türkiye is implementing several initiatives through projects. The **"Support Common Work in the Field of Climate Change Project"** is one of these studies and has involved the implementation of 37 award projects in 27 cities, with a total of 688,000 individuals reached through 539 climate change awareness-raising events. The **"Take Urgent Action to Combat Climate Change and Its Impacts Project"** has also been implemented, which involves the creation of climate change action plans in collaboration with local administrations to build climate-resilient cities. The "**Enhance Adaptation Actions in Türkiye Project"** is focused on increasing social resilience through improvement of sectoral and urban climate change adaptation. To support these efforts, tha project has several objectives including developing urban adaptation planning solutions.

Türkiye's policies and strategies demonstrate a commitment to transitioning to high-tech production, eco-efficiency, implementing effective waste management, sustainable urbanization, and encouraging sustainable travel as part of resource conservation efforts. Recent policies focused on increasing knowledge of resource efficiency, planning, measuring, and industrial productivity, as well as integrating environmentally friendly practices into decision- and policy-making processes.

In 2019, MoEUCC introduced the **"Urban Transformation Strategy Guidelines"** for municipalities. These guidelines include the following elements:

- City-level risk assessments,
- Prioritization of areas for urban transformation,
- Investments in resilience,
- Stakeholder engagement,
- Feasibility studies,
- Financing mechanisms.

These guidelines require a thorough analysis of the urban transformation needs within each municipality to allow for an assessment and prioritization of multi-hazard risks at the city level. In September 2019, MoEUCC launched a **"5-year Urban Transformation Action Plan"** to

operationalize these guidelines, which prioritizes the transformation of housing, public buildings, and urban areas that are prone to earthquake, flood, and landslide risks.

Türkiye is also preparing the **"Climate and Disaster Resilient Cities Project"** with MoEUCC and World Bank. This project aims to support the government in tackling the challenges related to climate and disaster-resilient housing and infrastructure interventions, focusing on the metropolitan municipalities of Istanbul, Izmir, Kahramanmaras, Manisa, and Tekirdag. These municipalities were selected due to their high vulnerability to the impacts of climate hazards such as floods, drought, and heatwaves. Additionally, all of these municipalities are located in high seismic risk zones. The Project will support the Government of Türkiye in developing and establishing an innovative approach for urban resilience with climate change and disaster risks and energy efficiency considerations that can be scaled up over time with various sources of financing.

Türkiye's national urban policy document is the **"Integrated Urban Development Strategy and Action Plan 2010-2023 (KENTGES)"** approved in 2010. KENTGES includes areas, themes, and dimensions of settlements and urbanization as well as settlements and spatial planning. It associates the space-related sectors with an integrated approach and provides harmonization with the fundamental national policies within the framework of sustainability principles. The main purpose of KENTGES is to improve the livability level as well as the quality of spatial and life in settlements and to establish a road map for the strengthening of economic, social and cultural structures of settlements.

Currently, the national urban policy document is being updated by MoEUCC as **"National Spatial Strategy Plan 2053 (draft),"** which contains spatial strategies to guide both spatial plans and urban development in the country. The document includes urban and rural development strategies specific to different regions and cities of the country.

In line with **"Türkiye's Green Development Revolution"** and **"Net Zero Emissions"** target, there are 10 targets in the "National Spatial Strategy Plan 2053 (draft)". One of these targets is greenhouse gas reduction and adaptation to climate change. In addition, strategies and actions related to climate change have been determined with other targets such as green mobility and accessibility, economic competition and welfare, resilience to disaster risks and ecological balance.

The development agencies located in 26 NUTS II regions of Türkiye, under the coordination of the Ministry of Industry and Technology Directorate General for Development Agencies, have extensive experience in regional development in Türkiye. These agencies focus on sustainable development by carrying out activities and providing project support in all areas of development, including entrepreneurship, innovation, tourism, rural development, social entrepreneurship and green growth. To address regional and rural-urban disparities, Türkiye

adopted the **"The National Strategy for Regional Development (NSRD 2014-2023)"** which covers the period from 2014 to 2023. The NSRD is currently being updated for the period after 2023 and new strategies will be set out under different spatial categories in regional development policies, taking green growth and resilience to disaster risks into account. In addition to the NSRD, all regions have regional development plans that have been prepared by development agencies and local stakeholders. These plans are important in tailoring policy and implementation to local needs and circumstances for identifying the potential of different regions. These plans will also be updated for the period after 2023 in line with the new NSRD.

TUBITAK MAM carries out various projects aimed at combating climate change in provinces. One such project is the **"Preparation of Climate Change Action Plans for the Provinces of Tekirdağ, Çanakkale and Yalova Project (2021-2022)"** at the request of the MoEUCC. The project is focused on increasing the adaptation and mitigation capacity of Tekirdağ Metropolitan Municipality, Çanakkale Municipality, and Yalova Municipality by assessing measures on a sectoral basis in light of future climate projections and current adaptation actions. The project will culminate in the publication of "Tekirdağ Climate Change Action Plan," "Çanakkale Climate Change Action Plan," and "Yalova Climate Change Action Plan," by the end of 2022. Additionally, the **"Sustainable Energy and Climate Action Plan of Mersin Project (2022-2023)"** is another project has been supported by TUBITAK MAM and the Mersin Metropolitan Municipality to mitigate climate change. The project involves a general evaluation of prioritized areas that are expected to be severely impacted by climate change and the determination of adaptation measures for these areas. By completing this plan, the municipality aims to fulfill its obligations as a signatory of the "Global Covenant of Mayors Europe" while also promoting sustainable development and energy efficiency in the region.

#### *6.3.3.8 Tourism and Cultural Heritage*

As mentioned in the 7th NC of Türkiye, Türkiye has implemented several studies in the tourism sector, including the **"Tourism Strategy and Action Plan (2007-2013) of Türkiye"**, the **"Tourism Strategy of Türkiye (2023)"** and the **"Eco-Labels and Environmentally Sensitive Certificate Systems"** by the Ministry of Culture and Tourism.

The MoCT is responsible for project design, maintenance-repair, restoration, and reinforcement activities targeting to immovable cultural assets (i.e., monuments, traditional dwelling, civil architecture, archaeological sites, etc.). As adaptation measures, the buildings; location, climatic conditions, physical characteristics of the building are all taken into account during these examinations. At this period, investigations and assessments for building materials are performed, and proposals for conservation materials (such as stone, repair mortar) and procedures are under re-evaluation to be durable under different climatic scenarios. Moreover, research is being conducted to explore the detrimental impacts of climate change on movable

and immovable cultural assets, particularly on the basis of materials, and to develop options for implementing appropriate preventative and protective measures.

Through Project Coordination Office, KVMGM has proposed an IPA III action to MoEUCC entitled **"Capacity Building in transition towards greener, digital and more resilient Cultural Heritage"** under **Window 3** and **Thematic Priority 2**. The proposed action intends to establish a **Climate Change and Disaster Monitoring and Coordination Center for Cultural Heritage** that will be devoted for preparing national frameworks, strategies, standards, and certificate programs, running research and investigation (R&I) activities, transfer of good practices, delivering personnel training, implementing pilot demonstrations, disseminating and exploiting the project results linked to climate risk assessment, adaptation, mitigation, reduction of net greenhouse gases emission at World Heritage Sites, historical buildings and museums.

#### *6.3.3.9 Energy*

In 2015, the EUAS (Energy Generation Company), which is owned by the Turkish State, carried out a project named **"Climate Change Impacts on Turkish Thermal Power Production."** The project aimed to address the challenges that climate change poses to the power generation sector. The project report presented several key findings, including the evaluation of options such as switching to air cooling systems in planned or existing power plants in order to reduce dependence on water, the use of effluent for agricultural irrigation, and the use of urban and industrial wastewater for cooling water. Additionally, creating a climate resilience strategy for the power generation sector has been addressed, which has an important place as a critical infrastructure. The project also aimed to establish new mechanisms for power generation plants by making detailed risk definitions on the basis of facility and system, identifying physical risks that may cause performance loss or prevent production, determining prevention costs and possible income losses by making an economic analysis of risks, and creating new mechanisms for risk transfer. In 2023, the water footprint of entire power plants in EUAS will be determined, and the expected water footprint will decrease year by year.

Hydropower is a clean and renewable source of energy. However, hydropower generation depends on the availability of water and is therefore affected by the impacts of climate change on water basins. Climate change can result in water scarcity, leading to lower river flows and lower accumulation of water into dams, and hence to a lower amount of water that can pass through turbines or run-of the river plants to generate electricity. Hydropower currently exists to store energy in a significant and effective way–in pumped storage power plants and could play an important role in the climate change adaptation of water resource availability. Electricity generation with pumped storage is thus much less vulnerable and more climate-resilient, especially in the dry region.

It has been suggested that the establishment of a **"Pumped Storage Hydraulic Power Plant (PSHPP)"** be done by the public, and a workshop be held in order to get the evaluations of the private sector's opinions on the subject. In line with this recommendation, a "Roadmap Workshop on Hydroelectric Power Plants with Pumping Storage" was held in Ankara on February 26, 2018, with the participation of relevant stakeholders, and ideas were exchanged among the stakeholders. Within the scope of feasibility studies, meetings were held in the Gökçekaya region and Ankara with the participation of the Japan International Coordination Agency (JICA) delegation. The Gökçekaya PSHPP project has been included in the 2020 investment program of the EUAS General Directorate. According to the Investment Program for the Year 2020 published in the Repetitive Official Gazette dated February 12, 2020.

The Ministry of Energy and Natural Resources is involved in the Enhancing Climate Adaptation Action in Türkiye Project's activities. Within the scope of the project, policy recommendations have been developed on energy resources, energy production facilities, energy storage units, energy transmission, distribution lines, and transformer centers, as well as electricity and fuel demand. Also, the studies required for the preparation of the National Climate Change Adaptation Strategy and Action Plan are still in progress.

#### *6.3.3.10 Industry*

Türkiye has national policies to increase adaptation capacity of its industry. To mitigate the adverse impact of declining water resources on industrial production, implementing water-saving practices and utilizing advanced technologies for water efficiency and treated wastewater reuse are critical to adapting the industry to climate change. The government provides legal regulations and financial support to incentivize these efforts, further reinforced by the Ministry of Agriculture and Forestry's implementation of the " Project of Industrial Water Use Efficiency According to NACE Codes". These measures not only enhance the resilience of the industry but also promote sustainability in the long-term. Within the project, 400 industrial facilities will be selected for their water use levels. A guide document containing the necessary techniques and measures to increase the industrial water efficiency of these facilities will be prepared. A NACE code-based action plan will be prepared to address industries across the country. In addition, legal and administrative gap analysis will be made regarding the improvement of water efficiency in industry. Additionally, the investment incentive system supports companies' investments in solar and wind energy-based electricity generation to meet their energy needs, as well as investments made towards green transformation.

#### *6.3.3.11 Transportation and Communication*

Türkiye developed the **"National Transport and Logistics Master Plan",** which adopted the Environmental (Sustainable) Scenario as a guide to achieving the sector's sustainability targets.

Within this scope, the railway sector, which is a more environmentally friendly mode of transportation, is the focal point of the master plan.

Türkiye takes steps to reduce emissions in order to achieve the global targets. In order to prevent the environmental impacts and adverse effects and eliminate them to certain extend, the **"Green Port Project"** has been developed by the Ministry of Transport and Infrastructure. The Green Port Project, which is a voluntarily based project, is focused primarily on port operations, and **"Green Port Certificates"** are being issued to the ports that fulfill the designated sectorial criteria. As of 2022, the "Green Port" certification of 20 port facilities has been completed. In addition, the application process for six more port facilities is still being considered.

The **"Inspection Directive for the Determination of Sulphur Content in Ship Fuels"** has been released by the Ministry of Transportation and Infrastructure in an effort to reduce sulphur emissions (SOx) from ships and mitigate the harmful effects of air pollution on people and the environment. Within the scope of the implementation of this directive, 10 portable sulphur measurement devices were donated to Regional Port Authorities, and the theoretical and practical training of the port authority staff was completed.

The Ministry of Transport and Infrastructure has also released a regulation that supports the transfer of cargo from a road to a seaway on August 9, 2022. The main objective of this regulation is to establish the policies and guidelines for the assistance to be provided to ship owners in order to increase the proportion of maritime transport in combined transportation and to encourage the conversion of cargoes currently transported by road to maritime transport.

The **"Preparation of Climate Change Strategies for Gaziantep, Erzurum, Ordu-Giresun and Muğla Milas-Bodrum Airports (2021-2023)"** which was launched in September 2021 with the support of the General Directorate of State Airports Authority and TUBITAK MAM. The 22-month project aims to identify the potential impacts of climate change in the region and determine which areas of airport activities will be most affected. Vulnerable areas will be identified, and mitigation and adaptation measures will be chosen based on a cost-benefit analysis (CBA) approach. The project will be carried out in the preparation of **"Climate Change Strategy"** documents for the four airports which will provide a roadmap on climate change adaptation and mitigation based on the evaluations.

## 6.4 MONITORING, REPORTING AND EVALUATION

Türkiye is updating its Climate Change Adaptation Strategy and Action Plan and establishing its Monitoring & Evaluation, reporting and communication system in scope of the "**Enhancing Adaptation Action in Türkiye (Iklime Uyum) Project"**. This system will be under the **"Climate Change Platform"** (iklimportal.gov.tr) which is being established in scope of the same project. Under the **Climate Change Platform** there will be also monitoring system of the **Local Climate Change Action Plans**.

# 7 FINANCIAL, TECHNOLOGICAL AND CAPACITY-BUILDING SUPPORT

As highlighted in the previous National Communications, Türkiye is not an Annex II country, therefore it does not have an obligation of providing support to developing countries within the scope of Articles 4.3, 4.4 and 4.5 of the Convention and Article 11 of the Kyoto Protocol.

Türkiye ratified Paris Agreement with a declaration underlining that Türkiye will implement the Agreement as a developing country. Türkiye is categorized as a developing country according to many international organizations, such as the United Nations Development Programme. United Nations "World Economic Situation and Prospects (WESP)" 2023 Report[204] places Türkiye in developing economies' list together with non-Annex countries. Also, according to categorization of World Bank, Türkiye is an upper middle-income country. Moreover, while Türkiye is an OECD member, it is listed among the countries eligible to Official Development Assistance (ODA) by OECD Development Assistance Committee.

The Conference of Parties Decision No. 1/CP.16 recognizes special circumstances of Türkiye and Decision No. 1/ CP.18 confirms the importance of financial, technological and capacity building support in order to ensure effective implementation of the Convention and strongly encourages Annex-II countries to provide Türkiye with financial, technological and capacity building support through multilateral agencies including the Global Environment Facility, (GEF), one of the UNFCCC financial mechanisms.

However, as a developing country, Türkiye is not able to benefit from the Green Climate Fund (GCF), which was created in 2010 as one of the financial mechanisms of the UNFCCC, and which started to support projects as of 2015, becoming the largest climate fund in the world. Türkiye is concerned that it cannot partner with Multilateral Development Banks in projects co-finance by GCF that would limits its access to international climate finance.

Despite having these difficulties, Türkiye, with an ambitious climate agenda, continues to finance many climate projects including large-scale investments from its public budget to combat climate change. Türkiye, as a developing country located in the Mediterranean Basin, which is one of the most vulnerable regions in the world to the adverse impacts of climate change, faces significant investment needs for mitigation and adaptation actions. In order to meet the increasing financial needs for Türkiye's sustainable development projects, primarily at renewable energy, energy efficiency and low carbon transport sectors receive external financing from multilateral development banks, bilateral agencies, and international climate funds.

[204] https://desapublications.un.org/file/1113/download

Moreover, the Turkish private sector is undertaking concrete measures to decrease GHG emissions. In recent years, many companies operating in Türkiye disclosed their mitigation targets and implementation roadmaps to accelerate progress towards Türkiye's 2053 Net Zero Target. However, Türkiye needs significant international financial support for its climate-friendly technical assistance and investment projects to implement its mitigation and adaptation actions in addition to its domestic public and private sources of finance.

In this context, given its strong mitigation potential and high absorption capacity to utilize climate finance, it is of critical importance to ensure Türkiye's access to financial mechanisms under the UNFCCC and the Paris Agreement, so that Türkiye is able to maintain its efforts to respond climate change, through implementing its nationally determined contribution within the framework of common but differentiated responsibilities and respective capabilities.

# 8 RESEARCH AND SYSTEMATIC OBSERVATION

This chapter provides an overview of Türkiye's national policies, research activities, and research and development (R&D) programs aimed at mitigating and adapting to climate change, as well as systematic observations of Türkiye including the atmosphere, terrestrial and oceanic climate, and cryosphere observations. Additionally, the chapter discusses additional actions to support capacity-building and national and international data sharing efforts.

## 8.1 GENERAL POLICY ON RESEARCH AND SYSTEMATIC OBSERVATION

Türkiye is among the countries that will mostly be affected from climate change, due to its geographical position, and is therefore contributing to the global efforts in climate change measures. Türkiye announced its "2053 Net Zero Emission Target" on September 27, 2021. By becoming a party to the Paris Agreement and announcing the net zero emission target, which is defined as the flagship target of the green development revolution of Türkiye, the Country has taken an important step towards green and sustainable growth. Türkiye is gearing up to take the necessary actions to transform its society accordingly. Türkiye is pursuing a **science, technology and innovation (STI) policy** aimed at promoting green growth and limiting the rising trend of emissions; as well as making efforts for adaptation to climate change.

There are ongoing studies in Türkiye that aim to gather all relevant actors in the STI ecosystem in Türkiye around a dedicated **"Green Strategic Research Agenda"** that will embrace the targets of the EU Green Deal. The motivation and high-level ownership of the Government for the green transformation of the economy will pave the way for the successful implementation of this Research Agenda. Türkiye's national vision within the scope of climate change is to become a country fully integrating climate change related objectives into its development policies, disseminating energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts to tackle climate change within its special circumstances and providing its citizens with a high quality of life and welfare with low carbon intensity. This action will strengthen Türkiye's STI policy by achieving the mobilization and enhancement of the Green Growth Research and Development Institute (RDI) Ecosystem in Türkiye.

Türkiye has been taking steps for a green economy as part of its fight against the negative impact of climate change and establishing new institutional arrangements for climate change issues, including the MoEUCC and the updating of the National Climate Change Action Plan.

The **"Türkiye's 2023 Industry and Technology Strategy"**, announced in 2019, focuses on the development and commercialization of breakthrough technologies in key industrial sectors that are vital for combating climate change and supporting the transition to the green economy in

Türkiye by 2030. This includes alternative fuels, energy storage, energy efficiency, agriculture technologies, biotechnology, artificial intelligence, nanotechnology, 5G and beyond, additive manufacturing, robotics, and autonomy. The strategy also highlights green production and industry policies aimed at reducing the impact of industrial production on the environment and prioritizes new investments in cleaner production and technological modernization of firms. Additionally, the strategy emphasizes the establishment and expansion of an industrial symbiosis ecosystem in Türkiye and the engagement of traditionally separate industries in a collective approach for industrial symbiosis.

**TUBITAK** took the responsibility for leading "**Science and Technology Commission**" within the context of the Climate Council of Türkiye organized in the beginning of this year. Science and Technology Commission was established to foresee the technologies of the future that are required and will contribute to Türkiye's 2053 net zero emission target and green development policy. Ground-breaking R&D and innovation-based solutions are discussed in specific themes chosen in accordance with the EU Green Deal topics. We aimed to foresee the technologies of the future for adaptation and mitigation to climate change, to enable Türkiye to develop its R&D and innovation capacity in these technologies, and thus to turn the climate change crisis into an opportunity in the medium/long term. With a multidisciplinary holistic approach, we held more than 40 online meetings with the participation of 100 experts from academia, private sector, NGOs and public institutions. We have prioritized 34 technology main topics and 262 sub-topics consisting of targets. The outcomes of this study have been translated into updated prioritized RDI topics for climate change mitigation and adaptation.

The R&D and innovation sub-topics to be focused on within the scope of the above-mentioned 5 theme are given below and details could be reached at the web site of the Council[205].

- Theme1: Climate Change, Environment and Biodiversity
- Theme 2. Clean and Circular Economy
- Theme 3. Clean, Accessible and Secure Energy Supply
- Theme 4. Green and Sustainable Agriculture: A Fairer, Healthier and Environmentally Friendly Food System from Farm to Fork
- Theme 5. Sustainable Smart Transportation

## 8.1 RESEARCH

### 8.1.1 Research and Development Institute (RDI) Supports

[205] https://iklimsurasi.gov.tr/en

There are several research institution in Türkiye which are actively working on climate research. TUBITAK and universities are the key institutions while the MoEUCC, MENR, MoAF, and Ministry of Health have their own strategy and research centers to develop technologies, which will enable Türkiye reach its climate targets. These ministries also provide RDI supports in their relevant technology areas. Annex II includes a list of research institutions in Türkiye which are active in climate change related research.

In line with the 2053 zero emission target of Türkiye, studies regarding the future planning are also carried out intensively in order to support the fight against climate change and environmental problems in priority R&D and Innovation issues. Türkiye's main national R&D and Innovation Support Programs involve priorities based on the Green Deal for innovative solutions to contribute to protect ecosystems from climate change, clean and circular economy, clean, accessible and secure energy supply, green and sustainable smart transport.

Within the scope of the **policies** of the Ministry of Treasury and Finance and the **Green Deal Action Plan** of the Ministry of Trade, it is planned to determine the necessary technologies to both comply with the European Green Deal and increase green production in the industry, to support R&D studies in order to develop the technologies to be determined, and to carry out studies for the dissemination and transfer of technologies.

TUBITAK has been one of the earliest institutions which announced the roadmap for the zero-emission target for the year 2053, which was determined in order to fulfill Türkiye's obligations arising from the Paris Climate Agreement. "**Prioritized R&D and Innovation Topics within the Scope of Green Deal Agreement Compliance"** is published at the beginning of the year 2021. This guidance document for prioritized topics focused on five main themes namely **"Climate Change, Environment and Biodiversity", "Clean and Circular Economy", "Clean, Accessible and Secure Energy Supply", "Green and Sustainable Agriculture", "Sustainable Smart Transportation".** Projects focusing on these topics are being prioritized in the TUBITAK's R&D and Innovation Supports and co-creation models for both knowledge creation and development of human resources are being mobilized by TUBITAK.

Tackling climate change and realizing the "2053 zero emission target" requires university, government and industry actors to collaborate and to join efforts and capabilities. Accordingly, TUBITAK directed its platform-based support tools to the areas of compliance with the European Green Deal for achieving impact and for mobilizing the R&D and innovation accumulation within the scope of co-creation models. In TUBITAK's new call for proposals of the "**High Technology Platforms Support" and "Industry Innovation Networks Mechanism (SAYEM)",** areas focusing on sustainable solutions to mitigate and adapt to climate change attracted significant attention. In the recent calls for TUBITAK "High Technology Platforms Support" and "Industry Innovation Networks Mechanism (SAYEM), high-tech platforms targeting the areas of harmonization with the European Green Deal, including the circular

economy topics with a focus on high-tech products and high-tech information-intensive services, are prioritized. The **"Advanced Materials High Technology Platform"**, where advanced material technologies are developed to provide cleaner production opportunities and the **"Turkish Photovoltaic Technologies Platform"**, where highly efficient and cost-effective solar cell technologies, including new generation solar energy technologies are developed; are examples of platform projects focusing on green technologies.

Within the scope of the **TUBITAK Entrepreneurship Support Program (BIGG)**, TUBITAK has announced a thematic call for Green Deal in September 2021. Over 900 entrepreneurs have applied the call with their business ideas focusing on climate change, environment and biodiversity, and regulation of carbon and greenhouse gas emission. Moreover, since 2014, TUBITAK have also been running the Global Clean Technologies Entrepreneurship Program under the auspices of the Ministry of Industry and Technology and in cooperation with UNIDO. Within the scope of TUBITAK Entrepreneurship Support Program (BIGG), we have provided a total of 476 million TL grant support to 1902 entrepreneurs.

With the country's strong performance under the **Horizon 2020 Framework Program**, actors from our RDI ecosystem have took part in 955 projects and received a total of 297.6 million Euros. Of these 1,360 participants from universities and companies from Türkiye, our researchers have undertaken the task of coordinator in 29 projects. In the Horizon Europe Program, universities, companies, and public institutions from Türkiye took part in 91 projects and were awarded 48.2 million Euros.

On the other hand, in 2021, TUBITAK opened special calls for support on the topics of combating mucilage in the Sea of Marmara, one of the priority issues Türkiye needs. TUBITAK supported 37 projects within the scope of the Mucilage Research Call opened with the guidance of the Marmara Sea Action Plan Science and Technical Board. Considering the teams of researchers involved in these projects; 153 researchers from 31 different institutions/organizations (university/research center/private sector) operating in this field have come together to create domestic and national solutions.

### 8.1.2 Human Resources Supports

TUBITAK gives a special importance to the field of green agreement in human resources support. Within the scope of the **High School and Secondary School Students Research Projects Competitions**, organized to encourage environmental awareness at an early stage, We support projects in the thematic areas of "Ecological Balance, Renewable Energy, Biodiversity, Water Literacy, Sustainable Development, Natural Heritage and Natural Resources, Agriculture and Livestock Technologies, Healthy Life and Nutrition, Food and Food Projects Supply Security, Natural Disasters and Disaster Management, Intelligent Transportation Systems" .

**TUBITAK High School Students Climate Change Research Projects Competition** was started in order to raise awareness of our students who are continuing their high school education on Climate Change issues. The competition is organized in five main areas: Environment, Economic Sectors, Weather and Climate, Water Studies, Sustainability and Welfare.

In addition, TUBITAK also started the **TUBITAK Polar Research Projects Competition Program** to encourage studies on polar sciences in Antarctica and Arctic regions. The thematic areas of the competition include "Meteorology, Climate, Atmosphere and Space, Terrestrial Ecosystem, Marine Ecosystem, Marine Pollution". In addition, we organize the **TUBITAK University Students Research Projects Competition** in order to contribute to the National Technology Move and the development of the needed qualified human resources. In this context, students are supported to develop projects in thematic areas, including many areas that serve green transformation, such as Ecological Balance, Renewable Energy, Biodiversity, and Sustainable Development.

In the new calls to be made within the scope of **TUBITAK University Students Research Projects Support** and **TUBITAK Industry-Oriented University Students Research Projects Support**, we prioritize projects focusing on scientific research and technologies that serve the Sustainable Development Goals, especially climate change. In graduate studies, we provide scholarships in priority fields such as "Energy Efficiency, Solar Energy, Coal Technologies, Wind Energy, Agriculture and Livestock Biotechnology" within the scope of **TUBITAK International Doctorate Scholarship Program**.

TUBITAK provides support to university- industry consortiums composed of 49 academic and 210 private sector organizations who came together to train 1162 PhD candidates in the fields needed by the industry within the context of the **Industrial Doctorate Fellowship Programme**. Among the projects supported are increasing water efficiency, environmental sustainability, sustainable agriculture, local biotechnological fertilizers, biobased adhesives, composite materials in textiles, environmentally friendly materials, clean production practices, energy efficiency in glass production, wastewater recovery, energy management in smart grids, etc. topics are included.

With the **International Fellowship for Outstanding Researchers Programme**, 190 top researchers have been integrated into our RDI ecosystem to work in various institutions and organizations, including R&D or design center of the private sector organizations or firms established within techno parks. In addition, we continue to support 82 qualified researchers, who have carried out pioneering research in Türkiye, with **TUBITAK's National Outstanding Researchers Program**.

### 8.1.3 Further Planning

The Green Deal Action Plan of Türkiye was released by the Ministry of Trade and provides a strategy for achieving a green transition of the economy. Within the scope of the Action Plan, **"Green Growth Technology Roadmap"** studies are being carried out by the MoIT and TUBITAK. The Technology Roadmap study is being conducted for the Iron-Steel, Aluminum, Cement, Chemicals, Plastics and Fertilizer sectors; which are critically important for the Turkish economy and have high carbon emissions. Because of the Technology Roadmap studies, priority R&D and innovation themes for each sector will be detailed. Benefiting from the outputs of this study, proper STI and investment support programs will be designed in cooperation with MoIT especially for projects that will provide domestic solutions to the technological needs of private sector organizations in Türkiye that will enable them to adapt to green transition. TUBITAK will contribute to the green transformation of the Turkish economy and industry and Türkiye's vision of green and sustainable development, with a focus on science and technology.

### 8.1.4 RDI Activities

TUBITAK is committed to developing technologies that can help the country face global risks and challenges, turning them into opportunities for innovation. To achieve this, TUBITAK emphasizes co-creation oriented new knowledge generation and human resources development. The concept of **"Twin Transition"** highlights the simultaneous impact of digital and green transformations on all systems, and TUBITAK recognizes the need to strengthen the R&D and innovation ecosystem to drive these transformations. TUBITAK encourages multi-disciplinary and multi-stakeholder solutions, with an approach based on "co-creation" and "succeeding together" to promote impact-oriented solutions.

Digital technologies are a priority in TUBITAK's R&D and innovation support programs. 42% of the prioritized technologies for 2020-2021 are in the field of information and communication technologies. Big data, cloud computing, artificial intelligence, robotics, embedded systems, and the internet of things are just a few examples of digital technologies that can benefit fields such as biodiversity, ecosystem monitoring and protection, air quality, precision agriculture, sustainable cities, and innovative agricultural systems. TUBITAK recognizes that taking an inter-, multi-, and trans-disciplinary approach to these technologies will accelerate progress towards addressing climate change.

TUBITAK aims to prepare for technological advancements that will foster sustainable development and position the country as a leader in R&D and innovation. The **Science and Technology Commission**'s outcomes are translated into prioritized RDI topics in TUBITAK's R&D and innovation support programs. The **"Prioritized R&D and Innovation Topics within the Scope of Green Deal Agreement Compliance"** has been renewed for academia and industry.

TUBITAK supports private sector organizations by encouraging the commercialization of research results and entrepreneurship processes in the STI ecosystem. **TUBITAK 's Order Based**

**R&D Program** allows technology developer SMEs to collaborate with customer firms and transform their technology-based solutions that meet sector needs into outputs with commercial value. TUBITAK has co-funded 180 projects with customer firms, involving 272 different companies.

**TUBITAK Marmara Research Center (MAM)** carries out projects that will respond to the critical needs of Türkiye in the most effective and shortest time possible and support the Turkish industry and reduce foreign dependency by transferring the know-how and technologies it has acquired to the private sector. TUBITAK Marmara Research Center was restructured and the "Climate Change and Sustainability Vice Presidency" was established. Several projects carried out by TUBITAK MAM to combat climate change (see Chapter 6.4).

SMART4ENV Project (Enhancing the Scientific Capacity of TUBITAK MAM in the Field of Smart Environmental Technologies for Climate Change Challenges) which runs from 2022 to 2025, aims to improve TUBITAK MAM in the field of smart environmental technologies for climate change challenges. The project seeks to strengthen TUBITAK MAM's scientific reputation, attractiveness, and networking channels while promoting scientific excellence in key applications of smart environmental solutions for the mitigation and adaptation of Türkiye's economy to climate change. The project will achieve this goal by developing capacity building and training programs for permanent scientists and early-stage researchers, fostering cooperation between academia, industry, and stakeholders in Türkiye, and providing a sustainable framework for research, international networking, mobility, and integration in the European Research Area. The project will also strengthen the experience of TUBITAK MAM's research staff, including a new generation of young scientists, by cooperating with EU partners of established scientific excellence and experience in awareness-raising to contribute to the implementation of environmental sustainability, digitalization, and green deal action plans in Türkiye.

Research infrastructures play an important role in ensuring the necessary R&D and innovation breakthrough for Turkey's 2053 net zero emission target. Considering the importance of its role in scientific and technological development, since the 2000s, the establishment and development of research infrastructures within universities and public institutions and organizations, in line with national and regional priorities and taking into account the needs of the public and private sectors, has been supported within the scope of investment programs. Some of these infrastructures are; Energy Institute and Environment and Cleaner Production Institute within TÜBİTAK Marmara Research Center, Solar Energy Research and Application Center (GÜNAM) within METU, Ege University Solar Energy Institute, Synthetic Natural Gas and Hydrogen Production Technologies Laboratory within Boğaziçi University, Synthetic Fuels and Chemicals Technology Centre within Istanbul Technical University.

All these studies and efforts were paid in order to find the technological issues where the most accurate and fastest results can be obtained for meeting the objectives set by Paris Agreement. Anticipating the technologies of the future in line with the net zero target will enable Türkiye to develop its R&D and innovation capacity in these technologies. In this way, it is aimed that Türkiye will turn the climate change crisis into an opportunity in the medium/long term.

## 8.2 SYSTEMATIC OBSERVATION

There are various types of systematic observation systems in Türkiye, including atmospheric climate observation, terrestrial climate observation, ocean climate observation, and cryosphere observation.

### 8.1.1 Atmospheric and Terrestrial Climate Observing Systems

The **Turkish State Meteorological Service (TSMS)** is one of the leading institutions in the use of modern and advance technology for atmospheric and terrestrial climate observing systems. The TSMS has access to a range of state-of-the-art technologies such as meteorological radars, automatic meteorology observation stations, upper atmosphere observation systems, lightning detection and tracking systems, meteorological satellites, satellite communication and ground receiving systems, and high-performance supercomputers. Meteorological studies require a robust communication infrastructure on both the national and global scale, and TSMS plays a crucial role in this by collecting, producing and distributing meteorological observation and measurement data in accordance with its national and international responsibilities through its strong communication infrastructure. With the widespread use of state-of-the-art observation systems across the country, it is possible to make automatic observations with electronic devices, thus obtaining faster, more accurate, continuous and timely observation data. [206]

The TSMS is the sole authority for conducting atmospheric measurements in Türkiye. The organization of the TSMS is widespread and covers the entire country, with 16 regional directorates, as shown in Figure 76. The observation network connected to these regional directorates is presented in Table 35.

[206] Turkish State Meteorological Service (TSMS), 2018 Performance Program

*Figure 76 - Distribution of the TSMS's regional directorates*

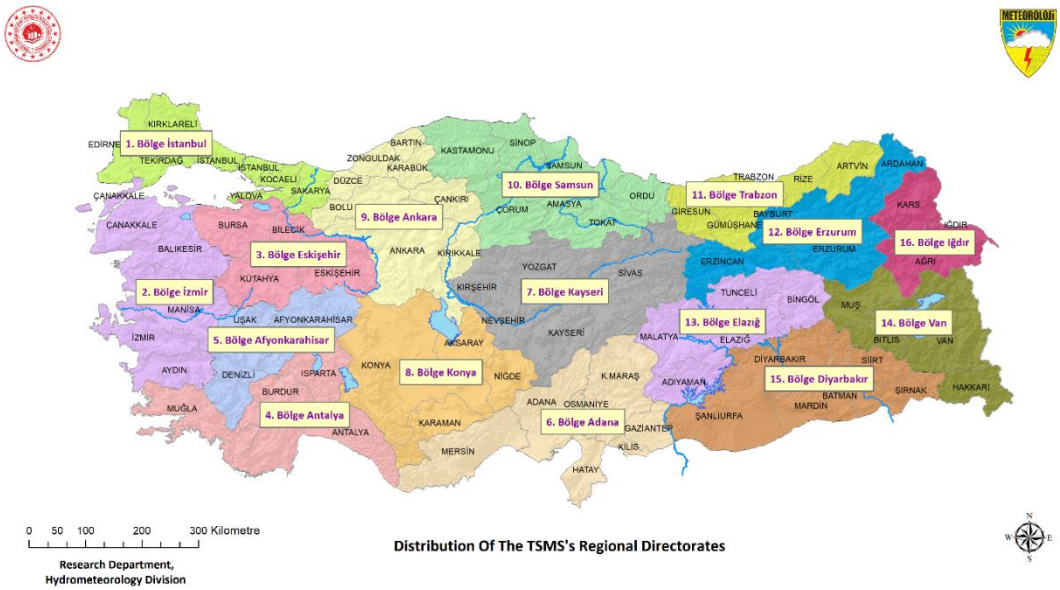



*Table 35 - Types of stations connected to the regional directorates*

| Directorate | AWOS | A-AWOS | Mobil-AWOS | M-AWOS | RADAR | Mobil RADAR | Marine RADAR | Rawinsonde | Mobil Rawinsonde | Lightning Detection | Handheld AWS | *LL WAS* | Sand and Dust Storm Observation Systems |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Region 1 İstanbul** | 136 | 6 | | 13 | 1 | | 2 | 1 | | 2 | 8 | | |
| **Region 2 İzmir** | 147 | 12 | | 28 | 2 | | | 1 | | 3 | 13 | | |
| **Region 3 Eskişehir** | 91 | 6 | 1 | 1 | 1 | | | | | 2 | 7 | | |
| **Region 4 Antalya** | 134 | 6 | | 13 | 2 | | | 1 | | 5 | 7 | 1 | 1 |
| **Region 5 Afyonkarahisar** | 95 | 3 | | | 1 | | | | | 2 | 4 | | |
| **Region 6 Adana** | 131 | 4 | | 8 | 2 | 1 | | 1 | | 4 | 5 | | |
| **Region 7 Kayseri** | 116 | 3 | | | 1 | | | 1 | | 2 | 4 | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Region 8 Konya** | 92 | 1 | | | 1 | | | | | 2 | 2 | | |
| **Region 9 Ankara** | 147 | 5 | | 4 | 2 | | | 1 | 1 | 3 | 18 | | 1 |
| **Region 10 Samsun** | 166 | 6 | | 11 | 1 | | | 1 | | 3 | 7 | | |
| **Region 11 Trabzon** | 134 | 2 | | 8 | 1 | | | | | 1 | 2 | | |
| **Region 12 Erzurum** | 70 | 2 | | | 1 | | | 1 | | 2 | 3 | | |
| **Region 13 Elazığ** | 94 | 5 | | | | | | | | 1 | 6 | | |
| **Region 14 Van** | 48 | 3 | | 4 | | | | | | 3 | 4 | | |
| **Region 15 Diyarbakır** | 87 | 7 | | | 1 | | | 1 | | 4 | 7 | | 1 |
| **Region 16 Iğdır** | 29 | 3 | | | | | | | | 2 | 3 | | |
| **Total** | **1,717** | **74** | **1** | **90** | **17** | **1** | **2** | **9** | **1** | **41** | **100** | **1** | **3** |

The TSMS cooperates with the World Meteorological Organization (WMO), of which it is a member. Through this international partnership, the TSMS is actively participates in all WMO programs, including the Global Observing System (GOS), the Global Climate Observing System (GCOS), Surface Radiation Network (SRN) and Global Atmospheric Watch (GAW). The GOS combines various international data collection systems, such as Global Upper Atmosphere Observing Systems, Global Climate Observing Systems, etc. on the national scale. The TSMS shares internationally, on behalf of Türkiye, airport observations (75 stations), upper atmosphere observations (9 stations), climatic observations (GCOS 7 stations and Regional Basic Climate Network 61 stations), synoptic observations (Regional Basic Synoptic Network 278 stations) and ozone observations (GAW 1 station) through a total of 308 stations (WMO WIGOS OSCAR).

The GCOS consists of surface network and upper atmosphere network and stations in GCOS are similar to those in GOS. Stations from Türkiye (Rize, Istanbul, Kastamonu, Sivas, Isparta, Finike) are GCOS stations.

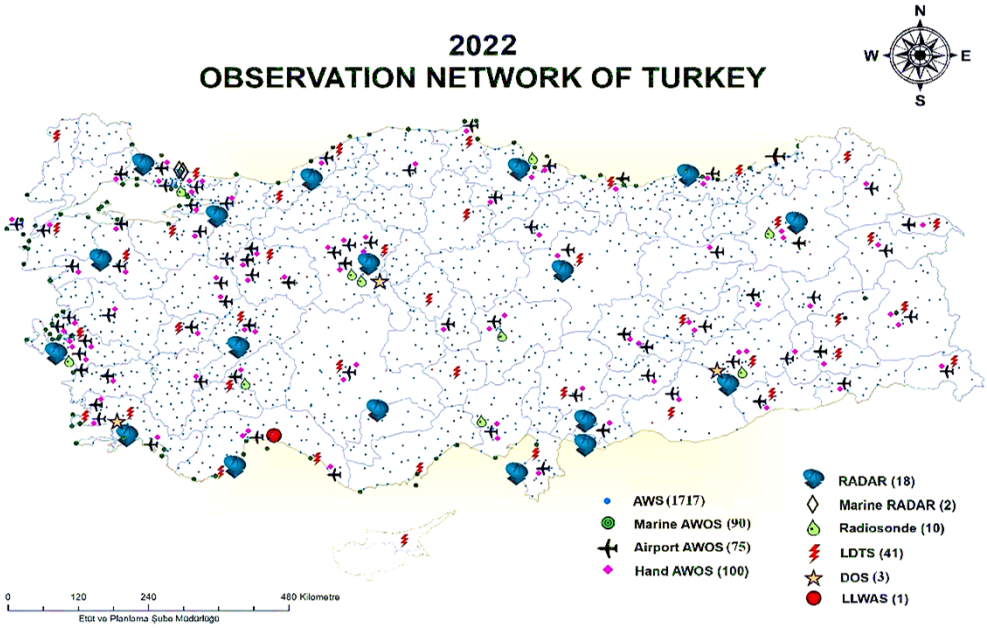
#### *8.2.1.1 Meteorological Observation Network*

In Türkiye, the observation network has been continuously expanding and modernizing since the implementation of planned observation in 1929. Today, the observation network consists of a wide range of systems that provide real-time weather information to the user, support forecasting, increase the consistency of forecasts, and facilitate research activities including climate and climate change. This observation network by TSMS in Türkiye is shown in Figure 77 and includes:

- Automatic Weather Observation Stations (AWOS)
- Airport Automatic Weather Observation Stations (A-AWOS)
- Handheld Automatic Weather Stations (HAWS)
- Meteorological Satellite Ground Receiver Systems
- Meteorological Radar Systems
- Lightning Detection and Tracking System (LDTS)
- Upper Atmosphere Observation Systems (Rawinsonde)
- Sand and Dust Observation Systems (DOS)
- Low-Level Wind Shear Alert System (LLWAS)
- Solar Radiation Observations
- Marine Automatic Weather Observation Stations (M-AWOS)
- Marine Radars

At the end of 2022, the number of systems in the observation network has reached 2,057 as shown in the Figure 77. These systems are managed and operated by the TSMS and are used to prepare meteorological products and services needed by various sectors.

*Figure 77 - Observation Network by TSMS in Türkiye*




TSMS operates a wide range of weather observation and monitoring systems in order to collect data on various meteorological parameters. In addition to ***"Automatic Weather Observation Station (AWOS)"***, TSMS operates ***"Airport Automatic Weather Observation Station (A-AWOS)"*** which are designed to prepare meteorological products and services that are essential for aviation at airports and flight safety. As of the first half of 2022, the number of observation stations has increased in the last 5 years and reached 75 airports across Türkiye, where data is collected from the 74 A-AWOS stations and 1 Mobile AWOS.

TSMS also uses ***"Handheld Automatic Weather Stations (HAWS)"*** as part of its weather observation and monitoring network. These HAWS provide an additional level of redundancy to existing systems by providing weather observations in case of the failure of the other systems, which are installed at the Regional Directorates and airports of TSMS. As of 2022, 100 HAWS have been put into service. They can also be used in the Meteorology Observation and Forecasting Centers (TIR) to supplement the data from the other systems.

***"Meteorological Satellite Ground Receiver Systems"*** are an important component of the weather observation and monitoring network operated by TSMS. In 1984, TSMS joined the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) as a founding member. As of 2022, TSMS is receiving real-time and near real-time data from 3 EUMETSAT geostationary orbit satellites and 2 polar orbit satellites.

***"Meteorological Radar Systems"*** are remote sensing systems that use radar waves to determine the density, position, direction, and speed of air masses in the atmosphere. These systems can provide a high resolution, large-scale view of weather conditions which makes them

an important tool for meteorological research and short-term weather forecasting. As of 2022, TSMS operates a meteorological radar network consisting of a total of 18 radars (17 C-Band radars and 1 X-Band radar). The C-band radars are located in Ankara, Istanbul, Balıkesir, Zonguldak, Izmir, Muğla, Antalya, Hatay, Samsun, Trabzon, Afyonkarahisar, Bursa, Karaman, Gaziantep, Şanlıurfa Erzurum and Sivas. The X-Band radar is at Istanbul Atatürk Airport .[207]

The ***"Lightning Detection and Tracking System (LDTS)"*** is used for detecting, tracking lightning and thunderbolt phenomena, as well as for short-term weather forecasting, known as Nowcasting. This system uses a network of sensors to detect and locate lightning strikes, and can provide information on the location, type, polarity and signal size of lightning and thunderbolt, as well as the height of lightning. As of 2022, TSMS is using the LDTS installed at 41 points across Türkiye.

***"Upper Atmosphere Observation Systems"*** such as rawinsondes, are used to obtain height data of temperature, humidity, wind and pressure levels in the atmosphere up to 35 km above ground level. These systems provide the upper atmosphere data required for presenting meteorological products and services, which are of vital importance for weather forecasting and flight safety. As the first half of the 2022, upper atmosphere observations are performed at 9 stations across Türkiye, these stations are Adana, Ankara, Diyarbakır, Erzurum, Isparta, Istanbul, Izmir, Samsun and Kayseri. Furthermore, 1 mobile system can be used to conduct upper atmosphere observations in any location .[208]

Sand and dust storms can have a significant impact on air quality, visibility and public health as well as on transportation and other human activities. The area extending from the Western Sahara through the Middle East and Central Asia to the Gobi Desert is often referred to as the "dust belt" due to high frequency of dust storms that occur in this region. Türkiye is situated near the Middle East, with territory in both Europe and Asia, thus making it vulnerable to dust storms from both North Africa and the Middle East. To better monitor the transboundary transport of dust, TSMS has been increasing its capacity in monitoring sand and dust storms. As of 2022, TSMS has installed 3 ***"Dust Observation Systems (DOS)"*** in strategic locations across the country.

A ***"Low-Level Wind Shear Alert System (LLWAS)"*** is a ground-based system that is used to detect wind shear and other associated weather phenomena, such as microbursts, close to an airport; particularly along the runway corridors. LLWAS has been installed in Antalya Airport in 2018, and continuously providing wind shear alerts.

***"Air Quality Observation Systems"*** are used to monitor the concentration of various pollutants in the air, such as particulate matter, ozone, nitrogen oxides, sulfur dioxide, and carbon

[207] Turkish State Meteorological Service (TSMS). 2022 Administrative Activity Report

[208] Turkish State Meteorological Service (TSMS). 2022 Administrative Activity Report

monoxide to understand the impacts of air pollution on human health and the environment. The samples coming from the Automatic Precipitation Collecting Systems located in 10 different regions of Türkiye are analyzed in the Acid Rain Laboratory in terms of acidity (pH), electrical conductivity, and metal analyses, anion and cation analyses are conducted, and transboundary pollution transportation is detected. As of 2022 in Türkiye, 365 air quality measuring stations have been established by various institutions, such as the Ministry of Environment, Urbanization and Climate Change (MoEUCC), municipalities, and Organized Industrial Zones. These stations measure parameters such as sulphur dioxide ($SO_2$) and particulate matter (PM10) parameters, nitrous oxides (NO, $NO_2$, $NO_x$), carbon monoxides (CO) and Ozone ($O_3$). All data is sent to and collected by the Data Operation Center of Environmental Reference Laboratory affiliated to the MoEUCC.

Ozone monitoring is an important aspect of meteorological observations, as ozone is a key component of the Earth's atmosphere and plays and important role in protecting life from the harmful effects of ultraviolet radiation from the sun. TSMS operates an ***"Ozone Monitoring Network"*** that uses "Brewer Spectrophotometer Device" to measure total ozone. Measurements are taken regularly and sent to the World Ozone and Ultraviolet Radiation Data Centre (WOUDC) and the results are also published.

#### *8.2.1.2 Hydrometeorological Observation Network*

The **General Directorate of State Hydraulic Works (DSI)** is responsible for carrying out hydrometeorological observation activities in Türkiye. Within the scope of observation activities, DSI carries out instantaneous hydrometric, hydrometeorological, sediment, snow and water quality observations in 25 basins across the country, as well as monitoring environmental water flow released from Hydroelectric Power Plants (HEPPs). The number of active stations in a hydrometeorological observation network as of 2022 is given in Table 36.

*Table 36 - Types and number of observation stations installed by State Hydraulic Works[39]*

| Type of Station | Number of Station | Number of On-line Station |
|---|---|---|
| Flow Monitoring Station | 1,340 | 915 |
| Lake Monitoring Station | 531 | 56 |
| Meteorological Monitoring Station | 56 | |
| Snow Observation Station | 260 | 46 |
| Sediment Intake Point | 155 | |

| | | |
|---|---|---|
| HEPP Environmental Flow Monitoring | 646 | 586 |
| Miscellaneous Monitoring Stations* | 1,382 | |
| Irrigation Canal Monitoring Station | 1,577 | |
| Underground Water Monitoring Stations | 2,812 | |
| **TOTAL** | **8,759** | **1,603** |

* Miscellaneous Monitoring stations are temporary monitoring stations usually used in planning studies of ponds (sampling two times in a month)

As shown in the Table 37, there are also 3,618 monitoring points within the scope of the water quality monitoring program between 2019-2021. These monitoring points are spread across 25 river basins in Türkiye to collect data on various water quality parameters.

*Table 37 - Water Quality Monitoring Points of 2019-2021*

| Basin Name | River | Lake | Coast | Transition | TOTAL |
|---|---|---|---|---|---|
| Büyük Menderes | 94 | 70 | 3 | 1 | 168 |
| Susurluk | 127 | 74 | 8 | 4 | 213 |
| Ergene | 89 | 47 | 0 | 1 | 137 |
| Konya Kapalı | 58 | 97 | 0 | 0 | 155 |
| Sakarya | 146 | 95 | 2 | 2 | 245 |
| Akarçay | 44 | 27 | 0 | 0 | 71 |
| Yeşilırmak | 84 | 94 | 4 | 1 | 183 |
| Batı Karadeniz | 63 | 58 | 8 | 1 | 130 |
| Batı Akdeniz | 72 | 60 | 9 | 3 | 144 |
| Doğu Akdeniz | 58 | 47 | 10 | 3 | 118 |
| Asi | 31 | 17 | 8 | 3 | 59 |
| Ceyhan | 86 | 79 | 5 | 1 | 171 |
| Seyhan | 55 | 72 | 3 | 1 | 131 |
| Marmara | 105 | 94 | 24 | 1 | 224 |

| | | | | | |
|---|---|---|---|---|---|
| Kuzey Ege | 58 | 33 | 9 | 1 | 101 |
| Küçük Menderes | 39 | 34 | 9 | 1 | 83 |
| Gediz | 55 | 34 | 7 | 1 | 97 |
| Burdur | 15 | 44 | 0 | 0 | 59 |
| Antalya | 50 | 57 | 7 | 1 | 115 |
| Kızılırmak | 175 | 98 | 2 | 1 | 276 |
| Doğu Karadeniz | 74 | 18 | 9 | 2 | 103 |
| Aras | 37 | 49 | 0 | 0 | 86 |
| Çoruh | 30 | 47 | 0 | 0 | 77 |
| Van Gölü | 22 | 76 | 0 | 0 | 98 |
| Fırat-Dicle | 221 | 153 | 0 | 0 | 374 |
| **TOTAL** | **1,888** | **1,574** | **127** | **29** | **3,618** |

Besides that, as mentioned in previous sections, water quality monitoring programmes have been revised in 2021 for 25 river basins by DGWM.

As 25% of Türkiye's power generation comes from hydraulic sources, it is vital to have accurate predictions of water flow and efficient operation of hydroelectric power plants. Inadequate predictions of water flow inefficient operation can lead to significant financial losses and problems like overflowing dams and floods. To address these issues, the **"Flow Estimation and Basin Optimization Model Project (ATHOM)"** was conducted between DSI and TUBITAK Marmara Research Center in the Seyhan Pilot Basin. The aim of the project is to develop a model that can accurately estimate the water flow in existing and single and sequential water structures, and accordingly the prepare water budgets and optimize the daily, monthly and annual operation of the facilities.

The ATHOM system was successfully developed and implemented in the Seyhan Basin, and it was decided to extend the system to the Euphrates-Tigris, Kızılırmak, Yeşilırmak and Ceyhan Basins, which include the largest river basins of Türkiye. As of June 2020, a new project was signed to further extend the use of ATHOM system for new basins under the name of the "ATHOM Development and Expansion Project". This new project includes the preparation of data infrastructures for new basins and completion of an operational data network. The studies for the development of new estimation and optimization models continue according to the

updated literature, with the goal of including all basins of the country in the ATHOM system, and thus enabling all the basins of the country to be managed by a single system, with widespread use of the ATHOM system.

#### *8.2.1.3 Early Warning and Forecasting Systems in Türkiye*

The TSMS is a member of key organizations such as World Meteorological Organization (WMO), European Centre for Medium-Range Weather Forecasts (ECMWF), European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), A Consortium for Convection-scale modelling Research and Development (ACCORD) and accessing to the latest information and tools to support studies on global climate change.

The TSMS uses global models like ECMWF IFS, ECMWF EPS and ARPEGE of Meteo-France as well as local numerical weather prediction models such as AROME, ALARO, WRF and A-LAEF. For marine forecasting, the TSMS uses WW3 and SWAN models. To ensure the high level of accuracy and consistency in weather forecasts and early warnings, TSMS utilizes high-performance computer systems with 4032 cores that have a capacity of approximately 167 teraflops operations per second.

There are various early warning and forecasting systems in Türkiye includes:

- Flash Flood Guidance System (FFGS)
- Agricultural Frost Warning System (AFWS)
- Drought Monitoring System (DMS)
- Meteorological Early Warning System for Forest Fires (MEUS)
- Avalanche Forecasts and Early Warning Model
- Inversion Forecasts
- Sand and Dust Storm Forecasts
- UV Index and Ozone Forecast Global Model (GME-Global Model)
- Solar Radiation Distribution Maps
- Highway Weather Forecasting System
- Seaway Weather Forecasting System
- Marina Forecasting System

The TSMS provides flood forecasts on a national and international scale as part of the ***"Flash Flood Guidance System (FFGS)".*** This system is used to determine which basins will be at risk of flooding up to 6 hours in advance, on a sub-basin scale. This allows TSMS to provide targeted flood warnings to those who may be affected.

***TSMS provides "Agricultural Frost Warning System (AFWS)"*** and ***"Frost Risk Forecast Maps"*** to agriculture producers protect their crops from frost damage. The AFWS make use of the latest meteorological data and forecasts to provide users with up-to-date information on frost risk and

the expected minimum temperatures on a province and district level basis and for different types of crops. The frost risk forecast maps, which are updated every day, use meteorological forecasts to show areas with different levels of frost risks for the next five days, with different colors on the map representing mild, moderate, strong and very strong risks. The program takes into account the stage of growth of the plant and based on the results of studies conducted by the United Nations Food and Agriculture Organization (FAO) and in Türkiye. By providing detailed frost risk forecast maps, the TSMS enables producers to take necessary precautions in order to prevent potential losses caused by frost .[209]

The TSMS uses the Standardized Precipitation Index (SPI) and Percent of Normal Index (PNI) method to conduct meteorological drought maps, which allow the severity of dry and wet periods to be determined. The ***"Drought Monitoring System (DMS)"*** software that enables the analysis and monitoring of meteorological drought phenomena on a monthly or yearly basis over long or different periods.

The ***"Meteorological Early Warning System for Forest Fires (MEUS)"*** has been developed to provide an early warning system that is well-suited to the conditions present in Türkiye, in order to aid in preventing forest fires. By evaluating the data obtained from the European Center for Medium-Range Weather Forecasts (ECMWF) using the MEUS and Angstrom index, high-risk areas for forest fires are identified and mapped. The MEUS and ANGSTROM index model outputs are used to create three-day forest fire risk maps that are shared with the General Directorate of Forestry (GDF) to help with early warning and prevention efforts.

In addition to the early warning systems, the TSMS also operates an ***"Avalanche Forecast and Early Warning Model"***. The model utilizes the outputs from the ECMWF forecast model to predict the potential for avalanches in specific areas and provide early warning to relevant sectors. These forecasts are enabling the relevant stakeholders to take necessary precautions.

The ***"Inversion Intensity Forecast for Urban Air Pollution Risk"*** study conducted by the TSMS to create Inversion Forecasts Risk Maps, particularly in the winter season, in provincial and district centers. These forecasts are published daily, allowing relevant institutions and organizations to take necessary precautions to mitigate the risk of air pollution.

The TSMS operates a ***"Sand and Dust Storm Forecasts"*** system which began operationally in 2010 with BSC-DREAM8b model developed by the Barcelona Supercomputing Center, has been providing 72 hours forecasts using the ECMWF-CAMS model since 2019. Additionally, Türkiye is also a host of the Virtual SDS Forecast Center for the West Asia which was established as part of the "Action Plan on the Cooperation on the Environment and Meteorology" agreed upon by Türkiye, Iran, Iraq, Syria and Qatar in 2010.

[209] Turkish State Meteorological Service (TSMS). 2018 Administrative Activity Report

***"UV Index and Ozone Forecast Global Model (GME-Global Model)"*** has been developed by the TSMS to provide real time monitoring forecasts of UV index and ozone levels. The GME-Global Model, developed by the German Meteorological Service (DWD), to provide forecasts of total ozone and UV index. Additionally, the TSMS has developed its own Statistical Model called "Three-Day Total Ozone and UV Index Forecast" which provides forecasts specifically for the city of Ankara as part of a TUBITAK Project.

The ***"Solar Radiation Distribution Maps"*** of Türkiye have been developed by the TSMS using a "Solar Radiation Model". The model uses satellite-based semi-dynamic model to produce information for 3600 grid points across Türkiye. A data archive with 20-km resolution has been created for the years 2004-2021, with daily model outputs. The areal average of the solar radiation intensity for Türkiye is calculated as 1645 kWh/m²/year. The accuracy of the calculated data has been tested using measurements from 54 ground observation stations, and it has been determined that the model outputs are 98% reliable on average. These Solar Radiation Distribution Maps are available on different scale to the public on the TSMS website.

The ***"Highway Weather Forecasting System"*** has been developed by the TSMS to help drivers plan their travels and stay safe on the road. It is a web-based service that provides detailed interprovincial weather forecasts up to 72 hours. The system is based on the ALORO model, which covers all the important main lines of Türkiye's highway network, providing pointwise meteorological forecast information on the route are available on the website.

The ***"Seaway Forecasting System"***, developed by the TSMS, is an interactive tool for the sea travel. It provides users with detailed information about the expected weather and marine conditions along their chosen route, using a combination of the METU-3 wave model and the WRF weather forecast model. The system covers the Black Sea, Mediterranean, Aegean, Marmara and Caspian seas, and allows users to access 5-day weather and marine forecasts for more than 200 domestic and foreign marinas/ports.

The ***"Marina Forecasting System"*** provides detailed meteorological forecasts for specific marinas or coastal regions. The system is designed to be user-friendly, allowing users to easily access the information they need to plan their yachting or coastal activities safely. It is also intended to help promote and support the growth of yacht and coastal tourism in Türkiye.

#### *8.2.1.4 Effective Communication of Meteorological Forecasts and Warnings*

The Turkish State Meteorological Service (TSMS) is responsible for preparing and communicating these warnings to the public and relevant institutions. As mentioned in the 7th NC, the TSMS communicates meteorological warnings through AFAD units, media organizations, local and administrative units, relevant public institutions and organizations, and citizens, as well as various channels, including the TSMS' website, SMS, telephone, fax, email, and participation in national television and radio broadcasts.

In addition to preparing and communicating meteorological warnings, the TSMS also prepares and presents short and medium-term weather forecasts to the public. These forecasts are updated daily with 3-hour periods for the short-term forecasts, and 5-day and 7-day periods for the medium-term forecasts. Long-term weather forecasts are presented on a monthly (weekly periods) and seasonal basis (3 months). The TSMS has demonstrated a high-level of consistency in precipitation and temperature forecasting, with an average of 85.4% for long-term precipitation forecasting and 91.5% in 2020 and 92.4% in 2021. Furthermore, the consistency average of long-term temperature forecasting was 83%, with a rate of 88.9% in 2020 and 88.1% in 2021.

#### *8.2.1.5 Meteorological Data Management: Observation, Archiving and Distribution*

The Turkish State Meteorological Service (TSMS) plays a critical role in collecting, archiving, and distributing meteorological data through its network of observation stations and automated weather stations. The institution uses various data sources, such as Automatic Weather Stations, Upper Atmosphere Observation Systems, Meteorological Radars, Marine Radars, Lightning Detection and Tracking System and Meteorological Satellites to gather information. Additionally, observations made by the experts are also used to supplement the data.

The data is then quickly and automatically sent to the center of the TSMS, where it is instantly sent to both domestic and international sources. All meteorological measurements and observation data obtained from the observation network are archived in electronic media at the center of the TSMS, and can be accessed, presented and sold through a user-based MEVBİS (Meteorological Data Information Presentation and Sales System) interface. This interface provides online access to ground observations, upper atmosphere observations, marine observations, lightning detection system records, precipitation intensity analysis data, climate bulletins, and data on climate projections, within the framework of user authority .[210]

#### *8.2.1.6 Calibration Center (KALMER)*

Calibration Center of TSMS has been providing calibration services for Temperature, Relative Humidity, Pressure, Wind Speed, Precipitation Amount and Intensity and Global Radiation sensors since 2009. On April 30th, 2010, the Calibration Center was accredited by Turkish Accreditation Agency (TURKAK) in accordance with ISO/IEC 17025:2017 to ensure the reliability of the measurements and make the quality of these measurements valid around the world. This accreditation was renewed by TURKAK on November 7th, 2018, for 4 years.

Temperature, Humidity, Pressure and Wind Speed Calibration Laboratories are accredited laboratories that implement the TS EN ISO/IEC 17025 standard. Precipitation Amount and

[210] Turkish State Meteorological Service (TSMS) 2018 Performance Program

Intensity, Global Radiation, Electrical and Wind Direction Calibration Laboratories also apply the TS EN ISO/IEC 17025 standard and use traceable reference devices.

In 2010, the Calibration Center of TSMS was recognized as the Economic Cooperation Organization Calibration Center (ECO-MCC) by the 2nd Meeting of the ECO Heads of Meteorological Organizations (Antalya, 18-19 October 2010). In the Report of the 19th Council of Ministers' Meeting (Istanbul, 22 December 2010), the ECO Meteorological Calibration Center (ECO-MCC) Section, Article 36. "The Council approved the establishment of the ECO Meteorological Calibration Center (ECO-MCC) in Ankara as an affiliated body of ECO and called on the Member States to extend support and cooperation to its activities." statement is included. Afterwards, in the 11th Economic Cooperation Organization (ECO) Summit Meeting (Istanbul, 23 December 2010), ECO Meteorological Calibration Center (ECO-MCC) was included in the Istanbul Declaration 2010. Also, the Calibration Center of TSMS is designated as the Regional Instrument Center (RIC) for WMO Regional Association (RA) VI with full capabilities and functions, according to the current RIC terms of reference adopted by WMO RA-VI at the Seventeenth Session held in Geneva in 2018.

### 8.1.2 Ocean Climate Observing Systems

The Turkish State Meteorological Service (TSMS), the General Command of Mapping and the Middle East Technical University, Institute of Marine Sciences (METU-IMS) play significant roles in ocean climate observing systems. The METU-IMS, which is a member of many international Global Ocean Observation System (GOOS) organizations such as EuroGOOS, MonGOOS, and Euro-Argo Program, conducts oceanographic and climatologic research, and coordinates the Marine Ecosystem and Climate Research Center (DEKOSIM) Project. This project aims to increase the long-term and continuous observation capacity in the Turkish seas and to use the data obtained from these observations to derive climate and ecosystem-relevant data products for the use of public and private end users and stakeholders in marine, maritime and climate change sectors. The project has established long-term marine observation systems in the Mediterranean and Black Seas, consisting of the deployment of 4 Argo floats in the Black Sea, 2 Argo floats in the Eastern Mediterranean, one coastal mooring system in the Eastern Mediterranean with sensors to obtain continuous oceanographic, meteorological, and atmospheric measurements, and an oceanographic time series program (ETS) operating since 1997 to measure physical and biochemical parameters of the water column at 3 stations, analyzed to understand long-term variability in the region, including climatic variability.

The TSMS is responsible for forecasting marine climate through its observation network as shown in Figure 78, and includes:

- Marine Automatic Weather Observation Stations (M-AWOS)
- Marine Radars

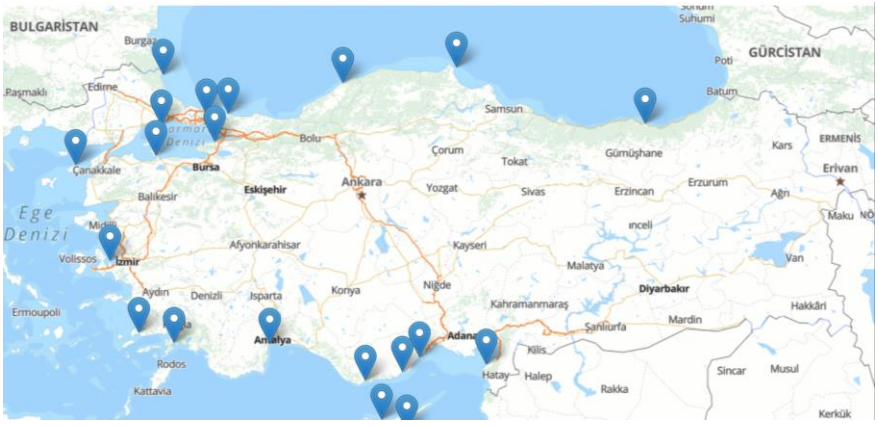
The TSMS operates "***Marine Automatic Weather Observation Station (M-AWOS)"*** to measure and monitor a variety of meteorological parameters, including temperature, humidity, wind direction and speed, precipitation, and seawater temperature. These systems are located in 89 M-AWOS, where lighthouses are located and on buoys in the seas. The data collected by M-AWOS systems is used to support maritime activities and to prepare meteorological products and services for the maritime industry. In addition to the standard meteorological parameters, the M-AWOS systems also have wavemeters, flow meters, salinity and conductivity detectors, which allows to collect even detailed information about the sea conditions.

The TSMS also uses "***Marine Radars***" to measure information about the waves, winds, and currents in the seas of Türkiye over a wide area. These radars use the remote sensing method to gather data. The TSMS currently operates 2 marine radars. As of 2015, Marine Radar products were made available to all users on the website of the TSMS. These systems provide data on current velocity and direction, wave height and direction, wind speed and direction, which is obtained every half hour.

In Türkiye, oceanographic observations and sea level observations are mainly carried out by marine sciences institutes and the General Command of Mapping. the ***"Turkish National Sea Level Monitoring Network (TUDES)"*** project is managed by the General Command of Mapping, and as of 2022, TUDES consists of a total of 20 digital and automatic mareograph stations that are distributed along the Turkish and TRNC coasts as shown in Figure 77. These stations meet the GLOSS standards, and they are equipped with sensors that can measure sea level and meteorological parameters such as temperature, humidity, and pressure. The data is then transmitted as 15-minute mean values to the data/processing center in Ankara.

Users can access sea level data at the local datum of each station through the TUDES Web portal, which is freely available to users. Users can also reach the sea level data at the national height datum after paying a standard annual subscription fee. The stations are being upgraded and changed from acoustic sensors that have sounding tubes to radar.

*Figure 78 - Turkish National Sea Level Monitoring Network (TUDES) stations*



As mentioned in the 7th NC, the data from seven tide gauge stations operated by the General Command of Mapping are instantaneously transmitted to Boğaziçi University, Kandilli Observatory and Earthquake Research Institute via satellite connection. The Kandilli Regional Earthquake and Tsunami Monitoring Center is the 24/7 operational National Tsunami Warning Center for Türkiye under the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and connected seas (ICG/NEAMTWS) initiative.

### 8.1.3 Cryosphere Observations

Türkiye has a long history of scientific research in the Antarctic region, dating back to 1967. Despite not officially becoming a party to the Antarctic Treaty until 1995, Turkish scientists have been conducting studies in the region for decades. Istanbul Technical University (ITU) established the Polar Research Center (PolReC) in 2014, becoming the first institutional initiative in polar sciences in Türkiye. In 2016, the Turkish Antarctic Research Expedition was organized in cooperation with the National Antarctic Science Center of Ukraine, marking the first interdisciplinary international Antarctic scientific expedition involving Turkish scientists.

Türkiye became a party to the Protocol on Environmental Protection (Madrid Protocol), an Additional Protocol to the Antarctic Treaty, in 2017, and our Ministry carries out the protocol's focal Point. Furthermore, the General Directorate of Environmental Management participates as the Focal Point in The Committee for Environmental Protection Meetings organized annually with the Antarctic Treaty Consultative Meeting. In addition, the Regulation on the Implementation of the Protocol on Environmental Protection in Antarctica was published in 2020 to determine the procedures and principles regarding the implementation of the activities of the Republic of Turkey in the Antarctic Treaty Area in accordance with the conditions specified in the Protocol on Environmental Protection of the Antarctic Treaty.

In 2019, an Automatic Meteorology Observation Station (AWOS) was installed by the TSMS on Horseshoe Island during an Antarctic Science expedition and data is continuously being collected. The meteorological data collected in Antarctica is shared with relevant institutions, scientists and researchers to aid in the understanding of the cryosphere and its impact on climate change.

## 8.2 OTHER ACTIONS TAKEN TO SUPPORT RELATED CAPACITY- BUILDING IN DEVELOPING COUNTRIES

### 8.2.1 International Cooperation by the Turkish State Meteorological Service

The Turkish State Meteorological Service (TSMS) has developed several key tools and systems to support its research and services in the field of climate and climate change. The

**"Meteorological Communication and Applications Package (METCAPPLUS)"** is a software package that facilitates communication between different forecasting centers and the preparation of various meteorological cards, maps, and graphs. It is also used in other countries such as Azerbaijan, Yemen, Georgia and the Turkish Republic of Northern Cyprus. Additionally, TSMS has developed the ***"Flash Flood Guidance System (FFGS) Model"*** which is being implemented in cooperation with international organizations like WMO, NOAA and HRC in Bosnia and Herzegovina, Romania, Serbia, Croatia, Montenegro, Moldova, Slovenia, Macedonia, and Albania were determined as the countries that would participate in the initial phase of the Southeast European Countries Guidance Project. Furthermore, TSMS serves as the ***"Eastern Mediterranean Climate Center (EMCC)"*** under the Regional Climate Center (RCC) in the WMO network, providing monthly climate monitoring, seasonal forecasting and data products for Greece, Türkiye, Syria, Lebanon, Jordan, Israel, Palestine, Egypt, Southern Cyprus and the Turkish Republic of Northern Cyprus that are located in the Eastern Mediterranean region.

In 2000, Türkiye was recognized as the ***"Regional Training Center (RTC)"*** of the World Meteorological Organization (WMO). The main functions of the RTC include organization of training, seminars, and conferences regarding the meteorology and related fields at the national and international levels. The TSMS currently operates three RTC in Ankara, Istanbul, and Alanya. As of 2022, the TSMS has trained over 1900 international participants from more than 150 countries through various training events. Due to the Covid-19 pandemic, the trainings were held online until these pandemic conditions improved. Now with the development of conditions, it is planned to organize the trainings in a hybrid format. The WMO RTC Türkiye organizes and hosts courses and training programs in various subjects of meteorology and related fields, including AWOS, Upper Air Observation Systems, Calibration, Radar and Satellite Meteorology, Aviation and Satellite Meteorology, Agricultural Meteorology, Climate Applications and Climate Change, Weather Forecasting, and Numerical Weather Forecasting.

### 8.2.2 International Cooperation by the General Directorate of Combating Desertification and Erosion

The **General Directorate of Combating Desertification and Erosion** (ÇEM) in Türkiye has been actively involved in international cooperation efforts to combat desertification and land degradation. One such initiative is the **"Ankara Initiative"** which was launched during the United Nations Convention to Combat Desertification 12th Conference of Parties (COP 12). The initiative aims to contribute to the implementation of the Convention and COP 12 decisions by committing to contribute $5 million to the UNCCD Secretariat for the four-year period from 2016-2019. The Initiative provides contribution in particularly preparation and implementation of the voluntary national Land Degradation Neutrality (LDN) targets reports by countries to achieve the SDGs 15.3 target. Other activities under the initiative, include, 3S Initiative

(Sustainability, Security and Stability), migration, land tenure, gender mainstreaming, media cooperation, Workshop on International Sand and Dust Storm, African Drought Conference, Drought Early Warning System Pilot Project in Colombia, LDN Target Setting Workshop for Africa, Central and Eastern Europe, Central Asia Countries, and also Training activities for Central and Eastern Europe and Central Asia, Pan African Agency Countries.

The ***"Boosting Restoration, Income, Development, Generating Ecosystem Services (BRIDGES) Project"*** is a first project initiated under the FAO-Türkiye Forestry Partnership programme (FTFP) called "Building Bridges Between Turkey and Africa's Great Green Wall". The project aims to support restoration activities, development of non-wood forest products, establish monitoring systems, improve information management, raise awareness, communication and visibility in three African countries (Eritrea, Mauritania and Sudan) last for three years. The BRIDGES Project also contributes to the Great Green Wall initiative, which is Africa's flagship programme, to bring prosperity and boost resilience in the drylands of over 20 countries around the Sahara by responding to the challenges of deforestation, desertification, biodiversity loss, climate change and food insecurity.

## 8.3 NATIONAL AND INTERNATIONAL DATA SHARING

The rapid advancements in technology and globalization have widened the gap between Türkiye and other developed countries. To bridge this gap, Türkiye has implemented the e-Government model which aims to increase transparency, efficiency, and citizen participation in government management using information and communication technologies. The e-Government Portal is a website that provides access to all public services in an efficient and effective way. To support this goal, institutions and organizations are also taking measures to remove obstacles to data access and usage.

As mentioned in ***the Systematic Observation Chapter***, the TSMS is responsible for preparing and presenting meteorological forecasts for Türkiye. They provide hourly forecasts for all provincial centers, daily forecasts (in 6-hour periods) and 5-day forecasts for all provincial and district centers, and weekly forecasts by region. These forecasts include information on weather conditions, temperature (highest and lowest), humidity, apparent temperature, and wind direction and speed. In addition, 3-day weather forecast data is prepared and published for some foreign centers. The TSMS also offers a variety of meteorological forecast services through the internet, including long-term forecasts (monthly and seasonal), wave forecast (daily, three-day, five-day), 24-hour wind forecast, as well as numerical forecast model products, stadium and Istanbul Park Forecast.

The TSMS also provides support to a wide range of sectors, including aviation, maritime, and agricultural sectors. Specialized meteorological products have been developed for these sectors

based on their specific needs, and new products are constantly being developed to meet new requirements. Some of the meteorological products provided by TSMS for these sectors include:

- **For the aviation sector:** Observations for Aviation (METAR - SPECI), Forecasts for Aviation (TREND - TAF-GAMET), Warnings for Aviation (SIGMET - AIRMET), Hezarfen, Helimet Cappadocia aviation web pages.
- **For the maritime sector:** METU-3 wave forecast model products, SWAN METU-3 wave forecast model products, HF Marine Radar Products, Marine forecast reports, Display of Automatic Marine Observation Stations, Seaway forecasting system, Marina forecasting system, Display of sea water temperatures, Display of Buoy Observations.
- **For the highway sector:** Highway weather forecasting system.
- **For the agriculture sector:** Agricultural Forecast Report, Agricultural Frost Warning System (ZDUS), Agricultural Frost Risk Estimation Maps, Harvest Time Estimation Program, Monthly Bulletin of Agricultural Meteorology, Reference Total Evaporation Maps (ET0), Phenology Maps, Maps of Plants' Resistance to Hot and Cold, Appropriate sowing time map according to soil temperature values.

All domestic and foreign-sourced meteorological data (observations, forecasts, etc.) prepared by the TSMS are collected and managed by the ***"Meteorological Communication and Distribution System (MSS)"*** which then redistributes them to the centers, as well as to the public. The MSS uses advanced technology such as telecommunication networks and computers to support its functions efficiently and effectively. In 2012, the system was updated to increase its capacity and capabilities, and in 2013, further hardware updates were made and WMO Information System- Data Collection and Production Center (WIS-DCPC) hardware and software were added to the MSS system to work in parallel.

The **General Directorate of Geographic Information System** established a national spatial information infrastructure called the **ATLAS Application**. The aim of this application is to facilitate geographic data sharing through a technical infrastructure that enables querying metadata via the national spatial data portal. Legislation preparation and data sharing standards have also been studied as part of the national geographic information infrastructure works. The ATLAS Application enables the web-based presentation of a variety of geographic data, including administrative boundaries, population density, transportation, hydrography, environmental planning, geology, and true orthophotos. These data, which are produced by all public institutions, local governments, private sector, and universities, are integrated with the Turkey National Geographic Information System (TUCBS) and can be viewed layer by layer based on the permissions granted by the data owner institutions. The ATLAS Application can be accessed at https://www.atlas.gov.tr.

# 9 EDUCATION, TRAINING AND PUBLIC AWARENESS

Türkiye is experiencing detrimental effects of climate change, including landslides, droughts, and heightened occurrences of extreme weather events. As these impacts continue to affect both the ecological and economic systems, society has increasingly turned its attention towards addressing climate change and its related issues. In response, the Ministry of National Education (MNE) in Türkiye has been taken proactive steps to prepare future generations and strengthen the education system to address these changes and transformations. Efforts of universities, other government institutions, municipalities, NGOs and private sector institutions have significantly contributed to raising public awareness about climate change. Nationwide and local public awareness initiatives are being implemented to mitigate the adverse impacts of climate change.

## 9.1 GENERAL POLICY ON EDUCATION, TRAINING AND PUBLIC AWARENESS

As mentioned in the 7th NC of Türkiye as well, the Constitution of the Republic of Türkiye, in Article 56, states that "Everyone has the right to live in a healthy and balanced environment. It is the duty of the state and citizens to improve the natural environment, to protect the environmental health, and to prevent environmental pollution", emphasizing the importance of protecting the environment. The Environment Law with the number 2872 came into force on August 9, 1983, with the purpose of protecting the environment, which is the common property of all living creatures, in accordance with sustainable environment and sustainable development principles. It was the first time that the notion of environment was the subject of a law.

The MNE oversees the educational system in Türkiye. The Ministry prepares educational policy, oversees its implementation, and is responsible for matters at all educational levels. As stated in the **"Climate Change Strategy 2010-2023"** document, Türkiye's national vision within the scope of climate change is to become a country fully integrated to climate change related objectives into its development policies, disseminating energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts for tackling climate change within its special circumstances and providing its citizens with a high quality of life and welfare with low carbon intensity. The primary objective of Türkiye within the scope of global fight against climate change is to take part in the global efforts for preventing climate change.

In cooperation with the MNE General Directorate of Basic Education and the European Commission TAIEX, the workshop on "Integration of Climate Change Awareness into Basic Education" was held on 22-23 November with 85 national and international participants. The purpose of the workshop is to raise awareness about the effects and consequences of climate change in primary education institutions, and to present strategies and methods to determine

what can be done at school and outside of school in the fight against climate change. The results of the workshop were reported.

### 9.1.1 Current Climate Change Awareness in Türkiye

As mentioned in the 7th NC, İklim Haber (Climate News) and KONDA have been conducting surveys in Türkiye to understand public perception and preferences on climate change. On average, 3,000 people were interviewed in around 30-31 cities each year, and the results were compared with other political and social preferences and trends between 2018 and 2021. The surveys found that the level of concern about climate change among respondents has decreased over time. Specifically, in March 2018, 75% of respondents expressed concern about climate change, but by December 2021, that number had dropped to 66%. When surveyed with the question "Are you concerned about climate change and to what extent?", the majority of respondents expressed varying degrees of worry, with 42% indicating they were "worried" and 24% stating they were "very worried". When compared to the previous year's survey, the overall proportion of respondents expressing "very worried" or "worried" decreased by 4%. Meanwhile, the percentage of respondents indicating they were "not worried" or "not worried at all" remained unchanged at 18%. The research shows that the majority of the public is concerned about climate change, and that this concern increases with education level. Additionally, 75% of participants believe that climate change is the result of human activities, while 25% believe it is a natural process. Respondents also prioritize protecting green areas, reducing harm caused by transportation, and increasing energy efficiency in buildings as ways to address climate change. Additionally, 77% of society believes climate change plays a role in extreme weather events such as floods, storms, and droughts, and 84% of those who think climate change is caused by humans also believe that extreme weather events are due to climate change.[211]

## 9.2 PRIMARY, SECONDARY AND HIGHER EDUCATION

The Turkish National Education System is consists of two main components: formal education and non-formal education, as outlined in the Fundamental Law of National Education No. 1739. Formal education pertains to regular education provided within a school setting for individuals in a specific age group and level, as per curriculum designed with specific objectives. Formal education includes pre-school, primary school, lower secondary school, and upper secondary school and higher education institutions. In accordance with the general objectives and basic principles of national education, the objectives of non-formal education, which covers citizens who have never entered the formal education system or are at any level of it or have left at that level, and which may accompany formal education. Compulsory education was expanded to

[211] Perception of Climate Change and Environmental Problems in Türkiye, 2021.

uninterrupted 8 years with law No. 4306 dated 16.08.1997 as of the 1997/98 educational year, but to 12 gradual years with law No. 6287 dated 30.03.2012 as of 2012/13 educational year.

The 2020-2021 National Education Statistics indicate the following net schooling ratios for different levels: 58.53% for pre-school, 96.12% for primary school, 95.67% for lower secondary school, and 87.95% for upper secondary school (MoNE, 2021).

### 9.2.1 Pre-primary Education

The goals of pre-school education include promoting the physical, mental, and emotional development of children from disadvantaged backgrounds, and ensuring proper language development. According to the 2020-2021 National Education Statistics, there are 24,458 pre-schools and 1,225,981 students receiving pre-school education (MNE, 2021). The pre-school education program includes activities related to climate change and environmental issues, such as teaching the importance of recycling and explaining the negative effects of climate change (MNE, 2013). Additionally, pre-school education emphasizes the use of nature in sensorial, cognitive, and physical education. Children are encouraged to explore and learn about the natural world around them, developing an understanding of science and nature. Ecoliteracy, or ecological literacy, is also emphasized, teaching children to understand natural processes and factors, communicate with the natural environment, and act for sustainability. Ecoliteracy-based pre-schools are becoming increasingly popular throughout the country.

### 9.2.2 Primary Education

The compulsory primary school age covers ages 6 to 14. Primary education aims to ensure that every child in Türkiye acquires the necessary knowledge, skills, behaviors and habits to become a good citizen. Furthermore, they are raised following the concept of national morals and are prepared for life and the next level of education through their interests, talents and capabilities. Primary education institutions consist of 4 years of primary school and 4 years of compulsory lower secondary schools, a total of 8 years. Lower secondary schools are compulsory and allow students to switch between different programmes.

The 4-year primary school and the 4-year lower-secondary school programs of the 12-year compulsory education that is given after pre-school education constitute primary education. According to the 2020-2021 National Education Statistics, there are 24,576 primary schools and 5,328,391 primary school students, and 19,025 lower-secondary schools and 5,212,969 lower-secondary school students (MNE,2021). Following the decisions of the Paris Agreement, the Strategic Plan of the MNE, the action plans of the MoEUCC and other institutions, and the decisions of the National Education Council, the curriculum of the Environmental Education elective course has been updated, and the course name has been changed to Environmental Education and Climate Change. This course will be taught in secondary schools ($6^{th}$, $7^{th}$, $8^{th}$ grades) as of the 2022-2023 academic year, with 2 lessons per week for a total of 72 hours. The

revised curriculum comprises six units that focus on human and nature, circular nature, environmental problems, global climate change, climate change and Türkiye, and sustainable development and environmentally friendly technologies. The primary goal is to enhance students' comprehension of the environmental problems underlying climate change, their origins, the correlation between climate change and natural calamities, and the resulting impacts on living organisms. Students are expected to gain knowledge on the effects of climate change in Türkiye, to realize the importance of national and international studies in the fight against climate change and to achieve productive skills in taking responsibility for reducing the negative effects of climate change. In addition, a booklet for first and second graders in special needs schools has been created to raise students' awareness of climate change. Also, this written material is planned to be on the digital platform with interactive and psychologically supportive elements for both students with and without special needs. Additional booklets intended to promote climate change awareness among students at various grade levels are planned for production. Finally, school projects and activities that center on climate change will be implemented in mainstream and special education schools in the near future.

### 9.2.3 Secondary Education

Upper secondary education comprises all educational institutions, including general, vocational, and technical education institutions that offer at least four years of compulsory formal or non-formal education in primary and lower secondary education. Pursuant to the fundamental principles and general goals of the National Education, the objectives and responsibilities of secondary education are twofold: (1) To instill in all students an awareness of, and ability to understand, problems to the extent that a basic, common culture allows them to seek solutions and develop the consciousness to contribute to the country's economic, social, and cultural progress; and (2) To prepare students for higher education or career fields in line with their interests, aptitudes, and abilities through diverse programs and schools. To accomplish these objectives, a balance maintained between students' expectations and abilities and society's needs.

According to the 2020-2021 National Education Statistics, Türkiye has 12,972 upper secondary schools with a student population of 6,318,602 (MoNE, 2021). The Ministry of National Education (MoNE) also provides in-service training for teachers and administrators to promote climate change awareness. From 2017 to 2022, the MoNE organized locally and centrally held courses and seminars on topics such as Energy Efficiency, Zero Waste Projects, Environmental Literacy, and Climate Change and Environmental Education. These programs trained a total of 339,639 teachers and administrators through both face-to-face and distance learning methods.

The MNE has taken further steps to address climate change by organizing a workshop aimed at preparing its own Climate Change Action Plan. During this workshop, experts from the central and provincial units of the MNE, as well as academic and environmental experts from the

MoEUCC, engaged in discussions related to climate change and its impact on public health and the environment. The topics discussed included climate change and its effects on the environmental and public health, energy efficiency and energy saving, conservation of water resources and water saving, air, water and soil pollution, and recycling and zero waste. The aim of the workshop was to determine appropriate measures for both mitigation and adaptation to climate change. By integrating climate change awareness into all schools and institutions, the Ministry hopes to encourage students to become responsible individuals who actively engage in efforts to address this global issue. The Climate Change Action Plan of the MNE is already being implemented in all schools and educational institutions.

#### 9.2.4 Higher Education

In Turkish education system, higher education includes all the educational institutions based on secondary education, which provide at least two years of higher education. Many studies about climate change are being conducted in various departments of higher education institutions. There are also master and doctorate programs, including courses such as "climate change and modeling", "sustainable development", environmental economy", "energy policies and finance", "ground system sciences", and "plant-climate models" to raise awareness about the adaptation and campaign processes related to global climate change, which is one of the most critical problems of today and meet the need of the country for educated employee/academician.

## 9.3 PUBLIC INFORMATION CAMPAIGNS

### 9.3.1 Climate Action and Energy Efficiency

Türkiye has implemented various national campaigns and projects aimed at increasing public knowledge and raising awareness about climate change. One such project is **"Raising Awareness Project for Climate Change"** which was coordinated by the Ministry of Environment, Urbanization, and Climate Change in partnership with Yıldırım Beyazıt University. The project aimed to increase awareness of students, teachers, and local authorities on climate change through seminars, training programs, and meetings held in 18 provinces and 14 cities, with a budget of 4 million TL. The project was completed by the end of 2017. Another notable project is the **"Enhancing Required Joint Efforts on Climate Action (IklimIN) Project"** which is previously mentioned in the 7th NC. The project included 38 initiatives to enhance technical capacity in climate change at national and local level, and to raise awareness among stakeholders of the immediacy of joint climate action.

The **"Voice of Meteorology Radio"**, operated by the Turkish State Meteorological Service (TSMS), broadcasts information on forest, water, and meteorology to the whole world via Türksat-4A 11958 Mhz, Symbol 27500, Vertical, Fec 5/6 and the internet, including weather forecasts and early warnings. TSMS also participates in projects, meetings, and events to share

information on scientific findings of climate and climate change and conducts public awareness-raising activities through the broadcasts of Meteor FM radio channel and the development of a smart phone app used by 2 million users. The organization also uses internet and social media to inform the public and raise awareness and contributes to educating young people in primary and secondary schools through a protocol with the Ministry of National Education, visiting over 100 schools to date.

The **"Family Education Program"** offered by the Ministry of Family, Labour and Social Services aims to increase the quality of life by educating and raising awareness among parents. The program includes several modules, such as education and communication, law, economics, media, and healthcare, that cover the full range of daily life. One of the modules, "Energy saving," specifically covers the concepts of greenhouse effect and global warming. As of April 2022, 2.5 million people have been reached by the Family Education Program.

The **"Technical Assistance for Water Ambassadors Education and Awareness Raising Project"** was implemented to raise awareness and educate young people about water conservation and environmental protection. The project was conducted in the Western Mediterranean Basin, Konya Closed Basin, Eastern Black Sea Basin, and Ankara and completed in 2017. The target group was the public, particularly pre-primary, primary, and secondary school students, university students, youth, teachers, and mothers. The project included education and media campaigns, the establishment of Water Ambassadors Clubs in schools, training for stakeholders, and national and international awareness campaigns. 120,000 individuals were trained in three pilot basins. Between 2018 and 2020, approximately 50,000 teachers and students received face-to-face and online ''Water Literacy'' training. In 2021, activities included providing Water Literacy information to around 5,000 students in 24 provinces with the Water Ambassadors Mobile Training truck, giving Water Literacy training to approximately 4,000 teachers in many provinces of Türkiye through 45 video conferences, holding a conference for students and academics at Malatya İnönü University, and carrying out two development agency projects initiated in 2020 with the partnership of DSI and Water Ambassadors Association, reaching around 1,000 children with the Mobile Education truck in Konya, and establishing Water Ambassadors Clubs in schools in Kaman. Additionally, a joint event was organized with the Ministry for the launch of the 1st Water Council.

The **"Young Climate Envoys Movement Project"** was initiated by the Turkish Ministry of Environment, Urbanization and Climate Change to increase youth participation in the fight against climate change in line with Türkiye's net-zero emissions and green development goals. The project involves young climate envoys from universities across Türkiye who work to increase social awareness of climate change and encourage green and climate-friendly studies. The project's objective is encourage young people to develop projects that will contribute to the fight against climate change and involve them in decision-making processes related to climate

change. The project is carried out in cooperation with UNICEF and operates within a set of guidelines approved by the Directorate of Climate Change. Climate envoys participate in programs and meetings related to climate change, including COP27, and will continue to voice their opinions on climate change at national and international meetings in 2023. The project aims to provide training to strengthen institutional capacities, expand climate communities in universities, and increase climate change awareness.

The **"Energy Efficiency Policies"** in Türkiye are crucial for achieving sustainable economic growth and development, as well as reducing greenhouse gas emissions. The goal is to reduce energy intensity by 20% by 2023 compared to 2011, and to decrease primary energy consumption by 14% by 2023 through the implementation of the **"National Energy Efficiency Action Plan"**. The Energy Efficiency Forum and Fair is held annually in the second week of January as part of the Energy Efficiency Week, with the aim of promoting energy efficiency through conferences, panels, product and technology fairs, awards, and cultural and arts activities. The "**Energy Lady Project**" is also in place to raise awareness among women, as they are a major group of energy consumers in the home, on how to use energy efficiently to contribute to the domestic and national economy. As of 2022, the project had reached 35,000 women from 24 provinces.

The **"Promoting Energy-Efficient Motors in Small and Medium Sized Enterprises in Türkiye Project"** is being conducted by the Ministry of Industry and Technology. One of the key components of this project is raising awareness about the importance of using energy-efficient electric motors in the industrial sector. To achieve this goal, the project has organized numerous seminars, webinars and meetings with participation from a wide range of stakeholders. Additionally, a webpage has been designed to serve as a repository for promotional and technical information on the advancement and promotion of energy-efficient motors. The project also publishes quarterly e-bulletins to keep stakeholders informed about the latest developments Türkiye.(Ministry of Industry and Technology, 2022)

## 9.4 TRAINING PROGRAMMES

### 9.4.1 Energy Efficiency Training

The Department of Energy Efficiency and Environment (DEEE) conducts various training activities to promote energy efficiency and environmental sustainability. The main focus of these trainings and audits include:

- Energy management in industrial enterprises and buildings
- Certification training for energy managers
- Certification training for survey projects
- International training programs for energy managers in other countries

- Creating awareness about energy efficiency
- Determining energy savings opportunities and amounts
- Supporting the implementation of efficient energy management systems in various types of buildings
- Auditing public buildings and issuing energy performance certificates (EKB).

The DEEE also participates in an ongoing project called **"International Energy Efficiency and Energy Management in Industry and Buildings Training Project."** This project is a collaboration between the General Directorate of Energy Affairs, Japan International Cooperation Agency (JICA), and Turkish Cooperation and Coordination Agency (TIKA). The aim is to improve knowledge and techniques related to energy efficiency and management in industry and buildings, and to help participants contribute to the reduction of $CO_2$ emissions and improve energy efficiency (Ministry of Energy and Natural Resources, 2022).

### 9.4.2 Staff Awareness and Engagement Training

Under the **"Training for the Institutional Capacity Building on Climate Change Adaptation (Iklimi Duy) Project"** which was completed in 2021, four training modules were developed and personnel from the Municipalities and the CCAMCB Member Organizations were trained. An Education Portal was also published as part of the project. In addition, the **"Enhancing Adaptation Action in Türkiye (Iklime Uyum) Project"** also includes workshops and trainings that have been held since 2020. Since 2009, the Union of Municipalities of Türkiye (TBB) has been providing training through its **"Municipal Academy"** corporate identity. The main goal of the Municipal Academy's training activities is to identify the municipalities' training needs and to meet those needs through appropriate training methods. These activities include symposiums, congresses, workshops, and various events. Approximately 100,000 municipal personnel benefit from these activities annually. Further information on these projects can be found in Chapter 6.4.2 as well.

The General Directorate of Forestry (GDF) has been working to create **"Sustainable Forest Management (SFM)"** criteria and indicators to help combat climate change and forest fires. To combat the increasing number of fires due to climate change, GDF trains both its staff and forest villagers. Between 2020 and 2021, GDF carried out various awareness-raising activities to educate a total of 405,132 citizens, including training of military units and local firefighters, training of hunters, shepherds, and farmers, and working with press organizations and local youth and sports groups. These efforts helped raise awareness about the importance of preventing forest fires.

## 9.5 ACCESS TO INFORMATION: RESOURCE AND INFORMATION CENTRES

In Türkiye, many organizations act as resource and information centers for the public on the topic of climate change. These organizations provide access to information through various means such as television and radio broadcasts, news publications, internet pages and channels, newspapers, journals, seminars, workshops, and conferences. The Ministries related to climate change in Türkiye publish monthly journals to keep the public informed on their activities and developments. Many institutions also prepare fact sheets and handouts to provide concise and easily accessible information on climate change. Kickoff and final meetings of projects are often open to the public, providing and opportunity for citizens to learn about and engage with the work being done to combat climate change. Public service broadcasts and short films that are aired on TV and radio channels also play an important role in raising public awareness about climate change. Some of the governmental web sites on climate change are https://iklim.gov.tr and https://cygm.csb.gov.tr/sss/iklim-degisikligi, TSMS's articles related to climate change https://mgm.gov.tr/iklim/yayinlar.aspx, MENR's https://www.enver.org.tr/en and https://www.enver.org.tr/enerji-cocuk.

The Chamber of Meteorological Engineers publishes reports and monthly climate bulletins on climate change and makes them available to the public through press and publications. The Chamber of Environmental Engineers have also organizes seminars or workshops about climate change.

## 9.6 INVOLVEMENT OF NGOS AND OTHER ORGANIZATIONS

In Türkiye, various public and non-governmental organizations, including associations, foundations, academia, and businesses, have recognized the importance of addressing climate change and have initiated a range of activities to increase resilience and address the issue. These groups play a crucial role in raising awareness and promoting sustainable practices among the general public. Additionally, they participate in workshops, events, and working groups where they can share their perspectives and ideas with state actors and other stakeholders. Environmental NGOs, in particular, have been implementing various initiatives to combat climate change, including promoting renewable energy, circular economy, carbon pricing, etc. Some initiatives include:

**TEMA Education Programs** are designed to enable preschool and primary school children to spend more time in nature, make observations, explore nature with a sense of curiosity and strengthen their ecological literacy skills. For middle school level and high school-age youth, the programs are designed to serve within the scope of different courses and club activities in cooperation with the Ministry of National Education and are carried out by volunteer teachers. The programs aim to raise children's awareness of ecological literacy and contribute to children becoming individuals who develop empathy with other living things in nature and are aware of

how their choices in daily life affect nature. The program, prepared with an interdisciplinary approach, also aims to connect children with nature by focusing on activities that allow them to meet with nature.

The **"Climate Change Education and Awareness Project"** is a joint initiative between the Ministry of National Education and TEMA Foundation, aimed at increasing understanding and awareness of climate change among children, youth, and adults. The project includes educational activities for primary, middle, and high school students, as well as awareness-raising activities for young people and adults. These activities include classroom trainings, educational materials such as posters, presentations, and movies, as well as climate change presentations, documentary screenings, and subsequent climate talks. The project has reached approximately 7,000 children at primary, middle and high school levels in 50 provinces through educational activities in 2022, and 553 young people and adults in 19 different provinces through awareness activities in the first half of 2022 (TEMA, 2022).

The **Union of Chambers and Commodity Exchanges of Türkiye (TOBB)**, the highest legal entity in Türkiye representing the private sector, organizes training, seminars, and information activities especially to increase the awareness of SMEs about climate change, circular economy, carbon pricing, etc. TOBB, with its 365 chambers and commodity exchanges, develops and implements projects and studies on climate change and green transition. In this scope, capacity-building and raising-awareness activities are performed for chamber/ commodity exchange members.

Technical training, including the calculation of greenhouse gas emissions, is provided for the industry sectors that will be most affected by the EU Carbon Border Adjustment Mechanism (CBAM). These trainings were organized for fertilizer, air conditioning, and textile sectors. In the scope of meetings of the Turkish Sector Assemblies, information regarding combating climate change, the EU Green Deal, CBAM, carbon footprint calculation, and other regulations made within the scope of the Green Deal is delivered to members.

Additionally, within the context of the Union, a climate portal (https://iklim.tobb.org.tr/) was established in order to facilitate the follow-up of developments on the European Green Deal and climate change; to collect the projects, studies, and documents in one place; to inform Union's members about the grants, incentives, and loans given and to announce them regarding events organized. On the website, there is also a **carbon footprint calculation software**. It is foreseen that this software will be commissioned at the beginning of 2023, and it is especially aimed at S**MEs to calculate their greenhouse gas emissions** simply and free of charge.

**Borsa Istanbul (BIST)** has played a significant role in promoting sustainability in finance by launching various projects related to the subject. In 2014, BIST launched the **"BIST Sustainability Index"** which aims to provide a benchmark for Borsa Istanbul companies with

high performance on corporate sustainability and to increase awareness, knowledge and practice on sustainability in Türkiye. The index also serves as a platform for institutional investors to demonstrate their commitment to companies managing environmental, social and governance (ESG) issues with high performance. Additionally, Borsa Istanbul has published the "Borsa Istanbul Sustainability Guide for Companies," which provides companies a roadmap on ESG issues. In 2021, Borsa Istanbul further expanded its sustainable investment options by launching the "Sustainability Participation Index," which appeals to investors who are sensitive to interest rate. These initiatives aim to create awareness, educate individuals and companies on sustainable practices, and provide sustainable investment options.

The **Turkish Industry and Business Association (TÜSİAD)**, which represents the Turkish business world, prioritizes combating climate change and sustainability by preparing reports and studies on these topics. These reports aim to increase awareness and contribute to the understanding of public and private institutions at the national and international level, different components of the Green Deal, as well as the analysis of climate change. Between 2019 and 2022, the following activities were carried out by TÜSİAD:

- Building the Future with a New Mindset Report
- Business Plastic Initiative (TÜSİAD, UNGC Türkiye and BCSD Türkiye Joint Initiative)
- The Impact of Circular Economy Action Plan on the Turkish Private Sector Report
- The New Climate Regime through the Lens of Economic Indicators Report
- Addressing Climate Change from an Economic Policy Perspective Report
- Investor and Finance-Oriented Risk Management and Reporting Document
- Internal Carbon Pricing Document
- European Green Deal Dialogues
- 360° Green Deal Training Seminars
- TÜSİAD Recommendations for the Development of the Energy Efficiency Sector
- Position Paper on Zero Carbon from Renewable Energy Perspective

## 9.7 INTERNATIONAL COOPERATION

### 9.7.1 Overview

Türkiye has been actively participating in various international activities related to climate change and sustainability. Turkish institutions, including universities, ministries, and research institutions such as the TÜBİTAK, support individuals and teams to attend international events and conferences, and also encourage the hosting of international activities in Türkiye. One key

area of international cooperation for Türkiye is in the Intergovernmental Panel on Climate Change (IPCC). Turkish experts work alongside other experts from around the world to contribute to IPCC meetings and reports, sharing their knowledge and expertise on climate change and its impacts. To support this international participation, Turkish institutions provide various forms of support for personnel, academic staff, and researchers. This includes financial support for travel and accommodation, as well as opportunities for networking and collaboration with international partners. As a result, many Turkish researchers, personnel, and academic staff have been able to present their work and findings on climate change issues at international conferences and organizations.

Another important aspect of Türkiye's international cooperation is its participation in United Nations Framework Convention on Climate Change (UNFCCC) meetings and sessions. The Turkish delegation has consistently participated in all Subsidiary Body for Implementation Meetings (SBI), Subsidiary Body for Scientific and Technological Advice Meetings (SBSTA), and Ad Hoc Working Group on the Paris Agreement (APA) sessions organized within the scope of UNFCCC, as well as interim sessions before UNFCCC Conferences of Parties (COP). This participation is crucial in ensuring that Türkiye's perspectives and concerns are represented in international discussions on climate change and its impacts.

Türkiye participates Montreal Protocol Meeting of the Parties (MOP); Open Ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer as well as Regional Ozone Network for Europe and Central Asia (ECA) cooperation meetings.

Since the recognition of the WMO Regional Training Center (RTC) Türkiye, the TSMS has organized and hosted more than 70 international training and workshops to meet the training needs of underdeveloped countries' meteorological services. More than 1900 participants attended these trainings and workshops. The international trainings are organized into specific topics such as weather forecasting, numerical weather forecasting models, surface observations and automatic meteorological stations, upper air observation systems, meteorological radars, climate monitoring and climate change, flash flood early warning systems, and agricultural meteorology. Many trainees from Balkan countries, Turkic Republics and African countries attend the trainings. Training programmes are carried out in the premises of WMO RTC Türkiye in Ankara, Alanya and Istanbul, depending on the capacity and content of the training. Alternative venues, such as social facility or hotel can be used depending on the number of participants and the transportation and financial options available.

### 9.7.2 International Events in Türkiye

Hosting international events can lead to significant opportunities and contributions for international cooperation for the host country. Therefore, Türkiye encourages institutions to organize and host such events as follows:

In line with Türkiye's 2053 net zero carbon emission target and green development policy, the **Climate Council** was held in Konya on 21-25 February 2022 with the participation of all stakeholders, in order to determine sectoral strategic targets, contribute to the legislation to be developed on climate and determine basic policies for different sectors and create a road map.

Within the framework of the **Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention),** cooperation studies are carried out between riparian countries in order to protect the Mediterranean marine environment and ensure its sustainable use. Under the contract, a conference of the parties is held every two years in order to take the necessary measures to ensure the protection and improvement of the marine environment in the Mediterranean Region. Representatives of 21 countries that are party to the Convention and the European Union and their senior officials, technical teams and focal points, international non-governmental organizations, members of the press and scientists participates in this conference. The 22nd meeting of the parties was held in Antalya on 7-10 December 2021. Following the 22nd meeting of the Conference of the parties to the Convention, the Presidency of the Bureau was transferred to Türkiye and a proposal for a regional activity center in terms of climate change was suggested at the 93rd Bureau meeting held in İstanbul on 24-25 March 2022.

**High Level Climate Dialogue (HLD)** was established in order to strengthen cooperation on climate change between Türkiye and the EU. During the ongoing process, 2 High Level Meetings, 3 working group meetings, preparatory meetings and study visits were held. Besides, It is planned that this process will continue in 2023 with different trainings and visits. So far, the carbon pricing working group have held 3 meetings for the establishment of the ETS in Türkiye.

**"UK - Turkey Race to Zero Summit"** was held online by TÜSİAD before United Nations Climate Change Conference (COP26) in July 2021. At this summit, British and Turkish business leaders discussed climate action in the private sector and the best practices that both countries can use in their industries to achieve net absorption goals (TÜSİAD, 2022).

TÜSİAD organized a webinar titled **"European Green Deal from the Perspective of the European Commission and the Private Sector"** in September 2021. In the webiner Türkiye's green transformation necessities were evaluated from the perspective of investors and the business world (TÜSİAD, 2021).

TÜSİAD also organized the **"Roadmap for a Carbon Neutral Türkiye"** event in November 2021 as a side event of the United Nations Climate Change Conference (COP26). The program was moderated by Professor Mehmet Emin Birpınar, Deputy Minister of Environment, Urbanization and Climate Change and Chief Climate Negotiator (TÜSİAD, 2021).

**"Climate Change and Sustainable Agriculture"** webinar was held in April 2022 with the cooperation of TÜSİAD and the United Kingdom International Trade Department. In the

webinar, with the participation of experts from Türkiye and the UK, the role of sustainable agricultural production in combating climate change, the impact of Farm to Fork Strategy and good practices for sustainable agriculture were discussed (TÜSİAD, 2022).

**"Sustainable Tourism and Circular Economy"** event was held in June 2022 by TÜSİAD-Sabancı University Competitiveness Forum (REF) with the support of the Ministry of Culture and Tourism. In the event, which was held with the participation of Deputy Minister of Culture and Tourism. In the event, sustainable tourism and circular economy issues within the scope of the Global Competitiveness Report published by the World Economic Forum were discussed (TÜSİAD, 2022).

At the United Nations Climate Change Conference (COP27) held in November 2022, TÜSİAD shared the best practices of the Turkish business world in combating climate change and the green transition studies carried out by TÜSİAD at the Turkish Pavilion. Additionally, TÜSİAD held a session titled "Sustainable Finance in Türkiye: Successful Cases, Challenges, and Opportunities " at the EBRD pavilion and another session titled " The Role of Sustainable Finance in Green Growth" at the International Chamber of Commerce's (ICC) "Make Climate Action a Business Forum for Everyone" pavilion at COP27.

The **"UCLG-MEWA Congress"**, which was held every three years, was hosted by Konya Metropolitan Municipality on 25-27 May 2022. The Presidency Court of Congress, the Administrative bodies, the Committee Presidency Dives, Strategic Priorities and the Master's Charter have been renewed. In the Congress, where the six thematic committees of UCLG-MEWA have been updated, Gaziantep Metropolitan Municipality President and President of the Turkish Municipality Association Fatma ŞAHIN has been elected as chairman of the Environment Committee (TBB, 2022).

**"Smart cities and municipalities Congress and Exhibition"** was held by the Turkish Municipality Union under the auspices of the Presidency on January 15-16, 2020, with the cooperation of the Ministry of Environment, Urbanization and Climate Change and the Ministry of Industry and Technology. The congress was attended by mayors, ambassadors, academics, senior executives of technology companies and representatives of NGOs at national and international levels from 41 countries (TBB, 2022).

The **"International Association of Agricultural Cities"**, established on June 24th, 2019, brings together cities that play a significant role in the agricultural sector. The organization, led by the president of Konya Metropolitan Mayor, aims to raise awareness on issues such as water management, climate change, drought and zero waste. Additionally, the association aims to transfer good practices in agriculture to the municipalities of member states, share technological developments and develop capacity through inter-municipal transfer. Membership in the organization, based in Konya, Türkiye, can increase cooperation activities on

agriculture, food security, and logistics; facilitate the transfer of good practices between municipalities and is expected to develop joint projects with Union member countries and municipalities. The membership of the Union is supported by the Turkish Municipality Association (TBB, 2022).

The **"3rd International Climate Analysis and Applications Course"** was held on October 15-19, 2018 in Ankara by WMO RTC Türkiye. 18 trainees from 16 countries participated in the training (TSMS, 2022).

The **"Eleventh International Training Workshop Climate Variability and Predictions"** and its follow-up **"Symposium on Variability and Predictability of the Global Climate System"** were held in Ankara on April 15-26, 2019, hosted by TSMS, in cooperation with the United States National Oceanic and Atmospheric Administration (NOAA) and United States Agency for International Development (USAID) and WMO (TSMS, 2022).

The **"Climate Analysis and Climate Models"** training was held at the Ankara facilities of WMO RTC Türkiye for two experts from the Azerbaijan National Meteorology Service on July 29-August 1, 2019 (TSMS, 2022).

The **"Flash Flood Guidance System (FFGS) Global Workshop**" event, which was planned to determine the sustainability strategy of the WMO FFGS project carried out for flash floods, which are extremely relatable to the negative effects of climate change on meteorological events, was hosted by TSMS with the participation of nearly 200 experts from 65 countries in Antalya (TSMS, 2022).

In the **"Online Training Workshop on Quality Management Systems for Climate Services"** event organized by the WMO on February 8-19, 2021, TSMS experts took part as trainers together with experts from the Bureau of Meteorology (BoM) of Australia (TSMS, 2022).

The General Directorate of Combating Desertification and Erosion has cooperation and carries out joint projects with the United Nations Convention to Combat Desertification Secretariat (UNCCD), the UNCCD Northern Mediterranean Regional Coordination Unit (RCU), the United Nations Convention on Biological Diversity Secretariat (UNCBD), the United Nations Food and Agriculture Organization (FAO, FAO-SEC), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the African Union Strategy for Africa (AU), the Pan African Agency of the Great Green Wall, the League of Arab States (LAS), the Arab Organization for Agricultural Development (AOAD) and the Ministerial Conference on Protection of Forests in Europe (FOREST EUROPE). International trainings are being held between the years 2011 and 2023 to exchange knowledge and to help increase their technical capacity on the combating desertification, land degradation neutrality, drought, and climate change. A total of 1145 experts from 108 countries have been trained up to the present (ÇEM, 2022).

## 9.8 MONITORING, REVIEW AND EVALUATION OF THE IMPLEMENTATION OF ARTICLE 6 OF THE CONVENTION

One of the working groups formed under **the Climate Change and Adaptation Coordination Board (CCACB)** is **Education, Raising Awareness, and Capacity Building Working Group**. This working group, coordinated by the MoEUCC, is responsible for providing the necessary contribution to the preparation of national reports submitted to the UNFCCC, developing policy in the field of education, training, and informing the public, conducting the studies towards raising awareness by maintaining the cooperation between institutions, reporting of the conducted studies nationwide about primary school, secondary school, and high school education, education materials, training programmes, source and information centers, public informing campaigns, participation of public and Non-governmental organizations in climate change campaign studies, and reporting of the studies done about participation in international activities (MNE, 2013). CCACB and its stakeholders monitor, review and evaluate the implementation of Article 6 of the Convention.

## 9.9 PUBLIC PARTICIPATION IN THE PREPARATION AND DOMESTIC REVIEW OF NATIONAL COMMUNICATION

Preparation of the 8th NC of Türkiye involved the participation of primary stakeholders, including NGOs. The DCC established an expert group for the drafting of the 8th NC. This expert group targeted the involvement of the CCACB members as the primary stakeholders. The CCACB predominantly has members from public institutions; however, it also has NGO representatives. Moreover, additional stakeholders were identified and involved in the process.

The principal approach for public participation was the organization of focus groups and bilateral meetings. The expert group organized several meetings with the stakeholders to gather their input, feedback, and suggestions on the report.

Besides the focus groups and bilateral meetings, the expert group sent the draft versions of the report in three rounds to the stakeholders to solicit their contributions and corrections. These letters provided an opportunity for stakeholders to submit their views on the issues discussed in the report, as well as to provide feedback on the overall process of public participation.

To further facilitate public participation, zoom meetings were organized with several participants. This allowed for the remote involvement of stakeholders who could not attend in-person meetings. The Zoom meetings provided an opportunity for stakeholders to interact with each other and share their thoughts on the report. Throughout the public participation process, the focus was on ensuring that all stakeholders had an equal opportunity to participate and that their views were considered.

Overall, the expert group designed the public participation process to be inclusive, transparent, and collaborative, focusing on gathering input from various stakeholders. By engaging with stakeholders in this way, the report benefited from a diversity of perspectives and insights, which helped ensure its relevance and usefulness to the broader community.

## ANNEX I - Türkiye's Eco-design, Eco-label and Automotive Regulations

Within the framework of the **By-Law on Ecodesign of Energy-Related Products**, (revised in 2021), the following Communiqués have come into force:

- Communiqué Regarding Ecodesign Requirements for Standby and Off Mode Electric Power Consumption of Electrical and Electronic Household and Office Equipment, which came into force in 2011 (revised in 2021) (in line with Commission Regulation (EC) No 1275/2008)
- Communiqué Regarding Ecodesign Requirements for Simple Set-Top Boxes, which came into force in 2011 (in line with Commission Regulation (EC) No 107/2009)
- Communiqué Regarding Eco-design Requirements for Light Sources and Separate Control Gears , which came into force in 2011 (revised in 2021) (in line with Commission Regulation (EU) No 2019/2020)
- Communiqué Regarding Ecodesign Requirements for No-Load Condition Electric Power Consumption and Average Active Efficiency of External Power Supplies, which came into force in 2011(revised in 2020) (in line with Commission Regulation (EU) No-2019/1782)
- Communiqué Regarding Ecodesign Requirements for Glandless Standalone Circulators and Glandless Circulators Integrated in Products, which came into force in 2011 (revised in 2014 and 2015) (in line with Commission Regulation (EC) No 641/2009)
- Communiqué Regarding Ecodesign Requirements for Electronic Displays, which came into force in 2011 (revised in 2021) (in line with Commission Regulation (EU) No2019/2021)
- Communiqué Regarding Ecodesign Requirements for Refrigerating Appliances, which came into force in 2011(revised in 2021) (in line with Commission Regulation EU) No 2019/2019)
- Communiqué Regarding Ecodesign Requirements for Refrigerating Appliances with direct sales, which came into force in 2021) (in line with Commission Regulation (EU) No 2019/2024
- Communiqué Regarding Ecodesign Requirements for Household Washing Machines and Household Washer-Dryers,, which came into force in 2011 (in line with Commission Regulation (EU) No2019/2023)
- Communiqué Regarding Ecodesign Requirements for Household Dishwashers, which came into force in 2011 (revised in 2021) (in line with Commission Regulation (EU) No2019/2022)

- Communiqué Regarding Ecodesign Requirements for Electric Motors and Variable Speed Drivers, which came into force in 2012 (revised in 2021) (in line with Commission Regulation (EU) No2019/178)
- Communiqué Regarding Ecodesign Requirements for Household Tumble Driers, which came into force in 2013 (in line with Commission Regulation (EC) No 932/2012)
- Communiqué Regarding Ecodesign Requirements for Air Conditioners and Comfort Fans, which came into force in 2012 (in line with Commission Regulation (EC) No 206/2012)
- Communiqué Regarding Ecodesign Requirements for Vacuum Cleaners, which came into force in 2015 (in line with Commission Regulation (EC) No 666/2013)
- Communiqué Regarding Ecodesign Requirements for domestic ovens, hobs and range hoods, which came into force in 2015 (in line with Commission Regulation (EC) No 66/2014)
- Communiqué Regarding Ecodesign Requirements for computers and computer servers, which came into force in 2015 (revised in 2021) (in line with Commission Regulation (EU) No 617/2013)

Within the framework of the **By-Law on the Indication by Labelling and Standard Product Information of The Consumption of Energy and Other Resources by Energy-Related Products,** No: 2011/2257, the following Communiqués have come into force:

- Communiqué Regarding Energy Labelling of Household Dishwashers, which came into force in 2012 (revised in 2021) (in line with Commission Regulation EU No 2019/2017)
- Communiqué Regarding Energy Labelling of Household Refrigerating Appliances, which came into force in 2021 (revised in 2015) (in line with Commission Regulation EU No 2019/2016
- Communiqué Regarding Energy Labelling of Refrigerating Appliances with direct sales, which came into force in 2021 (in line with Commission Regulation EU No 2019/2018)
- Communiqué Regarding Energy Labelling of Household Washing Machines and Household Washer-Dryers, which came into force in 2012 (revised in 2021) (in line with Commission Regulation EU No2019/2014)
- Communiqué Regarding Energy Labelling of Electronic Displays , which came into force in 2012 (revised in 2021) (in line with Commission Regulation EU No 1062/2010)
- Communiqué Regarding Energy Labelling of Household Tumble Driers, which came into force in 2013 (revised in 2015) (in line with Commission Regulation EC No 392/2012)
- Communiqué Regarding Energy Labelling of Air Conditioners, which came into force in 2013 (revised in 2015) (in line with Commission Regulation EU No 626/2011)
- Communiqué Regarding Energy Labelling of Light Sources, which came into force in 2021 (in line with Commission Regulation EU No 2019/2015)

- Communiqué Regarding Energy Labelling of Domestic Ovens and Range Hoods, which came into force in 2015 (in line with Commission Regulation EU No 65/2014)

In the **Automotive Sector**, legislative framework has been developed in line with the following EU legislation as a part of the approximation process:

- Regulation (EC) No 715/2007 of the European Parliament and of the Council of 20 June 2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information
- Regulation (EC) No 595/2009 of the European Parliament and of the Council of 18 June 2009 on type- approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI) and on access to vehicle repair and maintenance information and amending Regulation (EC) No 715/2007 and Directive 2007/46/EC and repealing Directives 80/1269/EEC, 2005/55/EC and 2005/78/EC
- Directive 2000/25/EC of the European Parliament and of the Council of 22 May 2000 on action to be taken against the emission of gaseous and particulate pollutants by engines intended to power agricultural or forestry tractors and amending Council Directive 74/150/EEC
- Commission Delegated Regulation (EU) 2015/96 of 1 October 2014 supplementing Regulation (EU) No 167/2013 of the European Parliament and of the Council as regards environmental and propulsion unit performance requirements of agricultural and forestry vehicles
- Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156/EEC

Other legislation that has come into force in various sectors are as follows:

- Communiqué Regarding Ecodesign requirements for water pumps, in line with Commission Regulation (EU) No 547/2012
- Communiqué Regarding Efficiency Requirements for New Hot-Water Boilers Fired with Liquid or Gaseous Fuels in line with Council Directive 92/42/EEC
- Communiqué Regarding the Energy Labelling of Space Heaters, Combination Heaters, Packages of Space Heater, Temperature Control and Solar Device and Packages Of Combination Heater, Temperature Control And Solar Device, in line with Commission Delegated Regulation (EU) No 811/2013
- Communiqué Regarding the Energy Labelling of Water Heaters, Hot Water Storage Tanks and Packages of Water Heater and Solar Device, in line with Commission Delegated Regulation (EU) No 812/2013

- Communiqué Regarding Ecodesign Requirements for Space Heaters and Combination Heaters, No 2018/3 in line with Commission Regulation (EU)
- Communiqué Regarding Ecodesign Requirements for Water Heaters and Hot Water Storage Tanks, in line with Commission Regulation (EU) No 814/2013
- Communiqué on Eco-design Requirements for Professional Refrigerated Storage Cabinets, Blast Cabinets, Condensing Units and Process Chillers (SGM:2020/3), in line with Commission Regulation (EU) No 2015/1095
- Communiqué on Energy Labelling of Professional Refrigerated Storage Cabinets (SGM:2020/4), in line with Commission Regulation (EU) No 2015/1094
- Communiqué on Eco-design Requirements for fans driven by motors with an electric input power between 125 W and 500 kW, in line with Commission Regulation (EU) No 327/2011
- Communiqué on Eco-design Requirements for ventilation units, in line with Commission Regulation (EU) No 1253/2014
- Communiqué on Energy Labelling of residential ventilation units, in line with Commission Delegated Regulation (EU) No 1254/2014
- Communiqué on Ecodesign requirements for Solid Fuel Local Space Heaters (2015/1185/EU)
- Communiqué on Energy Labelling of local space heaters, in line with Commission Delegated Regulation (EU) No 2015/1186
- Communiqué on Energy Labelling Of Solid Fuel Boilers And Packages Of A Solid Fuel Boiler, Supplementary Heaters, Temperature Controls And Solar Devices (2015/1187/EU)
- Communiqué on Ecodesign Requirements for local space heaters, in line with Commission Regulation (EU) No 2015/1188
- Communiqué on Ecodesign Requirements For Solid Fuel Boilers (2015/1189/EU)

## ANNEX II - Türkiye's climate change research center and institutions

- Ankara University, Department of Geography,
- Ankara University, Institute of Water Management
- Boğaziçi University Kandilli Observatory and Earthquake Research Institute
- Boğaziçi University, Climate Change and Applications Research and Application Center,
- Çukurova University, Dokuz Eylül University, Institute of Marine Sciences and Technology
- Directorate of Climate Change
- Directorate of Forestry Research Institute
- General Directorate of Agricultural Research and Policy
- General Directorate of Combating Desertification and Erosion
- General Directorate of Environmental Management
- General Directorate of Mapping
- General Directorate of Natural Heritage Conservation,
- General Directorate of Nature Conservation and National Parks,
- General Directorate of Water Management,
- Istanbul Technical University, Climate Change Application and Research Center
- Istanbul Technical University, Department of Meteorological Engineering,
- Istanbul Technical University, Eurasian Institute of Earth Sciences
- Istanbul Technical University, Polar Research Application and Research Center
- Istanbul University, Institute of Marine Sciences and Management,
- Marmara Municipalities Union, Sustainability and Climate Change Center
- Middle East University, Institute of Marine Sciences
- Middle East University, Solar Energy Research and Application Center (GÜNAM)
- Middle East University, Marine Ecosystem and Climate Research Center
- Ministry of Environment, Urbanization and Climate Change,
- Samsun University, Department of Meteorological Engineering
- Selçuk University, Agriculture and Climate Change Application and Research Center
- TENMAK
- TUBITAK, Konya Clean Energy, Climate Change and Sustainability Research Institute
- TUBITAK, Marmara Research Center
- Turkish Naval Forces, Office of Navigation, Hydrography and Oceanography,
- Turkish State Meteorological Service

# ANNEX 3: FIFTH BIENNIAL REPORT (BR5)

## [BR5] Chapter 1: Introduction

The Fifth Biennial Report is submitted as an annex to the Eighth National Communication of Türkiye and it is integrated into it. In this annex, the relevant chapters of the Eighth National Communication are referenced according to the structure proposed in the UNFCCC Guidelines for Biennial Reports. Moreover, this annex also includes GHG emissions of Türkiye in Common Tabular Format tables covering the period between 1990-2020.

## [BR5] Chapter 2: Summary of Greenhouse Gas Emissions and Removals

Chapter 3 of the Eighth National Communication contains detailed information to be presented in this section. Common Tabular Format Tables (CTF) reports are presented at below tables.

*Table 38 - Emission Trends: Summary (CTF Table 1) (kt CO2 eq.)*

| *GREENHOUSE GAS EMISSIONS* | Base year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ emissions without net $CO_2$ from LULUCF | 151,664.53 | 151,664.53 | 158,140.73 | 164,061.44 | 171,133.72 | 167,560.89 | 181,481.83 | 199,582.75 | 212,037.41 | 212,069.93 | 207,857.77 |
| $CO_2$ emissions with net $CO_2$ from LULUCF | 95,802.18 | 95,802.18 | 101,376.45 | 107,063.16 | 114,899.43 | 109,619.43 | 123,991.70 | 141,846.88 | 150,230.06 | 149,261.10 | 143,654.28 |
| $CH_4$ emissions without $CH_4$ from LULUCF | 42,479.30 | 42,479.30 | 43,366.88 | 43,276.91 | 43,057.65 | 42,774.37 | 42,601.95 | 42,956.03 | 42,216.70 | 42,410.73 | 43,774.81 |
| $CH_4$ emissions with $CH_4$ from LULUCF | 42,555.45 | 42,555.45 | 43,411.75 | 43,345.36 | 43,144.50 | 42,991.78 | 42,646.12 | 43,042.70 | 42,253.78 | 42,450.92 | 43,809.50 |
| $N_2O$ emissions without $N_2O$ from LULUCF | 24,950.87 | 24,950.87 | 24,733.99 | 25,252.02 | 26,041.36 | 23,565.44 | 23,865.75 | 24,536.02 | 24,044.03 | 25,330.40 | 25,630.06 |
| $N_2O$ emissions with $N_2O$ from LULUCF | 25,001.08 | 25,001.08 | 24,764.73 | 25,301.59 | 26,106.46 | 23,720.56 | 23,910.36 | 24,611.47 | 24,090.88 | 25,380.73 | 25,683.10 |
| HFCs | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| PFCs | 625.30 | 625.30 | 863.34 | 722.59 | 403.08 | 710.00 | 611.44 | 577.15 | 574.01 | 615.00 | 604.82 |
| Unspecified mix of HFCs and PFCs | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $SF_6$ | NO | NO | NO | NO | NO | NO | NO | 10.05 | 11.10 | 11.90 | 12.36 |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total (without LULUCF)** | 219,720.00 | 219,720.00 | 227,104.94 | 233,312.95 | 240,635.81 | 234,610.70 | 248,560.97 | 267,662.00 | 278,883.25 | 280,437.96 | 277,879.82 |
| **Total (with LULUCF)** | 163,984.01 | 163,984.01 | 170,416.27 | 176,432.69 | 184,553.47 | 177,041.77 | 191,159.62 | 210,088.26 | 217,159.84 | 217,719.64 | 213,764.06 |
| **Total (without LULUCF, with indirect)** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total (with LULUCF, with indirect)** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | Base year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Energy | 139,602.00 | 139,602.00 | 143,991.25 | 150,322.29 | 156,800.14 | 153,316.55 | 166,281.07 | 183,993.81 | 196,126.73 | 195,804.12 | 193,781.09 |
| 2. Industrial processes and product use | 22,983.49 | 22,983.49 | 24,880.61 | 24,491.90 | 24,676.46 | 24,347.48 | 25,851.74 | 26,259.53 | 27,097.56 | 27,451.98 | 25,908.12 |
| 3. Agriculture | 46,053.68 | 46,053.68 | 46,927.90 | 46,978.76 | 47,406.98 | 44,926.27 | 44,079.79 | 44,757.27 | 42,505.02 | 43,720.12 | 44,276.39 |
| 4. Land Use, Land-Use Change and Forestry[b] | -55,735.99 | -55,735.99 | -56,688.67 | -56,880.26 | -56,082.34 | -57,568.93 | -57,401.35 | -57,573.75 | -61,723.42 | -62,718.31 | -64,115.75 |
| 5. Waste | 11,080.83 | 11,080.83 | 11,305.19 | 11,520.00 | 11,752.23 | 12,020.41 | 12,348.37 | 12,651.39 | 13,153.94 | 13,461.74 | 13,914.20 |
| 6. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total (including LULUCF)** | 163,984.01 | 163,984.01 | 170,416.27 | 176,432.69 | 184,553.47 | 177,041.77 | 191,159.62 | 210,088.26 | 217,159.84 | 217,719.64 | 213,764.06 |

| *GREENHOUSE GAS EMISSIONS* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ emissions without net $CO_2$ from LULUCF | 229,858.21 | 213,483.47 | 221,148.22 | 236,683.29 | 244,688.74 | 264,768.62 | 282,266.69 | 313,578.16 | 310,532.30 | 316,319.32 | 316,036.48 |
| $CO_2$ emissions with net $CO_2$ from LULUCF | 167,996.89 | 148,466.68 | 148,418.17 | 161,952.75 | 170,916.60 | 190,158.57 | 207,319.65 | 238,876.97 | 240,628.03 | 243,039.38 | 242,298.35 |
| $CH_4$ emissions without $CH_4$ from LULUCF | 43,655.61 | 42,891.67 | 40,945.94 | 42,944.56 | 43,483.33 | 45,154.16 | 46,590.11 | 49,067.58 | 50,138.44 | 49,864.06 | 51,611.65 |
| $CH_4$ emissions with $CH_4$ from LULUCF | 43,815.46 | 42,936.97 | 41,004.45 | 42,990.31 | 43,516.93 | 45,173.39 | 46,643.51 | 49,147.87 | 50,343.67 | 49,896.37 | 51,634.81 |
| $N_2O$ emissions without $N_2O$ from LULUCF | 24,766.35 | 22,592.20 | 22,587.08 | 24,000.22 | 24,796.67 | 25,339.07 | 27,200.70 | 26,305.40 | 24,751.31 | 26,552.10 | 27,446.02 |
| $N_2O$ emissions with $N_2O$ from LULUCF | 24,901.37 | 22,650.56 | 22,656.13 | 24,066.90 | 24,859.13 | 25,394.45 | 27,284.83 | 26,418.83 | 24,950.75 | 26,648.61 | 27,541.31 |
| HFCs | 115.66 | 232.00 | 417.19 | 628.80 | 909.37 | 1,146.88 | 1,424.19 | 1,713.19 | 1,896.14 | 2,111.28 | 3,054.28 |
| PFCs | 601.00 | 592.20 | 586.39 | 581.79 | 580.13 | 559.96 | 460.96 | 574.44 | 527.72 | 259.26 | 461.74 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unspecified mix of HFCs and PFCs | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $SF_6$ | 13.34 | 13.16 | 13.95 | 15.16 | 16.44 | 17.67 | 19.40 | 21.04 | 21.98 | 21.30 | 65.48 |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total (without LULUCF)** | 299,010.16 | 279,804.70 | 285,698.77 | 304,853.83 | 314,474.67 | 336,986.35 | 357,962.05 | 391,259.81 | 387,867.90 | 395,127.31 | 398,675.65 |
| **Total (with LULUCF)** | 237,443.71 | 214,891.57 | 213,096.27 | 230,235.71 | 240,798.61 | 262,450.93 | 283,152.54 | 316,752.34 | 318,368.29 | 321,976.19 | 325,055.98 |
| **Total (without LULUCF, with indirect)** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total (with LULUCF, with indirect)** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Energy | 216,024.96 | 199,185.68 | 205,941.05 | 220,432.38 | 226,277.66 | 244,445.68 | 260,496.62 | 291,504.41 | 288,319.42 | 292,872.45 | 287,840.01 |
| 2. Industrial processes and product use | 26,311.80 | 25,931.57 | 26,923.22 | 28,261.93 | 30,836.07 | 33,700.31 | 36,733.43 | 39,261.75 | 41,072.99 | 43,037.05 | 48,980.22 |
| 3. Agriculture | 42,332.13 | 39,893.71 | 37,607.79 | 40,558.17 | 41,297.53 | 42,439.07 | 43,899.69 | 43,421.25 | 41,301.78 | 42,031.85 | 44,409.31 |
| 4. Land Use, Land-Use Change and Forestry[b] | -61,566.44 | -64,913.14 | -72,602.50 | -74,618.12 | -73,676.06 | -74,535.43 | -74,809.51 | -74,507.47 | -69,499.61 | -73,151.13 | -73,619.67 |
| 5. Waste | 14,341.27 | 14,793.74 | 15,226.71 | 15,601.35 | 16,063.42 | 16,401.30 | 16,832.31 | 17,072.41 | 17,173.70 | 17,185.96 | 17,446.12 |
| 6. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total (including LULUCF)** | 237,443.71 | 214,891.57 | 213,096.27 | 230,235.71 | 240,798.61 | 262,450.93 | 283,152.54 | 316,752.34 | 318,368.29 | 321,976.19 | 325,055.98 |

| *GREENHOUSE GAS EMISSIONS* | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Change from base |
|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | to latest reported year (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ emissions without net $CO_2$ from LULUCF | 341,862.34 | 355,882.64 | 347,152.67 | 363,866.34 | 384,330.49 | 405,304.51 | 430,220.40 | 422,568.91 | 401,719.74 | 413,433.09 | 172.60 |
| $CO_2$ emissions with net $CO_2$ from LULUCF | 264,270.08 | 280,832.53 | 270,000.99 | 285,869.89 | 286,653.88 | 309,129.07 | 330,188.34 | 328,021.56 | 317,496.70 | 356,186.68 | 271.79 |
| $CH_4$ emissions without $CH_4$ from LULUCF | 54,130.91 | 57,795.08 | 56,631.47 | 58,522.70 | 52,775.41 | 55,557.15 | 56,777.50 | 60,346.31 | 63,135.33 | 63,988.98 | 50.64 |
| $CH_4$ emissions with $CH_4$ from LULUCF | 54,156.17 | 57,867.65 | 56,709.48 | 58,543.66 | 52,796.56 | 55,617.32 | 56,835.14 | 60,363.30 | 63,183.50 | 64,097.74 | 50.62 |
| $N_2O$ emissions without $N_2O$ from LULUCF | 28,518.85 | 29,643.33 | 31,454.70 | 31,718.95 | 32,320.33 | 34,408.55 | 35,587.93 | 35,456.30 | 36,981.14 | 40,468.35 | 62.19 |
| $N_2O$ emissions with $N_2O$ from LULUCF | 28,623.86 | 29,778.60 | 31,601.74 | 31,826.90 | 32,437.34 | 34,551.46 | 35,731.86 | 35,573.41 | 37,124.46 | 40,658.38 | 62.63 |
| HFCs | 3,432.64 | 4,256.83 | 4,470.24 | 4,927.46 | 4,802.87 | 5,262.92 | 5,534.60 | 5,502.39 | 6,064.07 | 5,853.16 | 100.00 |
| PFCs | 480.36 | 359.06 | 270.60 | 255.42 | 158.99 | 140.67 | 73.11 | 36.62 | 62.18 | 37.83 | -93.95 |
| Unspecified mix of HFCs and PFCs | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| $SF_6$ | 67.37 | 68.58 | 69.02 | 74.88 | 81.83 | 78.61 | 118.33 | 128.39 | 115.71 | 115.78 | 100.00 |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Total (without LULUCF)** | 428,492.48 | 448,005.53 | 440,048.69 | 459,365.74 | 474,469.91 | 500,752.41 | 528,311.87 | 524,038.91 | 508,078.17 | 523,897.19 | 138.44 |
| **Total (with LULUCF)** | 351,030.49 | 373,163.26 | 363,122.08 | 381,498.20 | 376,931.47 | 404,780.07 | 428,481.38 | 429,625.66 | 424,046.63 | 466,949.58 | 184.75 |
| **Total (without LULUCF, with indirect)** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **Total (with LULUCF, with indirect)** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Change from base to latest reported year (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Energy | 309,922.13 | 321,567.62 | 308,339.29 | 326,754.01 | 341,980.80 | 361,686.41 | 382,389.04 | 374,144.80 | 365,409.72 | 367,576.85 | 163.30 |
| 2. Industrial processes and product use | 53,882.29 | 56,158.04 | 59,187.04 | 59,883.47 | 59,213.43 | 63,452.59 | 66,408.96 | 67,968.27 | 58,577.47 | 66,762.62 | 190.48 |
| 3. Agriculture | 46,901.07 | 52,662.08 | 55,857.58 | 56,219.32 | 56,133.27 | 58,893.78 | 63,262.40 | 65,337.76 | 68,022.52 | 73,155.37 | 58.85 |
| 4. Land Use, Land-Use Change and Forestry[b] | -77,461.99 | -74,842.27 | -76,926.61 | -77,867.54 | -97,538.44 | -95,972.34 | -99,830.48 | -94,413.25 | -84,031.54 | -56,947.61 | 2.17 |
| 5. Waste | 17,786.99 | 17,617.80 | 16,664.79 | 16,508.94 | 17,142.41 | 16,719.64 | 16,251.46 | 16,588.08 | 16,068.47 | 16,402.34 | 48.02 |
| 6. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Total (including LULUCF)** | 351,030.49 | 373,163.26 | 363,122.08 | 381,498.20 | 376,931.47 | 404,780.07 | 428,481.38 | 429,625.66 | 424,046.63 | 466,949.58 | 184.75 |

1 kt $CO_2$ eq equals 1 Gg $CO_2$ eq.

b Includes net $CO_2$, $CH_4$ and $N_2O$ from LULUCF.

*Table 39 - Emission trends ($CO_2$) (CTF Table 1(a)) (kt)*

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | *Base year* | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 129,891.36 | 129,891.36 | 134,516.51 | 140,772.12 | 147,150.71 | 144,098.52 | 156,801.42 | 174,372.18 | 186,001.72 | 185,560.22 | 182,742.20 |
| A. Fuel combustion (sectoral approach) | 129,671.03 | 129,671.03 | 134,253.02 | 140,518.49 | 146,919.66 | 143,879.50 | 156,592.18 | 174,163.64 | 185,795.12 | 185,365.98 | 182,563.79 |
| 1. Energy industries | 37,139.37 | 37,139.37 | 38,679.30 | 43,174.06 | 42,590.27 | 48,872.90 | 50,272.23 | 54,242.81 | 59,345.93 | 64,899.07 | 70,116.20 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2. Manufacturing industries and construction | 37,003.99 | 37,003.99 | 40,161.67 | 39,167.89 | 39,832.38 | 35,740.92 | 39,842.82 | 50,376.21 | 55,793.93 | 55,221.22 | 47,157.76 |
| 3. Transport | 26,250.81 | 26,250.81 | 24,982.32 | 25,639.91 | 31,268.75 | 29,789.14 | 33,179.97 | 35,277.22 | 33,702.48 | 31,816.76 | 33,634.52 |
| 4. Other sectors | 29,276.87 | 29,276.87 | 30,429.73 | 32,536.63 | 33,228.25 | 29,476.54 | 33,297.17 | 34,267.40 | 36,952.77 | 33,428.93 | 31,655.31 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| B. Fugitive emissions from fuels | 220.20 | 220.20 | 263.37 | 253.51 | 230.92 | 218.89 | 209.11 | 208.41 | 206.48 | 194.12 | 178.28 |
| 1. Solid fuels | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| 2. Oil and natural gas and other emissions from energy production | 220.20 | 220.20 | 263.37 | 253.51 | 230.92 | 218.89 | 209.11 | 208.41 | 206.48 | 194.12 | 178.28 |
| C. $CO_2$ transport and storage | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| **2. Industrial processes** | 21,286.63 | 21,286.63 | 23,160.83 | 22,802.75 | 23,327.49 | 22,981.13 | 24,228.52 | 24,648.67 | 25,464.47 | 25,827.83 | 24,360.74 |
| A. Mineral industry | 13,423.66 | 13,423.66 | 14,939.71 | 15,559.10 | 16,118.20 | 16,783.38 | 17,549.45 | 17,803.78 | 18,664.98 | 18,755.45 | 17,849.59 |
| B. Chemical industry | 565.24 | 565.24 | 523.50 | 523.85 | 465.16 | 385.63 | 472.11 | 451.84 | 464.48 | 444.62 | 203.83 |
| C. Metal industry | 7,114.37 | 7,114.37 | 7,507.18 | 6,556.48 | 6,570.20 | 5,638.19 | 6,004.14 | 6,169.59 | 6,092.69 | 6,424.35 | 6,057.32 |
| D. Non-energy products from fuels and solvent use | 183.37 | 183.37 | 190.44 | 163.32 | 173.93 | 173.93 | 202.82 | 223.46 | 242.33 | 203.41 | 249.99 |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| H. Other | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NA | NE, NA | NE, NA | NE, NA |
| **3. Agriculture** | 459.95 | 459.95 | 436.20 | 458.75 | 626.74 | 452.60 | 425.92 | 534.13 | 532.00 | 657.91 | 733.33 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Enteric fermentation | | | | | | | | | | | |
| B. Manure management | | | | | | | | | | | |
| C. Rice cultivation | | | | | | | | | | | |
| D. Agricultural soils | | | | | | | | | | | |
| E. Prescribed burning of savannas | | | | | | | | | | | |
| F. Field burning of agricultural residues | | | | | | | | | | | |
| G. Liming | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| H. Urea application | 459.95 | 459.95 | 436.20 | 458.75 | 626.74 | 452.60 | 425.92 | 534.13 | 532.00 | 657.91 | 733.33 |
| I. Other carbon-containing fertilizers | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **4. Land Use, Land-Use Change and Forestry** | -55,862.35 | -55,862.35 | -56,764.28 | -56,998.28 | -56,234.30 | -57,941.46 | -57,490.12 | -57,735.86 | -61,807.35 | -62,808.83 | -64,203.49 |
| A. Forest land | -52,956.36 | -52,956.36 | -54,470.07 | -54,243.78 | -54,477.65 | -56,521.77 | -55,036.25 | -55,917.51 | -59,061.71 | -60,396.63 | -61,671.78 |
| B. Cropland | 0.69 | 0.69 | 84.45 | 152.69 | 136.89 | 216.95 | 150.24 | 137.37 | 73.35 | 145.16 | 109.21 |
| C. Grassland | 0.03 | 0.03 | 78.40 | 184.20 | 245.18 | 377.28 | 287.74 | 417.87 | 225.17 | 402.71 | 417.71 |
| D. Wetlands | 0.01 | 0.01 | 43.91 | 90.39 | 246.16 | 219.74 | 156.38 | 120.92 | 146.46 | 367.57 | 260.19 |
| E. Settlements | NO | NO | 28.46 | 70.12 | 99.42 | 104.87 | 132.20 | 135.15 | 130.67 | 160.32 | 155.95 |
| F. Other land | NO | NO | 43.91 | 127.77 | 135.49 | 168.59 | 180.62 | 252.96 | 172.81 | 285.17 | 255.73 |
| G. Harvested wood products | -2,906.72 | -2,906.72 | -2,573.34 | -3,379.68 | -2,619.79 | -2,507.13 | -3,361.05 | -2,882.62 | -3,494.10 | -3,773.12 | -3,730.50 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Waste** | 26.59 | 26.59 | 27.18 | 27.81 | 28.78 | 28.64 | 25.96 | 27.77 | 39.22 | 23.97 | 21.51 |
| A. Solid waste disposal | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B. Biological treatment of solid waste | | | | | | | | | | | |
| C. Incineration and open burning of waste | 26.59 | 26.59 | 27.18 | 27.81 | 28.78 | 28.64 | 25.96 | 27.77 | 39.22 | 23.97 | 21.51 |
| D. Waste water treatment and discharge | | | | | | | | | | | |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 930.78 | 930.78 | 1,138.96 | 1,151.44 | 1,290.14 | 1,138.84 | 1,394.62 | 1,397.47 | 1,870.62 | 2,031.47 | 2,407.30 |
| Aviation | 551.80 | 551.80 | 715.77 | 804.05 | 977.48 | 788.29 | 807.21 | 1,002.70 | 1,368.47 | 1,522.97 | 1,513.51 |
| Navigation | 378.98 | 378.98 | 423.19 | 347.39 | 312.66 | 350.55 | 587.41 | 394.77 | 502.15 | 508.50 | 893.79 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ emissions from biomass** | 32,841.81 | 32,841.81 | 32,874.32 | 32,874.05 | 32,635.17 | 32,484.98 | 32,330.40 | 31,955.60 | 32,147.25 | 31,706.65 | 30,742.14 |
| **$CO_2$ captured** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| **Long-term storage of C in waste disposal sites** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Indirect $N_2O$** | | | | | | | | | | | |
| **Indirect $CO_2$ (3)** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total $CO_2$ equivalent emissions without land use, land-use change and forestry** | 151,664.53 | 151,664.53 | 158,140.73 | 164,061.44 | 171,133.72 | 167,560.89 | 181,481.83 | 199,582.75 | 212,037.41 | 212,069.93 | 207,857.77 |
| **Total $CO_2$ equivalent emissions with land use, land-use change and forestry** | 95,802.18 | 95,802.18 | 101,376.45 | 107,063.16 | 114,899.43 | 109,619.43 | 123,991.70 | 141,846.88 | 150,230.06 | 149,261.10 | 143,654.28 |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, without land use, land-use change and forestry** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total $CO_2$ equivalent emissions, including indirect $CO_2$, with land use, land-use change and forestry** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 204,493.88 | 188,587.28 | 195,541.44 | 209,828.52 | 215,444.21 | 232,906.63 | 248,482.96 | 277,129.86 | 272,156.01 | 276,415.04 | 271,645.32 |
| A. Fuel combustion (sectoral approach) | 204,325.91 | 188,432.48 | 195,393.07 | 209,683.21 | 215,303.88 | 232,764.91 | 248,347.73 | 276,996.84 | 272,021.02 | 276,276.70 | 271,489.04 |
| 1. Energy industries | 77,485.63 | 79,742.75 | 74,045.43 | 73,976.18 | 75,039.35 | 90,163.84 | 95,796.63 | 113,152.43 | 118,764.91 | 118,287.10 | 112,917.01 |
| 2. Manufacturing industries and construction | 57,657.32 | 45,469.59 | 56,855.70 | 66,387.60 | 63,557.97 | 62,731.09 | 69,749.05 | 71,520.70 | 47,168.69 | 46,033.95 | 52,119.64 |
| 3. Transport | 35,490.22 | 35,533.74 | 35,316.14 | 36,892.84 | 41,061.32 | 41,043.83 | 44,376.84 | 50,988.90 | 47,116.86 | 46,871.23 | 44,382.60 |
| 4. Other sectors | 33,692.74 | 27,686.40 | 29,175.81 | 32,426.59 | 35,645.24 | 38,826.15 | 38,425.20 | 41,334.81 | 58,970.57 | 65,084.42 | 62,069.79 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| B. Fugitive emissions from fuels | 167.85 | 154.67 | 148.24 | 145.18 | 140.20 | 141.60 | 135.10 | 132.90 | 134.86 | 138.22 | 156.16 |
| 1. Solid fuels | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| 2. Oil and natural gas and other emissions from energy production | 167.85 | 154.67 | 148.24 | 145.18 | 140.20 | 141.60 | 135.10 | 132.90 | 134.86 | 138.22 | 156.16 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C. $CO_2$ transport and storage | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| **2. Industrial processes** | 24,725.88 | 24,348.49 | 25,066.77 | 26,274.19 | 28,605.45 | 31,236.94 | 33,177.60 | 35,865.08 | 37,794.08 | 39,296.32 | 43,734.96 |
| A. Mineral industry | 18,417.57 | 18,102.33 | 18,736.40 | 19,489.91 | 20,964.38 | 23,246.38 | 25,306.36 | 27,530.27 | 29,100.59 | 30,724.63 | 34,086.82 |
| B. Chemical industry | 214.27 | 178.71 | 374.48 | 383.51 | 490.98 | 591.29 | 143.26 | 40.62 | 162.88 | 52.34 | 249.58 |
| C. Metal industry | 5,816.92 | 5,853.43 | 5,672.89 | 6,126.02 | 6,791.02 | 6,953.54 | 7,256.30 | 7,844.91 | 8,170.95 | 8,123.13 | 8,966.97 |
| D. Non-energy products from fuels and solvent use | 277.11 | 214.02 | 283.01 | 274.75 | 359.07 | 445.74 | 471.68 | 449.28 | 359.66 | 396.21 | 431.59 |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| H. Other | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA |
| **3. Agriculture** | 617.47 | 527.07 | 526.92 | 565.41 | 632.18 | 613.16 | 592.34 | 566.30 | 564.84 | 592.72 | 644.98 |
| A. Enteric fermentation | | | | | | | | | | | |
| B. Manure management | | | | | | | | | | | |
| C. Rice cultivation | | | | | | | | | | | |
| D. Agricultural soils | | | | | | | | | | | |
| E. Prescribed burning of savannas | | | | | | | | | | | |
| F. Field burning of agricultural residues | | | | | | | | | | | |
| G. Liming | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H. Urea application | 617.47 | 527.07 | 526.92 | 565.41 | 632.18 | 613.16 | 592.34 | 566.30 | 564.84 | 592.72 | 644.98 |
| I. Other carbon-containing fertilizers | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **4. Land Use, Land-Use Change and Forestry** | -61,861.32 | -65,016.80 | -72,730.06 | -74,730.54 | -73,772.13 | -74,610.04 | -74,947.04 | -74,701.19 | -69,904.27 | -73,279.94 | -73,738.13 |
| A. Forest land | -58,155.57 | -61,518.56 | -68,954.63 | -70,341.49 | -69,653.38 | -69,387.50 | -70,369.79 | -69,003.24 | -64,307.21 | -67,433.83 | -67,652.00 |
| B. Cropland | 33.42 | 86.22 | 306.44 | 175.64 | 425.20 | 197.72 | 431.53 | 277.06 | 454.00 | 191.66 | 435.48 |
| C. Grassland | 92.03 | 120.41 | 283.67 | 173.30 | 408.80 | 255.27 | 545.67 | 411.63 | 600.40 | 483.10 | 629.02 |
| D. Wetlands | 174.71 | 9.81 | 146.91 | 25.77 | 82.51 | 26.14 | 109.49 | 45.37 | 132.98 | 95.13 | 410.44 |
| E. Settlements | 144.74 | 147.26 | 202.75 | 192.31 | 269.57 | 272.89 | 347.08 | 352.83 | 375.62 | 359.55 | 425.72 |
| F. Other land | 186.80 | 175.96 | 283.66 | 221.99 | 394.65 | 310.40 | 485.66 | 462.66 | 538.96 | 431.96 | 600.58 |
| G. Harvested wood products | -4,337.47 | -4,037.91 | -4,998.85 | -5,178.07 | -5,699.48 | -6,284.96 | -6,496.68 | -7,247.49 | -7,699.03 | -7,407.52 | -8,587.37 |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Waste** | 20.98 | 20.62 | 13.09 | 15.17 | 6.90 | 11.87 | 13.80 | 16.91 | 17.38 | 15.24 | 11.21 |
| A. Solid waste disposal | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| B. Biological treatment of solid waste | | | | | | | | | | | |
| C. Incineration and open burning of waste | 20.98 | 20.62 | 13.09 | 15.17 | 6.90 | 11.87 | 13.80 | 16.91 | 17.38 | 15.24 | 11.21 |
| D. Waste water treatment and discharge | | | | | | | | | | | |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 2,877.79 | 2,340.89 | 4,338.33 | 4,726.51 | 6,144.26 | 6,705.97 | 6,141.29 | 6,086.12 | 7,316.49 | 8,108.61 | 8,265.77 |
| Aviation | 1,598.65 | 1,592.34 | 2,648.65 | 2,762.16 | 2,976.57 | 3,329.73 | 3,014.41 | 3,730.69 | 4,991.42 | 5,254.72 | 5,858.47 |
| Navigation | 1,279.14 | 748.55 | 1,689.68 | 1,964.35 | 3,167.69 | 3,376.24 | 3,126.88 | 2,355.43 | 2,325.07 | 2,853.89 | 2,407.30 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **CO2 emissions from biomass** | 29,720.99 | 28,530.38 | 27,455.69 | 26,370.34 | 25,358.84 | 24,373.84 | 23,495.12 | 22,670.27 | 21,830.56 | 21,115.22 | 20,326.31 |
| **CO2 captured** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| **Long-term storage of C in waste disposal sites** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Indirect N2O** | | | | | | | | | | | |
| **Indirect CO2 (3)** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| **Total CO2 equivalent emissions without land use, land-use change and forestry** | 229,858.21 | 213,483.47 | 221,148.22 | 236,683.29 | 244,688.74 | 264,768.62 | 282,266.69 | 313,578.16 | 310,532.30 | 316,319.32 | 316,036.48 |
| **Total CO2 equivalent emissions with land use, land-use change and forestry** | 167,996.89 | 148,466.68 | 148,418.17 | 161,952.75 | 170,916.60 | 190,158.57 | 207,319.65 | 238,876.97 | 240,628.03 | 243,039.38 | 242,298.35 |
| **Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Change from base to latest reported year (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 293,134.51 | 305,544.15 | 293,760.22 | 310,274.44 | 330,814.94 | 347,273.30 | 369,365.46 | 360,849.67 | 350,126.99 | 353,037.88 | 171.79 |
| A. Fuel combustion (sectoral approach) | 292,983.86 | 305,400.33 | 293,614.56 | 310,128.83 | 330,660.22 | 347,115.23 | 369,208.30 | 360,675.07 | 349,944.02 | 352,842.52 | 172.11 |
| 1. Energy industries | 124,957.88 | 125,865.22 | 120,365.75 | 131,143.42 | 134,536.39 | 144,654.81 | 155,914.26 | 158,359.55 | 148,637.45 | 142,025.95 | 282.41 |
| 2. Manufacturing industries and construction | 52,379.72 | 60,821.10 | 52,771.98 | 54,232.93 | 59,358.59 | 59,839.63 | 59,958.34 | 59,311.25 | 54,277.03 | 59,868.68 | 61.79 |
| 3. Transport | 46,366.82 | 61,248.52 | 67,478.09 | 72,084.28 | 74,271.58 | 80,207.78 | 83,064.08 | 82,902.43 | 80,745.15 | 79,032.48 | 201.07 |
| 4. Other sectors | 69,279.45 | 57,465.48 | 52,998.74 | 52,668.20 | 62,493.67 | 62,413.01 | 70,271.62 | 60,101.85 | 66,284.40 | 71,915.42 | 145.64 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | 0.00 |
| B. Fugitive emissions from fuels | 150.52 | 143.69 | 145.54 | 145.49 | 154.59 | 157.94 | 157.04 | 174.47 | 182.84 | 195.24 | -11.34 |
| 1. Solid fuels | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.00 |
| 2. Oil and natural gas and other emissions from energy production | 150.52 | 143.69 | 145.54 | 145.49 | 154.59 | 157.94 | 157.04 | 174.47 | 182.84 | 195.24 | -11.34 |
| C. $CO_2$ transport and storage | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.00 |
| **2. Industrial processes** | 48,156.19 | 49,684.30 | 52,577.77 | 52,803.73 | 52,703.88 | 56,734.02 | 59,403.77 | 60,460.53 | 50,302.44 | 58,734.55 | 175.92 |
| A. Mineral industry | 36,224.76 | 37,306.91 | 40,536.37 | 40,881.29 | 40,301.33 | 43,816.05 | 46,470.44 | 46,206.70 | 38,563.84 | 47,109.30 | 250.94 |
| B. Chemical industry | 1,011.93 | 1,191.96 | 792.81 | 975.75 | 1,337.23 | 940.02 | 741.68 | 1,511.79 | 1,112.02 | 1,084.73 | 91.91 |
| C. Metal industry | 10,065.76 | 10,579.91 | 10,715.00 | 10,547.53 | 10,798.82 | 11,831.73 | 12,040.12 | 12,535.68 | 10,488.62 | 10,406.50 | 46.27 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D. Non-energy products from fuels and solvent use | 853.74 | 605.52 | 533.59 | 399.16 | 266.50 | 146.22 | 151.53 | 206.36 | 137.97 | 134.03 | -26.91 |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| H. Other | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | 0.00 |
| **3. Agriculture** | 557.55 | 639.77 | 807.30 | 787.69 | 810.59 | 1,295.35 | 1,449.63 | 1,257.47 | 1,287.94 | 1,657.03 | 260.27 |
| A. Enteric fermentation | | | | | | | | | | | |
| B. Manure management | | | | | | | | | | | |
| C. Rice cultivation | | | | | | | | | | | |
| D. Agricultural soils | | | | | | | | | | | |
| E. Prescribed burning of savannas | | | | | | | | | | | |
| F. Field burning of agricultural residues | | | | | | | | | | | |
| G. Liming | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.00 |
| H. Urea application | 557.55 | 639.77 | 807.30 | 787.69 | 810.59 | 1,295.35 | 1,449.63 | 1,257.47 | 1,287.94 | 1,657.03 | 260.27 |
| I. Other carbon-containing fertilizers | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **4. Land Use, Land-Use Change and Forestry** | -77,592.27 | -75,050.11 | -77,151.67 | -77,996.45 | -97,676.61 | -96,175.43 | -100,032.06 | -94,547.35 | -84,223.04 | -57,246.40 | 2.48 |
| A. Forest land | -69,429.50 | -67,273.01 | -68,041.75 | -68,133.86 | -87,703.79 | -85,332.50 | -90,290.21 | -84,877.41 | -75,390.47 | -48,400.98 | -8.60 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B. Cropland | 186.10 | 405.08 | 197.49 | 287.37 | 436.72 | 322.37 | 346.26 | 329.39 | 357.25 | 370.51 | 53,562.71 |
| C. Grassland | 389.56 | 637.53 | 457.31 | 743.80 | 972.43 | 646.36 | 695.51 | 698.85 | 757.32 | 765.03 | 2,772,578.72 |
| D. Wetlands | 169.32 | 608.03 | 378.61 | 170.19 | -24.13 | 267.30 | 284.02 | 218.28 | 184.24 | 184.61 | 1,494,709.22 |
| E. Settlements | 393.76 | 435.34 | 397.46 | 420.32 | 419.22 | 405.58 | 412.62 | 406.90 | 413.11 | 418.91 | 100.00 |
| F. Other land | 440.93 | 647.65 | 539.99 | 564.57 | 763.97 | 617.32 | 653.05 | 650.08 | 670.61 | 696.38 | 100.00 |
| G. Harvested wood products | -9,742.43 | -10,510.74 | -11,080.78 | -12,048.84 | -12,541.04 | -13,101.86 | -12,133.31 | -11,973.45 | -11,215.10 | -11,280.86 | 288.10 |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **5. Waste** | 14.09 | 14.42 | 7.37 | 0.48 | 1.07 | 1.84 | 1.54 | 1.24 | 2.38 | 3.62 | -86.38 |
| A. Solid waste disposal | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| B. Biological treatment of solid waste | | | | | | | | | | | |
| C. Incineration and open burning of waste | 14.09 | 14.42 | 7.37 | 0.48 | 1.07 | 1.84 | 1.54 | 1.24 | 2.38 | 3.62 | -86.38 |
| D. Waste water treatment and discharge | | | | | | | | | | | |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 8,720.45 | 10,302.77 | 11,552.99 | 13,182.48 | 13,827.13 | 13,635.78 | 13,885.54 | 15,106.12 | 16,750.72 | 7,568.48 | 713.13 |
| Aviation | 6,769.01 | 7,684.30 | 8,660.75 | 9,922.40 | 11,085.16 | 10,629.74 | 11,014.81 | 12,005.61 | 13,917.42 | 5,842.41 | 958.79 |
| Navigation | 1,951.44 | 2,618.47 | 2,892.24 | 3,260.08 | 2,741.97 | 3,006.04 | 2,870.73 | 3,100.52 | 2,833.30 | 1,726.07 | 355.45 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **CO2 emissions from biomass** | 15,628.03 | 15,295.59 | 14,955.92 | 14,395.52 | 12,771.31 | 11,940.31 | 10,747.64 | 11,450.62 | 11,716.37 | 12,948.69 | -60.57 |
| **CO2 captured** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | 0.00 |
| **Long-term storage of C in waste disposal sites** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **Indirect N2O** | | | | | | | | | | | |
| **Indirect CO2 (3)** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | 0.00 |
| **Total CO2 equivalent emissions without land use, land-use change and forestry** | 341,862.34 | 355,882.64 | 347,152.67 | 363,866.34 | 384,330.49 | 405,304.51 | 430,220.40 | 422,568.91 | 401,719.74 | 413,433.09 | 172.60 |
| **Total CO2 equivalent emissions with land use, land-use change and forestry** | 264,270.08 | 280,832.53 | 270,000.99 | 285,869.89 | 286,653.88 | 309,129.07 | 330,188.34 | 328,021.56 | 317,496.70 | 356,186.68 | 271.79 |
| **Total CO2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry** | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |

b Fill in net emissions/removals as reported in CRF table Summary 1.A of the latest reported inventory year. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

*Table 40 - Emission trends ($CH_4$) (CTF Table 1(b)) (kt)*

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | *Base year* | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 310.48 | 310.48 | 301.20 | 302.64 | 295.70 | 279.48 | 285.76 | 285.78 | 304.49 | 310.76 | 342.72 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Fuel combustion (sectoral approach) | 138.93 | 138.93 | 139.80 | 143.04 | 139.64 | 128.32 | 133.26 | 131.77 | 138.20 | 128.76 | 121.06 |
| 1. Energy industries | 0.44 | 0.44 | 0.45 | 0.49 | 0.50 | 0.57 | 0.59 | 0.63 | 0.70 | 0.77 | 0.85 |
| 2. Manufacturing industries and construction | 1.84 | 1.84 | 1.96 | 1.69 | 1.78 | 1.30 | 1.60 | 2.37 | 2.65 | 3.01 | 2.28 |
| 3. Transport | 3.95 | 3.95 | 3.81 | 4.16 | 5.00 | 4.94 | 5.45 | 5.86 | 7.02 | 7.46 | 7.78 |
| 4. Other sectors | 132.70 | 132.70 | 133.58 | 136.70 | 132.35 | 121.52 | 125.61 | 122.91 | 127.84 | 117.52 | 110.15 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| B. Fugitive emissions from fuels | 171.55 | 171.55 | 161.41 | 159.60 | 156.06 | 151.16 | 152.50 | 154.02 | 166.28 | 182.00 | 221.66 |
| 1. Solid fuels | 143.93 | 143.93 | 128.77 | 127.09 | 124.56 | 119.93 | 119.40 | 118.69 | 127.49 | 142.59 | 179.25 |
| 2. Oil and natural gas and other emissions from energy production | 27.62 | 27.62 | 32.64 | 32.51 | 31.51 | 31.23 | 33.11 | 35.33 | 38.79 | 39.41 | 42.41 |
| C. $CO_2$ transport and storage | | | | | | | | | | | |
| **2. Industrial processes** | 0.32 | 0.32 | 0.30 | 0.31 | 0.31 | 0.32 | 0.30 | 0.33 | 0.34 | 0.32 | 0.31 |
| A. Mineral industry | | | | | | | | | | | |
| B. Chemical industry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C. Metal industry | 0.32 | 0.32 | 0.30 | 0.31 | 0.31 | 0.31 | 0.30 | 0.32 | 0.34 | 0.32 | 0.30 |
| D. Non-energy products from fuels and solvent use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| G. Other product manufacture and use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| H. Other | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE |
| **3. Agriculture** | 1,004.56 | 1,004.56 | 1,041.42 | 1,028.37 | 1,017.54 | 1,013.38 | 988.29 | 989.39 | 920.44 | 911.79 | 917.01 |
| A. Enteric fermentation | 895.87 | 895.87 | 928.86 | 920.98 | 905.45 | 893.57 | 872.61 | 871.68 | 812.53 | 795.61 | 798.52 |
| B. Manure management | 94.08 | 94.08 | 97.62 | 93.20 | 96.81 | 106.43 | 101.04 | 102.18 | 92.33 | 99.10 | 102.17 |
| C. Rice cultivation | 4.00 | 4.00 | 3.99 | 3.76 | 4.05 | 3.59 | 4.50 | 5.03 | 4.97 | 5.40 | 5.86 |
| D. Agricultural soils | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E. Prescribed burning of savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| F. Field burning of agricultural residues | 10.60 | 10.60 | 10.96 | 10.43 | 11.23 | 9.80 | 10.14 | 10.52 | 10.61 | 11.68 | 10.46 |
| G. Liming | | | | | | | | | | | |
| H. Urea application | | | | | | | | | | | |
| I. Other carbon-containing fertilizers | | | | | | | | | | | |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **4. Land use, land-use change and forestry** | 3.05 | 3.05 | 1.79 | 2.74 | 3.47 | 8.70 | 1.77 | 3.47 | 1.48 | 1.61 | 1.39 |
| A. Forest land | 3.05 | 3.05 | 1.79 | 2.74 | 3.47 | 8.70 | 1.77 | 3.47 | 1.48 | 1.61 | 1.39 |
| B. Cropland | NO, NE, IE | NO, NE, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| C. Grassland | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E. Settlements | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| F. Other land | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| G. Harvested wood products | | | | | | | | | | | |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Waste** | 383.81 | 383.81 | 391.75 | 399.76 | 408.75 | 417.80 | 429.73 | 442.74 | 463.40 | 473.55 | 490.95 |
| A. Solid waste disposal | 269.18 | 269.18 | 275.74 | 282.39 | 290.04 | 297.77 | 305.12 | 317.13 | 331.64 | 348.53 | 366.50 |
| B. Biological treatment of solid waste | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.31 | 0.35 | 0.35 | 0.32 | 0.36 |
| C. Incineration and open burning of waste | 2.69 | 2.69 | 2.74 | 2.78 | 2.83 | 2.87 | 2.63 | 2.85 | 4.06 | 2.51 | 2.28 |
| D. Waste water treatment and discharge | 111.56 | 111.56 | 112.90 | 114.21 | 115.50 | 116.78 | 121.67 | 122.42 | 127.35 | 122.19 | 121.82 |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total $CH_4$ emissions without $CH_4$ from LULUCF** | 1,699.17 | 1,699.17 | 1,734.68 | 1,731.08 | 1,722.31 | 1,710.97 | 1,704.08 | 1,718.24 | 1,688.67 | 1,696.43 | 1,750.99 |
| **Total $CH_4$ emissions with $CH_4$ from LULUCF** | 1,702.22 | 1,702.22 | 1,736.47 | 1,733.81 | 1,725.78 | 1,719.67 | 1,705.84 | 1,721.71 | 1,690.15 | 1,698.04 | 1,752.38 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.06 | 0.04 | 0.06 | 0.06 | 0.09 |
| Aviation | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Navigation | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.05 | 0.04 | 0.05 | 0.05 | 0.08 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **$CO_2$ emissions from biomass** | | | | | | | | | | | |
| **$CO_2$ captured** | | | | | | | | | | | |
| **Long-term storage of C in waste disposal sites** | | | | | | | | | | | |
| **Indirect $N_2O$** | | | | | | | | | | | |
| **Indirect $CO_2$ (3)** | | | | | | | | | | | |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 360.32 | 329.74 | 320.35 | 313.70 | 313.49 | 336.84 | 346.52 | 424.17 | 484.36 | 491.36 | 489.85 |
| A. Fuel combustion (sectoral approach) | 121.24 | 107.85 | 109.61 | 111.93 | 113.75 | 112.44 | 108.52 | 111.54 | 153.40 | 171.79 | 167.08 |
| 1. Energy industries | 0.97 | 1.00 | 0.96 | 0.99 | 1.00 | 1.21 | 1.30 | 1.55 | 1.59 | 1.71 | 1.72 |
| 2. Manufacturing industries and construction | 3.44 | 2.16 | 3.17 | 3.59 | 3.48 | 3.13 | 3.96 | 4.16 | 1.82 | 1.85 | 1.66 |
| 3. Transport | 8.91 | 8.43 | 7.86 | 8.08 | 8.35 | 8.59 | 9.22 | 10.45 | 10.53 | 10.96 | 11.44 |
| 4. Other sectors | 107.92 | 96.27 | 97.62 | 99.27 | 100.92 | 99.51 | 94.04 | 95.38 | 139.45 | 157.26 | 152.26 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| B. Fugitive emissions from fuels | 239.07 | 221.88 | 210.75 | 201.78 | 199.75 | 224.40 | 237.99 | 312.62 | 330.97 | 319.57 | 322.77 |
| 1. Solid fuels | 193.45 | 175.48 | 162.38 | 146.57 | 142.73 | 157.63 | 164.78 | 229.02 | 244.73 | 242.44 | 246.03 |
| 2. Oil and natural gas and other emissions from energy production | 45.62 | 46.40 | 48.37 | 55.20 | 57.02 | 66.77 | 73.21 | 83.61 | 86.23 | 77.13 | 76.75 |
| C. $CO_2$ transport and storage | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2. Industrial processes** | 0.35 | 0.33 | 0.30 | 0.32 | 0.33 | 0.37 | 0.35 | 0.37 | 0.38 | 0.36 | 0.41 |
| A. Mineral industry | | | | | | | | | | | |
| B. Chemical industry | 0.00 | 0.00 | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA |
| C. Metal industry | 0.35 | 0.33 | 0.30 | 0.32 | 0.33 | 0.37 | 0.35 | 0.37 | 0.38 | 0.36 | 0.41 |
| D. Non-energy products from fuels and solvent use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| H. Other | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE | NA, NE |
| **3. Agriculture** | 878.22 | 860.09 | 775.06 | 847.17 | 850.78 | 882.10 | 913.56 | 926.24 | 904.22 | 886.87 | 951.44 |
| A. Enteric fermentation | 769.36 | 748.56 | 678.98 | 754.98 | 758.75 | 787.18 | 814.08 | 823.01 | 803.36 | 784.23 | 837.84 |
| B. Manure management | 93.35 | 96.55 | 80.68 | 76.54 | 74.82 | 78.36 | 82.03 | 87.32 | 84.32 | 85.50 | 98.83 |
| C. Rice cultivation | 5.12 | 5.28 | 5.39 | 5.71 | 6.24 | 7.32 | 8.47 | 8.11 | 8.63 | 8.34 | 8.08 |
| D. Agricultural soils | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E. Prescribed burning of savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| F. Field burning of agricultural residues | 10.39 | 9.71 | 10.01 | 9.94 | 10.97 | 9.24 | 8.98 | 7.81 | 7.91 | 8.80 | 6.69 |
| G. Liming | | | | | | | | | | | |
| H. Urea application | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Other carbon-containing fertilizers | | | | | | | | | | | |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **4. Land use, land-use change and forestry** | 6.39 | 1.81 | 2.34 | 1.83 | 1.34 | 0.77 | 2.14 | 3.21 | 8.21 | 1.29 | 0.93 |
| A. Forest land | 6.39 | 1.81 | 2.34 | 1.83 | 1.34 | 0.77 | 2.14 | 3.21 | 8.21 | 1.29 | 0.93 |
| B. Cropland | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| C. Grassland | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| E. Settlements | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| F. Other land | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| G. Harvested wood products | | | | | | | | | | | |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Waste** | 507.34 | 525.51 | 542.13 | 556.58 | 574.72 | 586.85 | 603.17 | 611.93 | 616.58 | 615.97 | 622.77 |
| A. Solid waste disposal | 383.26 | 400.69 | 417.17 | 432.08 | 448.54 | 462.48 | 476.67 | 488.21 | 496.87 | 496.33 | 502.58 |
| B. Biological treatment of solid waste | 0.39 | 0.49 | 0.74 | 0.88 | 0.73 | 0.66 | 0.61 | 0.71 | 0.62 | 0.55 | 0.70 |
| C. Incineration and open burning of waste | 2.25 | 2.23 | 1.43 | 1.68 | 0.66 | 1.18 | 1.60 | 1.64 | 1.56 | 1.27 | 0.87 |
| D. Waste water treatment and discharge | 121.44 | 122.09 | 122.78 | 121.94 | 124.79 | 122.53 | 124.29 | 121.37 | 117.53 | 117.83 | 118.62 |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total $CH_4$ emissions without $CH_4$ from LULUCF** | 1,746.22 | 1,715.67 | 1,637.84 | 1,717.78 | 1,739.33 | 1,806.17 | 1,863.60 | 1,962.70 | 2,005.54 | 1,994.56 | 2,064.47 |
| **Total $CH_4$ emissions with $CH_4$ from LULUCF** | 1,752.62 | 1,717.48 | 1,640.18 | 1,719.61 | 1,740.68 | 1,806.94 | 1,865.74 | 1,965.91 | 2,013.75 | 1,995.85 | 2,065.39 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 0.13 | 0.08 | 0.17 | 0.20 | 0.31 | 0.34 | 0.31 | 0.24 | 0.25 | 0.29 | 0.26 |
| Aviation | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 |
| Navigation | 0.12 | 0.07 | 0.16 | 0.18 | 0.29 | 0.31 | 0.29 | 0.21 | 0.21 | 0.26 | 0.22 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ emissions from biomass** | | | | | | | | | | | |
| **$CO_2$ captured** | | | | | | | | | | | |
| **Long-term storage of C in waste disposal sites** | | | | | | | | | | | |
| **Indirect $N_2O$** | | | | | | | | | | | |
| **Indirect $CO_2$ (3)** | | | | | | | | | | | |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Change from base to latest reported year (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 503.02 | 523.97 | 465.34 | 532.50 | 294.91 | 418.52 | 354.58 | 381.86 | 468.81 | 433.69 | 39.68 |
| A. Fuel combustion (sectoral approach) | 146.48 | 154.49 | 130.24 | 129.69 | 81.27 | 81.04 | 92.94 | 82.39 | 89.11 | 98.28 | -29.26 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Energy industries | 1.91 | 1.90 | 1.81 | 1.91 | 1.94 | 2.03 | 2.11 | 2.01 | 1.81 | 1.83 | 318.23 |
| 2. Manufacturing industries and construction | 1.53 | 1.88 | 1.65 | 1.75 | 2.02 | 2.03 | 2.05 | 3.22 | 3.30 | 3.48 | 89.55 |
| 3. Transport | 11.49 | 12.60 | 13.03 | 13.62 | 14.54 | 15.41 | 15.38 | 15.85 | 16.04 | 15.15 | 283.18 |
| 4. Other sectors | 131.55 | 138.11 | 113.75 | 112.41 | 62.76 | 61.56 | 73.39 | 61.31 | 67.97 | 77.82 | -41.36 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | 0.00 |
| B. Fugitive emissions from fuels | 356.54 | 369.48 | 335.10 | 402.81 | 213.64 | 337.49 | 261.64 | 299.47 | 379.70 | 335.41 | 95.52 |
| 1. Solid fuels | 266.47 | 274.04 | 252.98 | 292.74 | 109.31 | 235.83 | 147.26 | 195.40 | 270.80 | 222.33 | 54.47 |
| 2. Oil and natural gas and other emissions from energy production | 90.08 | 95.44 | 82.12 | 110.08 | 104.33 | 101.66 | 114.39 | 104.07 | 108.89 | 113.09 | 309.41 |
| C. $CO_2$ transport and storage | | | | | | | | | | | |
| **2. Industrial processes** | 0.45 | 0.51 | 0.53 | 0.55 | 0.60 | 0.69 | 0.65 | 0.69 | 0.64 | 0.62 | 95.55 |
| A. Mineral industry | | | | | | | | | | | |
| B. Chemical industry | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | |
| C. Metal industry | 0.45 | 0.51 | 0.53 | 0.55 | 0.60 | 0.69 | 0.65 | 0.69 | 0.64 | 0.62 | 96.69 |
| D. Non-energy products from fuels and solvent use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H. Other | NA, NE | NA, NE | NA, NE | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | NE, NA | 0.00 |
| **3. Agriculture** | 1,027.24 | 1,161.90 | 1,212.65 | 1,228.46 | 1,214.05 | 1,218.58 | 1,352.70 | 1,455.95 | 1,503.10 | 1,560.29 | 55.32 |
| A. Enteric fermentation | 913.87 | 1,031.61 | 1,076.23 | 1,086.18 | 1,077.90 | 1,079.36 | 1,204.41 | 1,285.44 | 1,334.73 | 1,384.58 | 54.55 |
| B. Manure management | 98.09 | 113.50 | 119.86 | 126.53 | 121.24 | 124.48 | 133.91 | 155.45 | 152.82 | 159.96 | 70.02 |
| C. Rice cultivation | 8.16 | 9.96 | 9.22 | 9.17 | 9.59 | 9.71 | 9.35 | 10.09 | 10.51 | 10.46 | 161.32 |
| D. Agricultural soils | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| E. Prescribed burning of savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| F. Field burning of agricultural residues | 7.12 | 6.83 | 7.34 | 6.58 | 5.32 | 5.03 | 5.04 | 4.97 | 5.03 | 5.30 | -50.07 |
| G. Liming | | | | | | | | | | | |
| H. Urea application | | | | | | | | | | | |
| I. Other carbon-containing fertilizers | | | | | | | | | | | |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **4. Land use, land-use change and forestry** | 1.01 | 2.90 | 3.12 | 0.84 | 0.85 | 2.41 | 2.31 | 0.68 | 1.93 | 4.35 | 42.83 |
| A. Forest land | 1.01 | 2.90 | 3.12 | 0.84 | 0.85 | 2.41 | 2.31 | 0.68 | 1.93 | 4.35 | 42.83 |
| B. Cropland | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | 0.00 |
| C. Grassland | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | NO, NA | 0.00 |
| D. Wetlands | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| E. Settlements | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | 0.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| F. Other land | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | 0.00 |
| G. Harvested wood products | | | | | | | | | | | |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **5. Waste** | 634.53 | 625.42 | 586.73 | 579.39 | 601.46 | 584.49 | 563.16 | 575.35 | 552.87 | 564.95 | 47.20 |
| A. Solid waste disposal | 515.65 | 506.37 | 480.57 | 481.36 | 503.13 | 484.52 | 460.97 | 463.12 | 440.09 | 449.46 | 66.97 |
| B. Biological treatment of solid waste | 0.68 | 0.64 | 0.48 | 0.51 | 0.54 | 0.56 | 0.54 | 0.48 | 0.51 | 0.48 | 27.61 |
| C. Incineration and open burning of waste | 0.79 | 0.68 | 0.36 | 0.03 | 0.04 | 0.07 | 0.05 | 0.04 | 0.08 | 0.12 | -95.41 |
| D. Waste water treatment and discharge | 117.41 | 117.73 | 105.32 | 97.49 | 97.75 | 99.35 | 101.60 | 111.72 | 112.18 | 114.89 | 2.98 |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Total $CH_4$ emissions without $CH_4$ from LULUCF** | 2,165.24 | 2,311.80 | 2,265.26 | 2,340.91 | 2,111.02 | 2,222.29 | 2,271.10 | 2,413.85 | 2,525.41 | 2,559.56 | 50.64 |
| **Total $CH_4$ emissions with $CH_4$ from LULUCF** | 2,166.25 | 2,314.71 | 2,268.38 | 2,341.75 | 2,111.86 | 2,224.69 | 2,273.41 | 2,414.53 | 2,527.34 | 2,563.91 | 50.62 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 0.22 | 0.29 | 0.32 | 0.36 | 0.33 | 0.34 | 0.34 | 0.37 | 0.36 | 0.20 | 418.05 |
| Aviation | 0.05 | 0.05 | 0.06 | 0.07 | 0.08 | 0.07 | 0.08 | 0.08 | 0.10 | 0.04 | 958.45 |
| Navigation | 0.18 | 0.24 | 0.26 | 0.29 | 0.25 | 0.27 | 0.26 | 0.28 | 0.26 | 0.16 | 358.96 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **$CO_2$ emissions from biomass** | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO2 captured** | | | | | | | | | | | |
| **Long-term storage of C in waste disposal sites** | | | | | | | | | | | |
| **Indirect N2O** | | | | | | | | | | | |
| **Indirect CO2 (3)** | | | | | | | | | | | |

*Table 41 - Emission trends (N2O) (CTF Table 1(c)) (kt)*

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | *Base year* | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 6.54 | 6.54 | 6.53 | 6.66 | 7.57 | 7.49 | 7.84 | 8.31 | 8.43 | 8.31 | 8.29 |
| A. Fuel combustion (sectoral approach) | 6.54 | 6.54 | 6.52 | 6.65 | 7.57 | 7.48 | 7.83 | 8.31 | 8.43 | 8.30 | 8.29 |
| 1. Energy industries | 0.38 | 0.38 | 0.39 | 0.45 | 0.44 | 0.51 | 0.51 | 0.56 | 0.61 | 0.66 | 0.68 |
| 2. Manufacturing industries and construction | 0.35 | 0.35 | 0.38 | 0.34 | 0.34 | 0.30 | 0.34 | 0.46 | 0.52 | 0.55 | 0.46 |
| 3. Transport | 2.08 | 2.08 | 2.00 | 2.09 | 2.51 | 2.44 | 2.67 | 2.85 | 2.72 | 2.61 | 2.65 |
| 4. Other sectors | 3.73 | 3.73 | 3.75 | 3.77 | 4.28 | 4.23 | 4.31 | 4.44 | 4.58 | 4.49 | 4.51 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| 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 |
| 1. Solid fuels | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| 2. Oil and natural gas and other emissions from energy production | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C. $CO_2$ transport and storage | | | | | | | | | | | |
| **2. Industrial processes** | 3.57 | 3.57 | 2.85 | 3.22 | 3.15 | 2.18 | 3.37 | 3.41 | 3.49 | 3.32 | 3.10 |
| A. Mineral industry | | | | | | | | | | | |
| B. Chemical industry | 3.57 | 3.57 | 2.85 | 3.22 | 3.15 | 2.18 | 3.37 | 3.41 | 3.49 | 3.32 | 3.10 |
| C. Metal industry | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D. Non-energy products from fuels and solvent use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **3. Agriculture** | 68.72 | 68.72 | 68.64 | 69.84 | 71.62 | 64.23 | 63.58 | 65.40 | 63.63 | 68.01 | 69.19 |
| A. Enteric fermentation | | | | | | | | | | | |
| B. Manure management | 10.35 | 10.35 | 10.79 | 10.75 | 10.66 | 10.51 | 10.06 | 10.12 | 9.59 | 9.63 | 9.71 |
| C. Rice cultivation | | | | | | | | | | | |
| D. Agricultural soils | 58.10 | 58.10 | 57.57 | 58.82 | 60.67 | 53.46 | 53.26 | 55.00 | 53.77 | 58.07 | 59.20 |
| E. Prescribed burning of savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| F. Field burning of agricultural residues | 0.27 | 0.27 | 0.28 | 0.27 | 0.29 | 0.25 | 0.26 | 0.27 | 0.28 | 0.30 | 0.27 |
| G. Liming | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H. Urea application | | | | | | | | | | | |
| I. Other carbon containing fertlizers | | | | | | | | | | | |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **4. Land use, land-use change and forestry** | 0.17 | 0.17 | 0.10 | 0.17 | 0.22 | 0.52 | 0.15 | 0.25 | 0.16 | 0.17 | 0.18 |
| A. Forest land | 0.17 | 0.17 | 0.10 | 0.15 | 0.19 | 0.48 | 0.10 | 0.19 | 0.08 | 0.09 | 0.08 |
| B. Cropland | NO, IE | NO, IE | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| C. Grassland | NO, NA | NO, NA | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| D. Wetlands | NO | NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| E. Settlements | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| F. Other land | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE |
| G. Harvested wood products | | | | | | | | | | | |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Waste** | 4.90 | 4.90 | 4.98 | 5.03 | 5.05 | 5.19 | 5.30 | 5.22 | 5.13 | 5.37 | 5.43 |
| A. Solid waste disposal | | | | | | | | | | | |
| B. Biological treatment of solid waste | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| C. Incineration and open burning of waste | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.06 | 0.04 | 0.03 |
| D. Waste water treatment and discharge | 4.84 | 4.84 | 4.92 | 4.97 | 4.99 | 5.13 | 5.24 | 5.16 | 5.05 | 5.31 | 5.38 |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total direct N2O emissions without N2O from LULUCF** | 83.73 | 83.73 | 83.00 | 84.74 | 87.39 | 79.08 | 80.09 | 82.34 | 80.68 | 85.00 | 86.01 |
| **Total direct N2O emissions with N2O from LULUCF** | 83.90 | 83.90 | 83.10 | 84.90 | 87.61 | 79.60 | 80.24 | 82.59 | 80.84 | 85.17 | 86.18 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.05 | 0.06 | 0.07 |
| Aviation | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 |
| Navigation | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **CO2 emissions from biomass** | | | | | | | | | | | |
| **CO2 captured** | | | | | | | | | | | |
| **Long-term storage of C in waste disposal sites** | | | | | | | | | | | |
| **Indirect N2O** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| **Indirect CO2 (3)** | | | | | | | | | | | |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 8.47 | 7.90 | 8.02 | 9.27 | 10.05 | 10.46 | 11.24 | 12.65 | 13.61 | 14.00 | 13.25 |
| A. Fuel combustion (sectoral approach) | 8.46 | 7.90 | 8.02 | 9.26 | 10.05 | 10.46 | 11.24 | 12.65 | 13.60 | 14.00 | 13.25 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Energy industries | 0.72 | 0.73 | 0.63 | 1.73 | 2.12 | 2.56 | 2.88 | 3.81 | 4.01 | 4.51 | 4.00 |
| 2. Manufacturing industries and construction | 0.61 | 0.41 | 0.56 | 0.64 | 0.65 | 0.59 | 0.73 | 0.76 | 0.40 | 0.42 | 0.46 |
| 3. Transport | 2.52 | 2.38 | 2.42 | 2.45 | 2.61 | 2.63 | 2.74 | 2.85 | 2.64 | 2.56 | 2.43 |
| 4. Other sectors | 4.61 | 4.38 | 4.41 | 4.44 | 4.67 | 4.68 | 4.90 | 5.23 | 6.55 | 6.52 | 6.36 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE |
| 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 |
| 1. Solid fuels | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| 2. Oil and natural gas and other emissions from energy production | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C. $CO_2$ transport and storage | | | | | | | | | | | |
| **2. Industrial processes** | 2.84 | 2.47 | 2.79 | 2.53 | 2.40 | 2.45 | 5.51 | 3.62 | 2.76 | 4.50 | 5.55 |
| A. Mineral industry | | | | | | | | | | | |
| B. Chemical industry | 2.84 | 2.47 | 2.79 | 2.53 | 2.40 | 2.45 | 5.51 | 3.62 | 2.76 | 4.50 | 5.55 |
| C. Metal industry | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| D. Non-energy products from fuels and solvent use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **3. Agriculture** | 66.31 | 59.95 | 59.41 | 63.13 | 65.09 | 66.35 | 68.69 | 66.10 | 60.84 | 64.66 | 67.04 |
| A. Enteric fermentation | | | | | | | | | | | |
| B. Manure management | 9.42 | 9.00 | 8.47 | 9.00 | 9.13 | 9.47 | 9.99 | 9.73 | 9.47 | 9.15 | 9.80 |
| C. Rice cultivation | | | | | | | | | | | |
| D. Agricultural soils | 56.61 | 50.69 | 50.68 | 53.87 | 55.68 | 56.64 | 58.46 | 56.17 | 51.17 | 55.28 | 57.07 |
| E. Prescribed burning of savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| F. Field burning of agricultural residues | 0.27 | 0.25 | 0.26 | 0.26 | 0.28 | 0.24 | 0.23 | 0.20 | 0.20 | 0.23 | 0.17 |
| G. Liming | | | | | | | | | | | |
| H. Urea application | | | | | | | | | | | |
| I. Other carbon containing fertlizers | | | | | | | | | | | |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **4. Land use, land-use change and forestry** | 0.45 | 0.20 | 0.23 | 0.22 | 0.21 | 0.19 | 0.28 | 0.38 | 0.67 | 0.32 | 0.32 |
| A. Forest land | 0.35 | 0.10 | 0.13 | 0.10 | 0.07 | 0.04 | 0.12 | 0.18 | 0.45 | 0.07 | 0.05 |
| B. Cropland | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.05 | 0.05 | 0.06 |
| C. Grassland | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.02 |
| D. Wetlands | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| E. Settlements | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE |
| F. Other land | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| G. Harvested wood products | | | | | | | | | | | |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **5. Waste** | 5.49 | 5.49 | 5.57 | 5.61 | 5.67 | 5.77 | 5.84 | 5.90 | 5.85 | 5.94 | 6.26 |
| A. Solid waste disposal | | | | | | | | | | | |
| B. Biological treatment of solid waste | 0.02 | 0.03 | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 | 0.04 |
| C. Incineration and open burning of waste | 0.03 | 0.03 | 0.02 | 0.03 | 0.01 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 | 0.01 |
| D. Waste water treatment and discharge | 5.44 | 5.42 | 5.51 | 5.53 | 5.61 | 5.71 | 5.77 | 5.83 | 5.78 | 5.89 | 6.21 |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Total direct $N_2O$ emissions without $N_2O$ from LULUCF** | 83.11 | 75.81 | 75.80 | 80.54 | 83.21 | 85.03 | 91.28 | 88.27 | 83.06 | 89.10 | 92.10 |
| **Total direct $N_2O$ emissions with $N_2O$ from LULUCF** | 83.56 | 76.01 | 76.03 | 80.76 | 83.42 | 85.22 | 91.56 | 88.65 | 83.73 | 89.42 | 92.42 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 0.08 | 0.06 | 0.12 | 0.13 | 0.17 | 0.18 | 0.17 | 0.16 | 0.20 | 0.22 | 0.23 |
| Aviation | 0.04 | 0.04 | 0.07 | 0.08 | 0.08 | 0.09 | 0.08 | 0.10 | 0.14 | 0.15 | 0.16 |
| Navigation | 0.03 | 0.02 | 0.04 | 0.05 | 0.08 | 0.09 | 0.08 | 0.06 | 0.06 | 0.07 | 0.06 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **$CO_2$ emissions from biomass** | | | | | | | | | | | |
| **$CO_2$ captured** | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Long-term storage of C in waste disposal sites** | | | | | | | | | | | |
| **Indirect N2O** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE |
| **Indirect CO2 (3)** | | | | | | | | | | | |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Change from base to latest reported year (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Energy** | 14.13 | 9.81 | 9.88 | 10.63 | 12.73 | 13.26 | 13.96 | 12.58 | 11.95 | 12.41 | 89.71 |
| A. Fuel combustion (sectoral approach) | 14.13 | 9.81 | 9.88 | 10.63 | 12.73 | 13.25 | 13.95 | 12.58 | 11.95 | 12.40 | 89.76 |
| 1. Energy industries | 4.23 | 3.84 | 4.06 | 4.36 | 3.86 | 4.14 | 4.58 | 3.35 | 2.71 | 2.87 | 664.18 |
| 2. Manufacturing industries and construction | 0.44 | 0.50 | 0.45 | 0.44 | 0.49 | 0.50 | 0.48 | 0.62 | 0.59 | 0.65 | 87.33 |
| 3. Transport | 2.46 | 3.23 | 3.56 | 3.81 | 3.90 | 4.19 | 4.43 | 4.42 | 4.30 | 4.26 | 104.94 |
| 4. Other sectors | 7.01 | 2.24 | 1.82 | 2.02 | 4.48 | 4.42 | 4.47 | 4.18 | 4.36 | 4.62 | 23.78 |
| 5. Other | IE | IE | IE | IE | IE | IE | IE | IE | IE | IE | 0.00 |
| 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 | -13.41 |
| 1. Solid fuels | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | 0.00 |
| 2. Oil and natural gas and other emissions from energy production | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -13.41 |
| C. CO2 transport and storage | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2. Industrial processes** | 5.82 | 5.96 | 5.99 | 6.07 | 4.87 | 4.09 | 4.24 | 6.12 | 6.77 | 6.73 | 88.58 |
| A. Mineral industry | | | | | | | | | | | |
| B. Chemical industry | 5.82 | 5.96 | 5.99 | 6.07 | 4.87 | 4.09 | 4.24 | 6.12 | 6.77 | 6.73 | 88.58 |
| C. Metal industry | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| D. Non-energy products from fuels and solvent use | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| E. Electronic industry | | | | | | | | | | | |
| F. Product uses as ODS substitutes | | | | | | | | | | | |
| G. Other product manufacture and use | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | NO, NE, NA | 0.00 |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **3. Agriculture** | 69.34 | 77.10 | 83.00 | 82.95 | 83.80 | 91.05 | 93.94 | 92.89 | 97.84 | 109.03 | 58.65 |
| A. Enteric fermentation | | | | | | | | | | | |
| B. Manure management | 10.69 | 12.04 | 12.66 | 13.10 | 13.17 | 13.25 | 14.59 | 15.51 | 16.03 | 16.98 | 64.11 |
| C. Rice cultivation | | | | | | | | | | | |
| D. Agricultural soils | 58.46 | 64.88 | 70.15 | 69.68 | 70.49 | 77.68 | 79.22 | 77.25 | 81.68 | 91.91 | 58.19 |
| E. Prescribed burning of savannas | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| F. Field burning of agricultural residues | 0.18 | 0.18 | 0.19 | 0.17 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.14 | -50.07 |
| G. Liming | | | | | | | | | | | |
| H. Urea application | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Other carbon containing fertlizers | | | | | | | | | | | |
| J. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **4. Land use, land-use change and forestry** | 0.35 | 0.45 | 0.49 | 0.36 | 0.39 | 0.48 | 0.48 | 0.39 | 0.48 | 0.64 | 278.44 |
| A. Forest land | 0.06 | 0.16 | 0.17 | 0.05 | 0.05 | 0.13 | 0.13 | 0.04 | 0.11 | 0.24 | 42.83 |
| B. Cropland | 0.06 | 0.06 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 100.00 |
| C. Grassland | 0.03 | 0.02 | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 100.00 |
| D. Wetlands | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 100.00 |
| E. Settlements | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | NO, IE | 0.00 |
| F. Other land | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | NO, NE, IE | 0.00 |
| G. Harvested wood products | | | | | | | | | | | |
| H. Other | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 0.00 |
| **5. Waste** | 6.41 | 6.60 | 6.68 | 6.79 | 7.06 | 7.07 | 7.28 | 7.39 | 7.53 | 7.63 | 55.93 |
| A. Solid waste disposal | | | | | | | | | | | |
| B. Biological treatment of solid waste | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 27.61 |
| C. Incineration and open burning of waste | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -95.12 |
| D. Waste water treatment and discharge | 6.36 | 6.56 | 6.64 | 6.76 | 7.03 | 7.03 | 7.25 | 7.36 | 7.50 | 7.60 | 57.24 |
| E. Other | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **6. Other (as specified in the summary table in CRF)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total direct N2O emissions without N2O from LULUCF** | 95.70 | 99.47 | 105.55 | 106.44 | 108.46 | 115.46 | 119.42 | 118.98 | 124.10 | 135.80 | 62.19 |
| **Total direct N2O emissions with N2O from LULUCF** | 96.05 | 99.93 | 106.05 | 106.80 | 108.85 | 115.94 | 119.91 | 119.37 | 124.58 | 136.44 | 62.63 |
| **Memo items:** | | | | | | | | | | | |
| **International bunkers** | 0.24 | 0.28 | 0.32 | 0.36 | 0.38 | 0.37 | 0.38 | 0.42 | 0.46 | 0.21 | 721.28 |
| Aviation | 0.19 | 0.21 | 0.24 | 0.28 | 0.31 | 0.30 | 0.31 | 0.34 | 0.39 | 0.16 | 958.79 |
| Navigation | 0.05 | 0.07 | 0.07 | 0.08 | 0.07 | 0.08 | 0.07 | 0.08 | 0.07 | 0.05 | 358.31 |
| **Multilateral operations** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **CO2 emissions from biomass** | | | | | | | | | | | |
| **CO2 captured** | | | | | | | | | | | |
| **Long-term storage of C in waste disposal sites** | | | | | | | | | | | |
| **Indirect N2O** | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | NO, NE | 0.00 |
| **Indirect CO2 (3)** | | | | | | | | | | | |

*Table 42 - Emission trends (HFCs, PFCs, SF6 and NF3) (CTF Table 1(d)) (kt)*

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | *Base year* | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Emissions of HFCs and PFCs - (kt CO2 equivalent)** | 625.30 | 625.30 | 863.34 | 722.59 | 403.08 | 710.00 | 611.44 | 577.15 | 574.01 | 615.00 | 604.82 |
| **Emissions of HFCs - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HFC-23 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-32 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-41 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-43-10mee | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-125 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-134 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-134a | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-143 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-143a | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-152 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-152a | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-161 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-227ea | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-236cb | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-236ea | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-236fa | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-245ca | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-245fa | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HFC-365mfc | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Unspecified mix of HFCs(4) - (kt $CO_2$ equivalent) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Emissions of PFCs - (kt CO2 equivalent)** | 625.30 | 625.30 | 863.34 | 722.59 | 403.08 | 710.00 | 611.44 | 577.15 | 574.01 | 615.00 | 604.82 |
| $CF_4$ | 0.08 | 0.08 | 0.11 | 0.09 | 0.05 | 0.09 | 0.08 | 0.07 | 0.07 | 0.08 | 0.08 |
| $C_2F_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $C_3F_8$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $C_4F_{10}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| c-$C_4F_8$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $C_5F_{12}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $C_6F_{14}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| C10F18 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| c-C3F6 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Unspecified mix of PFCs(4) - (kt $CO_2$ equivalent) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Unspecified mix of HFCs and PFCs - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Emissions of SF6 - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | 10.05 | 11.10 | 11.90 | 12.36 |
| $SF_6$ | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 | 0.00 |
| **Emissions of NF3 - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Emissions of HFCs and PFCs - (kt $CO_2$ equivalent)** | 716.65 | 824.20 | 1,003.57 | 1,210.59 | 1,489.50 | 1,706.85 | 1,885.15 | 2,287.63 | 2,423.86 | 2,370.54 | 3,516.02 |
| **Emissions of HFCs - (kt $CO_2$ equivalent)** | 115.66 | 232.00 | 417.19 | 628.80 | 909.37 | 1,146.88 | 1,424.19 | 1,713.19 | 1,896.14 | 2,111.28 | 3,054.28 |
| HFC-23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HFC-32 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-41 | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 |
| HFC-43-10mee | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-125 | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 |
| HFC-134 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-134a | 0.08 | 0.16 | 0.29 | 0.43 | 0.63 | 0.79 | 0.98 | 1.18 | 1.30 | 1.43 | 2.07 |
| HFC-143 | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 |
| HFC-143a | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-152 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-152a | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.04 | 0.18 | 0.33 |
| HFC-161 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-227ea | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| HFC-236cb | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HFC-236ea | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-236fa | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 |
| HFC-245ca | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 | 0.00 |
| HFC-245fa | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| HFC-365mfc | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 | 0.00 |
| Unspecified mix of HFCs(4) - (kt $CO_2$ equivalent) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Emissions of PFCs - (kt CO2 equivalent)** | 601.00 | 592.20 | 586.39 | 581.79 | 580.13 | 559.96 | 460.96 | 574.44 | 527.72 | 259.26 | 461.74 |
| $CF_4$ | 0.08 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | 0.07 | 0.07 | 0.03 | 0.06 |
| $C_2F_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $C_3F_8$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $C_4F_{10}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| c-$C_4F_8$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $C_5F_{12}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $C_6F_{14}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| C10F18 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| c-C3F6 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| Unspecified mix of PFCs(4) - (kt $CO_2$ equivalent) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| **Unspecified mix of HFCs and PFCs - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Emissions of SF6 - (kt $CO_2$ equivalent)** | 13.34 | 13.16 | 13.95 | 15.16 | 16.44 | 17.67 | 19.40 | 21.04 | 21.98 | 21.30 | 65.48 |
| $SF_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Emissions of $NF_3$ - (kt $CO_2$ equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |

| *GREENHOUSE GAS SOURCE AND SINK CATEGORIES* | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Change from base to latest reported year (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Emissions of HFCs and PFCs - (kt $CO_2$ equivalent)** | 3,913.01 | 4,615.90 | 4,740.85 | 5,182.88 | 4,961.86 | 5,403.59 | 5,607.71 | 5,539.01 | 6,126.25 | 5,890.99 | 842.11 |
| **Emissions of HFCs - (kt $CO_2$ equivalent)** | 3,432.64 | 4,256.83 | 4,470.24 | 4,927.46 | 4,802.87 | 5,262.92 | 5,534.60 | 5,502.39 | 6,064.07 | 5,853.16 | 100.00 |
| HFC-23 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| HFC-32 | NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.07 | 0.14 | 0.22 | 0.42 | 100.00 |
| HFC-41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NO, IE | 0.00 |
| HFC-43-10mee | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| HFC-125 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.03 | 0.04 | 0.05 | 0.05 | 0.03 | 100.00 |
| HFC-134 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NO, IE | 0.00 |
| HFC-134a | 2.29 | 2.77 | 2.88 | 3.14 | 3.00 | 3.26 | 3.38 | 3.28 | 3.56 | 3.31 | 100.00 |
| HFC-143 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NO, IE | NO, IE | 0.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HFC-143a | NO | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 100.00 |
| HFC-152 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| HFC-152a | 0.64 | 0.85 | 1.11 | 1.27 | 1.42 | 1.50 | 1.53 | 1.58 | 2.09 | 2.23 | 100.00 |
| HFC-161 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| HFC-227ea | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 | 100.00 |
| HFC-236cb | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| HFC-236ea | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| HFC-236fa | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 100.00 |
| HFC-245ca | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| HFC-245fa | NO | NO | NO, IE | 0.01 | 0.01 | 0.01 | NO, IE | NO, IE | NO, IE | 0.04 | 100.00 |
| HFC-365mfc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| Unspecified mix of HFCs(4) - (kt $CO_2$ equivalent) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Emissions of PFCs - (kt CO2 equivalent)** | 480.36 | 359.06 | 270.60 | 255.42 | 158.99 | 140.67 | 73.11 | 36.62 | 62.18 | 37.83 | -93.95 |
| $CF_4$ | 0.06 | 0.05 | 0.03 | 0.03 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | -97.29 |
| $C_2F_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | -48.07 |
| $C_3F_8$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| $C_4F_{10}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| c-$C_4F_8$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $C_5F_{12}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| $C_6F_{14}$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| C10F18 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| c-C3F6 | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| Unspecified mix of PFCs(4) - (kt $CO_2$ equivalent) | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Unspecified mix of HFCs and PFCs - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| **Emissions of SF6 - (kt CO2 equivalent)** | 67.37 | 68.58 | 69.02 | 74.88 | 81.83 | 78.61 | 118.33 | 128.39 | 115.71 | 115.78 | 100.00 |
| $SF_6$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 100.00 |
| **Emissions of NF3 - (kt CO2 equivalent)** | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |
| $NF_3$ | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | 0.00 |

c Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO2 equivalent emissions.

d In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories", HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.)

## [BR5] Chapter 3: Quantified Economy-Wide Emission Reduction Target

All countries are under the threat of climate change without exceptions. Being one of the countries in the Mediterranean where severe climate change impacts are projected according to IPCC Türkiye is expected to face severe impacts due to climate change. Türkiye recognizes that climate change represents a pressing and complex problem that can lead to serious environmental and socioeconomic consequences and that it has become one of the most significant threats to the lives of future generations due to its long-term and cross sectoral effects. Efforts are necessary to limit emissions of greenhouse gases, the main cause of anthropogenic climate change, and to pursue multilateral international cooperation as nations seek to reduce impacts from and adapt to climate change.

Türkiye did not have any targets for emission reduction under the Kyoto Protocol. Türkiye has submitted its Nationally Determined Contribution (NDC) and established a reduction target under the Paris Agreement.

### [BR5] Chapter 3.1: Emission reduction target for 2020

When the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992, Türkiye, as an Organization for Economic Cooperation and Development (OECD) member, was included among the Annex I and Annex II countries which bear most of the burden of the commitments made under the agreement. However, Türkiye did not engage actively in Convention implementation until 2001, following negotiations which resulted in UNCCC parties agreeing that Türkiye's "special circumstances" should be recognized and that it could invoke the "common but differentiated responsibilities" principle under the Convention. As a result of decision 26/CP.7 of the UNFCCC adopted in 7th Conference of Parties (COP7) held in Marrakech in 2001, Türkiye was removed from Annex II of the UNFCCC and State Parties were invited to recognize the special conditions which place Türkiye in a different position from other Annex I countries.

After this decision, Türkiye became a party to UNFCCC on 24 May 2004. Then, it became an official party to the Kyoto Protocol on 26 August 2009. However, when Kyoto Protocol was adopted, Türkiye was not in Annex-B as it was not a Party to the UNFCCC, thus **Türkiye was not subject to any quantified emission reduction or limitation targets**.

## [BR5] Chapter 3.2: Emission reduction target for 2030 (Nationally Determined Contribution (NDC))

Türkiye submitted its INDC in October 2015 to Secretary of UNFCCC. Türkiye's INDC was "up to 21 percent reduction in GHG emissions from the Business as Usual (BAU) level by 2030. Implementation period of INDC is between the years 2020 and 2030".

As a developing country, Türkiye's historical contribution to global GHG emissions is less than 1%. Türkiye declared during the ratification of the Paris Agreement in 2021 that "*Türkiye will implement the Agreement as a developing country and in the scope of its NDC statements, provided that the Agreement and its mechanisms do not prejudice its right to economic and social development*".

| Parameter | Information |
|---|---|
| **Base Year** | 2012 |
| **Target Year** | 2030 |
| **[Whether it is a single- year or multi-year target]** | [Single year target (FY 2030)] |
| **Emissions Reduction Target** | Up to 21 percent reduction in GHG emissions from the Business as Usual (BAU) level by 2030. |
| **Time frame and/or period for implementation** | 2021-2030 |
| **Gases Covered** | All greenhouse gases included in the national inventory:<br>- Carbon dioxide ($CO_2$);<br>- Methane ($CH_4$);<br>- Nitrous oxide ($N_2O$);<br>- Hydrofluorocarbons (HFCs);<br>- Perfluorocarbons (PFCs);<br>- Sulfur hexafluoride ($SF_6$);<br>- Nitrous trifluoride ($NF_3$). |
| **Assumptions and methodological approaches** | Methodological approaches are based on using the IPCC 2006 Guidelines and IPCC 2013 KP Supplement.<br>Global warming potential on a 100 year timescale in accordance with the IPCC's 4th Assessment Report. |
| **Sectors Covered** | Economy-wide. |

| | |
|---|---|
| | Energy;<br>Industrial Processes and Products Use; Agriculture;<br>Land Use Land-Use Change and Forestry; Waste. |
| **Land Use Land-Use Change and Forestry (LULUCF)** | Included |
| **Use of International Market Mechanisms** | Türkiye aims to use carbon credits from international market mechanisms to achieve its 2030 mitigation target in a cost-effective manner and in accordance with the relevant rules and standards. |

### [BR5] Chapter 4: Progress in Achievement of Quantified Economy-wide Emission Reduction Targets

Chapter 5 of the Eighth National Communication contains detailed information to be presented in this section.

### [BR5] Chapter 5: Projections

Chapter 5 of the Eighth National Communication contains detailed information to be presented in this section.

### [BR5] Chapter 6: Provision of Financial, Technological and Capacity-Building Support to Developing Country Parties

Chapter 7 of the Eighth National Communication contains detailed information to be presented in this section.

### [BR5] Chapter 7: Other Reporting Matters

There are no additional reporting matters.

# 10 REFERENCES

**7th NC, 2019.** Republic of Türkiye, Ministry of Environment and Urbanization (MoEU), Seventh National Communication of Türkiye under the UNFCCC. https://unfccc.int/documents/199646

**11th Development Plan, 2019.** Presidency of the Republic of Türkiye, Presidency of Strategy a nd Budget, 2019. https://www.sbb.gov.tr/wp-content/uploads/2022/07/Eleventh_Development_Plan_2019-2023.pdf

**CRF, 2022.** TurkStat, Türkiye, 2022 Common Reporting Format (CRF) Table. https://unfccc.int/documents/461898

**Ministry of Health, 2022.** Republic of Türkiye, Ministry of Health, Health Statistics Annual 202 0.

**Ministry of Trade, 2021**. Republic of Türkiye, Ministry of Trade, Green Deal Action Plan, 2021. 2021. https://ticaret.gov.tr/data/6of1200013b876eb28421b23/MUTABAKAT%20YEŞİL.pdf

**MENR, 2010.** Republic of Türkiye, Ministry of Energy and Natural Resources, Energy Efficiency Strategy Paper. https://www.resmigazete.gov.tr/eskiler/2012/02/20120225-7.htm

**MENR, 2017.** Republic of Türkiye, Ministry of Energy and Natural Resources, National Energy and Mining Policy (2017).

**MENR, 2018.** Republic of Türkiye, Ministry of Energy and Natural Resources, National Energy Efficiency Action Plan (2017-2023). https://enerji.gov.tr//Media/Dizin/EVCED/tr/EnerjiVerimliliği/UlusalEnerjiVerimliliğiEylemPlanı/Belgeler/UEVEP.pdf

**MENR, 2021.** Republic of Türkiye, Ministry of Energy and Natural Resources, https://enerji.gov.tr/Media/Dizin/BHIM/tr/Duyurular//genel_aydinlatma_usul_ve_esaslar_202110120910.pdf

**MENR, 2022.** Republic of Türkiye, Ministry of Energy and Natural Resources, Türkiye National Energy Plan (2022). https://enerji.gov.tr//Media/Dizin/EIGM/tr/Raporlar/TUEP/Türkiye_Ulusal_Enerji_Planı.pdf

**MENR, 2023_a.** Republic of Türkiye, Ministry of Energy and Natural Resources, Energy Balanc e Tables. https://enerji.gov.tr/duyuru-detay?id=20299

**MENR, 2023_b.** Republic of Türkiye, Ministry of Energy and Natural Resources, Türkiye Electri city Investments Year 2022 Month December Summary Report https://enerji.gov.tr//Media/Dizin/EIGM/tr/Raporlar/PRP/EYÖRA/2022/Aralık/ElektrikYatırımları2022AralıkAyıÖzetRaporu.pdf

**MoAF, 2017.** Republic of Türkiye, Ministry of Agriculture and Forestry, Structural Changes and Reforms in Turkish Agriculture 2003-2016.

**MoAF, 2019.** Republic of Türkiye, Ministry of Agriculture and Forestry, National Strategy and Action Plan to Combat Desertification (2019-2030). https://webdosya.csb.gov.tr/db/cem/icerikler/collesme-ile-mucadele-ulusal-stratejisi-ve-eylem-plani_k-20211111075541.pdf

**MoAF, 2023_a.** Republic of Türkiye, Ministry of Agriculture and Forestry, General Directorate o f Forestry, Forestry Statistics 2021. https://www.ogm.gov.tr/tr/e-kutuphane/resmi-istatistikler

**MoAF, 2023_b.** Republic of Türkiye, Ministry of Food Agriculture and Forestry, Maps of Agricul tural Basins, https://www.tarimorman.gov.tr/Sayfalar/Icerikler.aspx?IcerikId=296c5dc2-2d3f-427d-af9a-70c4a2f131a6

**MoCT, 2023.** Republic of Türkiye, Ministry of Culture and Tourism,

**MoEU, 2010.** Republic of Türkiye, Ministry of Environment and Urbanization (MoEU), National Climate Change Strategy (NCCS) (2010 - 2023). https://webdosya.csb.gov.tr/db/iklim/editordosya/iklim_degisikligi_stratejisi_EN(2).pdf

**MoEU, 2012.** Republic of Türkiye, Ministry of Environment and Urbanization (MoEU), National Climate Change Action Plan (NCCAP) (2011 - 2023). https://webdosya.csb.gov.tr/db/iklim/editordosya/file/eylem%20planlari/iklim_degisikligi_eylem_plani_EN_2014.pdf

**MoEU, 2016.** Republic of Türkiye, Ministry of Environment and Urbanization (MoEU), National Waste Management Action Plan (NWMAP) (2016-2023). https://cygm.csb.gov.tr/ulusal-atik-yonetimi-ve-eylem-plani-2016-2023-hazirlandi.-haber-221234

**MoEU, 2019.** Republic of Türkiye, Ministry of Environment and Urbanization (MoEU), National Smart Cities Strategy and Action Plan (2020-2023). https://akillisehirler.gov.tr/wp-content/uploads/EylemPlani.pdf

**MoEUCC, 2021.** Republic of Türkiye, Ministry of Environment, Urbanization and Climate Chan ge, Building Industry Energy Efficiency Technology Atlas. https://webdosya.csb.gov.tr/db/meslekihizmetler/icerikler/atlas_ocak_small-20210126120540.pdf

**MoEUCC, 2023_a.** Republic of Türkiye, Ministry of Environment, Urbanization and Climate Ch ange; Environmental Statistics. http://cevreselgostergeler.csb.gov.tr/atik-duzenli-depolama-tesis-sayisi-belediye-sayisi-hizmet-verilen-nufus-i-85750

**MoEUCC, 2023_b.** Republic of Türkiye, Ministry of Environment, Urbanization and Climate Ch ange; Environmental Statistics. https://cevreselgostergeler.csb.gov.tr/kanalizasyon-sebekesiyle-hizmet-verilen-nufus-i-85747

**MoEUCC, 2023_c.** Republic of Türkiye, Ministry of Environment, Urbanization and Climate Cha nge; Climate Council. https://iklimsurasi.gov.tr

**MoIT, 2019.** Republic of Türkiye, Ministry of Industry and Technology, Industry and Technolog y Strategy for 2023. https://www.sanayi.gov.tr/assets/pdf/SanayiStratejiBelgesi2023.pdf

**MoTI, 2020.** Republic of Türkiye, Ministry of Transport and Infrastructure. National Intelligent Transportation Systems Strategy Document and 2020-2023. https://www.uab.gov.tr/uploads/pages/kutuphane/ulusal-akilli-ulas-im-sistemleri-strateji-belgesi-ve-2020-2023-eylem-plani.pdf

**MoTI, 2022_a.** Republic of Türkiye, Ministry of Transport and Infrastructure. Transport and Lo gistics Master Plan, 2053. https://www.uab.gov.tr/uploads/pages/bakanlik-yayinlari/20221025-2053-ulastirma-ve-lojistik-ana-plani-eng.pdf

**MoTI, 2022_b.** Republic of Türkiye, Ministry of Transport and Infrastructure, Budget Presentati on. https://sgb.uab.gov.tr/uploads/pages/butce-2023/2023-butce-sunumu-sikistirildi.pdf

**MoIT, 2019.** Republic of Türkiye, Ministry of Industry and Technology, Industry and Technology Strategy for 2023. https://www.sanayi.gov.tr/assets/pdf/SanayiStratejiBelgesi2023.pdf

**MTP, 2021.** Republic of Türkiye, Medium - Term Programme (MTP) 2022 - 2024. The Presiden cy of Strategy and Budget (SBB) https://www.sbb.gov.tr/wp-content/uploads/2021/10/Medium_Term_Programme_2022-2024.pdf

**NDC, 2021.** Republic of Türkiye. https://unfccc.int/sites/default/files/NDC/2022-06/The_INDC_of_TURKEY_v.15.19.30.pdf

**NIR, 2022.** TurkStat, Turkish Greenhouse Gas Inventory, 1990 to 2020. National Inventory Rep ort (NIR) for submission under the United Nations Framework Convention on Climate Change. https://unfccc.int/documents/461926

**OECD, 2016.** OECD, Innovation, Agricultural Productivity and Sustainability in Turkey, OECD F ood and Agricultural Reviews, OECD Publishing, Paris. http:// dx.doi.org/10.1787/9789264261198-en

**OECD, 2022.** OECD, Türkiye Economic Snapshot, Economic Forecast Summary (November 20 22). https://www.oecd.org/economy/turkiye-economic-snapshot/

**OECD, 2023.** OECD Data, Passenger transport statistics.https://data.oecd.org/transport/passenger-transport.htm

**TEİAŞ, 2021.** Capacity of Production Projections https://www.epdk.gov.tr/Detay/Icerik/3-0-66/elektrikuretim-kapasite-projeksiyonlari

**TEİAŞ, 2023.** Republic of Türkiye, Ministry of Energy and Natural Resources, Turkey Electricity Production-Transmission Statistics. https://www.teias.gov.tr/turkiye-elektrik-uretim-iletim-istatistikleri

**TSMS, 2022.** Turkish State Meteorological Service, 2022 Administrative Activity Report

**TSMS, 2023,** Turkish State Meteorological Service, 2023 https://mgm.gov.tr/eng/Yearly-Climate/State_of_the_Climate_in_Turkey_in_2022.pdf

**TurkStat, 2016.** Turkish Statistical Institute, Foreign trade by months and years 1985 – 2015 https://data.tuik.gov.tr/Bulten/Index?p=Dis-Ticaret-Istatistikleri-Aralik-2015-21797

**TurkStat, 2018.** Turkish Statistical Institute, Population Projections, 2018 - 2080, Population and Demography Statistics, https://data.tuik.gov.tr/Bulten/Index?p=Nufus-Projeksiyonlari-2018-2080-30567

**TurkStat, 2021_a.** Turkish Statistical Institute, The Results of Address Based Population Registration System, 2020, https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2020-37210

**TurkStat, 2021_b.** Turkish Statistical Institute, Foreign Trade Statistics, December 2020, https://data.tuik.gov.tr/Bulten/Index?p=Dis-Ticaret-Istatistikleri-Aralik-2020-37412

**TurkStat, 2021_c.** Turkish Statistical Institute, Annual Industry and Service Statistics 2020 https://data.tuik.gov.tr/Bulten/Index?p=Yillik-Sanayi-ve-Hizmet-Istatistikleri-2020-37190

**TurkStat, 2021_d.** Turkish Statistical Institute, Waste Statistics, 2020. https://data.tuik.gov.tr/Bulten/Index?p=Atik-Istatistikleri-2020-37198

**TurkStat, 2022_a.** Turkish Statistical Institute, Annual Gross Domestic Product, 2021. https://data.tuik.gov.tr/Bulten/Index?p=Yillik-Gayrisafi-Yurt-Ici-Hasila-2021-45834

**TurkStat, 2022_b.** Turkish Statistical Institute, Building Permits, Quarter IV: October-December, 2021. https://data.tuik.gov.tr/Bulten/Index?p=Yapi-Izin-Istatistikleri-IV.-Ceyrek:-Ekim---Aralik,-2021-45828

**TurkStat, 2022.** Turkish Statistical Institute, Environmental Statistics, Household Solid Waste Composition and Tendency Survey Results.

**TurkStat, 2023_a.** Turkish Statistical Institute, The Results of Address Based Population Registration System, 2022. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2022-49685

**TurkStat, 2023_b.** Turkish Statistical Institute, National Accounts, Annual National Account Statistics, https://biruni.tuik.gov.tr/medas/?kn=136&locale=en

**TurkStat, 2023_c.** Turkish Statistical Institute, Foreign trade by months and years, 2013 - 2022 https://data.tuik.gov.tr/Bulten/Index?p=Dis-Ticaret-Istatistikleri-Aralik-2022-49633.

**TurkStat, 2023_d.** Turkish Statistical Institute, Agricultural Land and Forest Area Statistics. https://data.tuik.gov.tr/Kategori/GetKategori?p=Tarim-111

**TurkStat, 2023_e.** Turkish Statistical Institute, Population Projections and Estimations, New Mid-year Population. https://data.tuik.gov.tr/Kategori/GetKategori?p=Nufus-ve-Demografi-109

**TurkStat, 2023_f.** Turkish Statistical Institute, Transportation and Communication Statistics, Road Motor Vehicles Statistics. https://data.tuik.gov.tr/Kategori/GetKategori?p=Ulastirma-ve-Haberlesme-112

**TurkStat, 2023_g.** Turkish Statistical Institute, Transportation and Communication Statistics, Total Passenger and Freight Traffic at the Airports. https://data.tuik.gov.tr/Kategori/GetKategori?p=Ulastirma-ve-Haberlesme-112

**TurkStat, 2023_h.** Turkish Statistical Institute, Tourism Statistics, Quarter IV: October-December and Annual, 2022. https://data.tuik.gov.tr/Bulten/Index?p=Turizm-Istatistikleri-IV.Ceyrek:-Ekim-Aralik-ve-Yillik,-2022-49606

**TURSAB, 2023.** Association of Turkish Travel Agents (TÜRSAB), Tourism Statistics. https://www.tursab.org.tr/istatistikler

**TURÇEV, 2023.** Türkiye Foundation for Environmental Education (TÜRÇEV), 2022 Blue Flag Data. http://www.mavibayrak.org.tr/tr/Default.aspx

**World Bank, 2023.** World Bank national accounts data, and OECD National Accounts data files, Agriculture, forestry, and fishing, value added (% of GDP) https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS