IRAQ SECOND NATIONAL COMMUNICATION AND INITIAL BIENNIAL UPDATE REPORT

2024

جمهورية العراق
وزارة البيئة

gef

UN environment programme

SECOND NATIONAL COMMUNICATION AND INITIAL BIENNIAL UPDATE REPORT

REPUBLIC OF IRAQ

SUBMITTED TO
THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)
2024

This report is one of the most significant national documents that demonstrates Iraq's commitment to addressing the impacts of climate change and global warming, as well as fulfilling its obligations under the provisions of the United Nations Framework Convention on Climate Change (UNFCCC) in accordance with Decision 17 of the Eighth Conference of the Parties (COP8).

This report represents one of the most important national documents that confirm Iraq's commitment to mitigating the impacts of climate change and global warming, as well as its compliance with the provisions of the Framework Convention. It is the result of a collaborative effort that brought together a national team from the Ministry of Environment, all relevant ministries, as well as national and international experts. Accordingly, the report provides a comprehensive analysis of climate change issues and presents a detailed review of Iraq's past and ongoing efforts to reduce the impacts of climate change and greenhouse gas emissions.

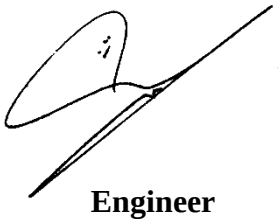
It is worth noting that Iraq's contribution to carbon dioxide equivalent (CO_2e) emissions amounted to 87,412.64 Gg in the year 2000, compared to 177,617.1 Gg in 2019. The report also presents projected figures for the potential achievements in the period from 2030 to 2050 across both the primary energy and renewable energy sectors, as well as in energy efficiency improvements, based on reductions estimated using both the baseline scenario and the mitigation scenario for the period 2021–2050. Notably, projections indicate that the total cumulative net reductions in Iraq's CO_2e emissions are expected to reach 78.324 million tons in 2030, compared to 2,311.78 million tons in 2050.

The report highlights the significant attention given to addressing the negative impacts of climate change, as these impacts vary from one sector to another depending on their severity and the extent of damage they inflict on populations, their living areas, and their livelihoods. This is particularly evident in the consequences of climate-related phenomena, including, but not limited to the sharp increase in temperatures, which in Iraq has risen at twice the global average rate, a more than 30% decline in precipitation levels, rising humidity levels and an increase in the frequency of dust storms, rising sea levels, which threaten to displace over five million people from their homes, the spread of epidemics and other diseases, posing risks to water and food security, as well as national security and various aspects of life in Iraq.

Despite the commendable efforts made in preparing and extensively reviewing the report—led by a team of highly competent experts—and the formation of a national team of scientists and researchers to ensure the highest quality standards, some gaps and shortcomings remain. We are committed to addressing these in Iraq's upcoming national communications.

Finally, I would like to express my deep gratitude to the team of experts from the Iraqi Ministry of Environment (MOE), as well as experts from various ministries, government agencies, relevant organizations, specialized research institutes, academic institutions, and universities for their collaboration in providing the most up-to-date data.

In conclusion, I extend my highest appreciation to all the national team experts and express my gratitude to the Royal Society of Jordan and the International Center for Agricultural Research in the Dry Areas (ICARDA) for their valuable efforts. I also thank the United Nations Environmental Programme -Regional Office for West Asia (UNEP ROWA) and the Global Environment Facility (GEF) for their support in preparing this report



Engineer
Nizar Amedi
Minister of Environment,

Table of participants in the drafting of the SNC and BUR

General Supervision	
Dr. Jasim Abdulaziz Hamadi	Ministry of Environment
Dr. Kamran Ali Hassan	Ministry of Environment
Dr. Bushra Ali Ahmed	Ministry of Environment
Dr. Raghad Assad Kazem	Ministry of Environment
Youssef Muayad Youssef	Ministry of Environment
Technical Coordination and Follow-up with all Technical Teams and Editing Annexes 2 and 3 of the Report	
Samar Youssef Al Khanou	Ministry of Environment
National Circumstances and Cross-Cutting Issues	
Hadi Hamdi Mahdi (Team Leader)	Ministry of Environment
Dr. Basim Mohammed Hashem	Ministry of Science and Technology
Hussein Ali Moussa	Ministry of Commerce
Sami Ali Abu Katif	Ministry of Planning
Colonel Lawrence Abbas Fadel	Ministry of Interior
Mustafa Mahmoud Mustafa	Ministry of Environment
Hala Fouad Saleh	Ministry of Environment
Sattar Abdulredha	Ministry of Environment
Oday Hadi Haddawi	Ministry of Environment
Inventory of Greenhouse Gases and Analysis of Mitigation Measures	
Samar Youssef Al Khanou (Team Leader)	Ministry of Environment
Energy Sector	
Samar Youssef Al Khanou (Team Leader)	Ministry of Environment
Nashwan Mohammed Khudair	Ministry of Oil
Maha Ibrahim Dawood	Ministry of Electricity
Dr. Maitham Adham	Ministry of Industry
Ayaat Abdul Khaliq	Civil Aviation Authority
Dr. Nahla Mohammed Jassim	Ministry of Transport
Zaman Hameed Jihad	Ministry of Transport
Industrial Sector	
Ahmed Mahdi Saleh (Team Leader)	Ministry of Environment
Omar Ghazi Rashid	Ministry of Industry
Dr. Lamia Shihab Ahmed	Ministry of Environment
Israa Yassin Abdul Hussein	Ministry of Environment
Agricultural Sector	
Raqiya Fouad Hassan (Team Leader)	Ministry of Environment
Dr. Rawiya Mazal Mahmoud	Ministry of Agriculture
Ruba Ajur	Royal Scientific Society – Jordan
Waste Sector	
May Jubouri Dawood (Team Leader)	Ministry of Environment
Osama Latif Mohammed	Ministry of Reconstruction, Housing, Municipalities, and Public Works
Thawra Ahmed Ibrahim	Baghdad Municipality
Suad Abdul Mahdi	Baghdad Municipality
Vulnerability Assessment and Adaptation Measures	
Sahar Hussein Jassim (Team Leader)	Ministry of Environment
Water Resources Sector	

Dr. Ghofran Ziyab Abdul Hussein (Team Leader)	Ministry of Water Resources
Rana Fadel Shakir	Ministry of Environment
Agricultural Sector	
Dr. Rawiya Mazal Mahmoud	Ministry of Agriculture
Inas Akram Radeef (Team Leader)	Ministry of Environment
Health and Education Sector	
Zeina Amir Sabri (Team Leader)	Ministry of Environment
Dr. Abdul Hamid Mohammed Jawad	Ministry of Higher Education and Scientific Research
Dr. Hanin Akram Hameed	Ministry of Education
Riyadh Hatem Mohammed	Ministry of Culture
Dr. Marwa Mahdi Hadi	Ministry of Health
Natural Systems and Climate Sector	
Mohammed Fadel Abdul (Team Leader)	Ministry of Environment
Ahmed Sami Aboud	Ministry of Transport / Meteorological and Seismic Monitoring Authority
Dalal Ali Qais	Ministry of Environment Environmental
Protection and Improvement Authority / Kurdistan Region Government (KRG)	
Bror Ghaleb Hassan (Coordinator with Regional Ministries)	
Haval Ahmed Mohammed - Representative of Environmental Protection and Improvement Authority, KRG	
Mohannad Ayoub Mustafa - Representative of Environmental Protection and Improvement Authority, KRG	
Sara Amer - Representative of Environmental Protection and Improvement Authority, KRG	
Team for Administrative and Financial Affairs Monitoring	
Khalil Nu'man Imran	Ministry of Environment
Noor Awda Kashash	Ministry of Environment
National Technical Review	
Government Team for Document Review and Audit	
Dr. Ali Abdul-Zahra Al-Lami	Prime Minister's Office / Advisory Commission
Dr. Ihsan Abdul-Amir Jassim	Prime Minister's Office / Advisory Commission
Yusuf Mueid Yusuf	Ministry of Environment
Dr. Neam Nabil Hashim	Ministry of Environment
Ghaith Mahdi Hamdi	Ministry of Environment
Dr. Fouad Hussein Saeed	Ministry of Water Resources
Dr. Saddam Qahtan Wahid	Ministry of Water Resources
Dr. Mohammed Jabbar Ajrash	Ministry of Oil
Dr. Israa Ismail Hussein	Ministry of Electricity
Dr. Zina Abdullah Khalaf	Ministry of Environment
Samer Samir Khalil	Ministry of Environment
Haider Yusuf Ibrahim	Ministry of Environment
Naba Fadel Burhan	Ministry of Environment
Hamza Qasim Ali	Ministry of Environment
Review, Data Collection, and Editing of Sections from the Following Chapters of the Report	
Suzan Sami Al-Bana	Review and Compilation of Data Sources and Information and Editing Parts of the Following Chapters of the Report: Executive Summary Chapter on National Context and Cross-Cutting Issues Chapter on Vulnerability Assessment and Adaptation Actions Chapter on Other Information: Public Awareness, Education, and Capacity Building Compilation and Full Document Verification
International Technical Review	

Royal Scientific Society - Jordan

Technical Support, Capacity Building, and Preparation and Editing of Parts of the Report for Each of:

Raafat Assi, Ruba Ajur	Training and Capacity Building Regarding Reporting Obligations and Updates
Ruba Ajur, Safwan Bani Saleh Abd al-Ghani Arab	National Inventory of Greenhouse Gases for Various Sectors Using Guidelines 2006 IPCC
Ruba Ajur, Safwan Bani Saleh	Development and Analysis of Mitigation Scenarios
Ruba Ajur	Monitoring, Reporting, Verification, Gap Analysis, and Other Information

International Center for Agricultural Research in the Dry Areas (ICARDA)

Preparation of Climate Risk Assessment Studies for Soil, Water, and Climate Sectors Using Climate Models.

United Nations Environment Program

Sami Dimassi	Regional Director and Representative of the United Nations Environment Programme for West Asia
Dr. Abdul-Majeid Haddad	Deputy Regional Director
Tarek Al-Khoury	Regional Coordinator, Climate Action
Dr. Maya Atie	Regional Expert on Climate Change

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Acronyms	Definition
APSIM	The Agricultural Production Systems simulator
BUR	Biennial Updating Report
CNRM CNRM-CM5	National Centre for Meteorological Research CNRM-CM5 is an Earth system model designed to run climate simulations. It consists of several existing models designed independently and coupled through the OASIS software developed at CERFACS
CCGT	Combined Cycle Gas Turbines
EC-EARTH	EC-Earth Climate Simulations EC-Earth - A European community Earth System Model These models simulate the physical, chemical, and biological processes that govern the Earth system, at different levels of complexity. As such, they are essential tools for understanding and predicting climate variability and climate change.
ECMWF	European Center for Medium-Range Weather Forecasts
EEA	European Environment Agency
EMEP	The cooperative program for monitoring and evaluation of the long-range transmission of air pollutants in Europe
GCMS	Global Climate Models
GFDL	Geophysical Fluid Dynamics Laboratory- Climate Model Scientists at the Geophysical Fluid Dynamics Laboratory develop and use dynamical, numerical models and computer simulations to improve our understanding and make projections of the behavior of the atmosphere, the oceans, and climate, using supercomputer and data storage resources.
GIS	Geographical Information System
ICARDA	International Center for Agricultural Research in the Dry Areas
IPCC	Intergovernmental Pannal on Climate Change
IPPs	Independent Power Producers
KBA	Key Biodiversity Areas
LEAP	Low Emissions Analysis Platform
LMP	Lower Mesopotamia plains
MAT	Mean of the Annual Temperatures
MST	Mean Seasonal Temperatures
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NPP	Net Primary Production
NSEPRAP	The national strategy and action plan to reduce environmental pollution
NSWMP	The National Solid Waste Management Program
PET	Potential Evapotranspiration
RICCAR	Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in Arab Region
SWAT	Soil and Water Assessment Tools
SWLRI	Strategic study of Water and Land Resources in Iraq
SNC	Second National Communication
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
WWF	Wide Fund for Nature

LIST OF SYMBOLS AND UNITS

FIRST: SYMBOLS

Symbol	Designation
CO	Carbon Monoxide
CO_2	Carbone Dioxide
CO_2-eqv	Equivalent Carbone Dioxide
CH_4	Methane
N_2O	Nitrate oxide
NO_X	Nitrogen Oxides
NMVOC	Non-methane volatile organic compounds
SO_2	Sulphur Dioxide

SECOND: UNITS

Designation	Symbol
Degree Celsius	C°
Donum	Du
Gigagram	Gg
Hectar	Ha
Kilogram	Km
Kilometer	Kt
Kiloton	KW
Kilowatt	MCM
million cubic meters	MM
Millimeter	MMSCM/Y
Million Ton	Mt
Megawatt	MW
Cubic meter per second	M^3/s
Million parts per	Ppm
Terajoules	TJ
Ton oil equivalent	TOE (toe)

EXECUTIVE SUMMARY

Executive Summary

This report provides general information about Iraq and the prevailing conditions within the country. It analyzes the impact of climate change on the most affected sectors and highlights the vulnerabilities within each of these sectors. The report also reviews the contribution of each sector to greenhouse gas emissions, based on the available accurate data and information, and in accordance with the 2006 guidelines issued by the Intergovernmental Panel on Climate Change (IPCC).

General background

The area of the Republic of Iraq is 435,052 km². It is located in the south of Asia, occupying the entire northeastern part of the Arab world, in a region suffering from drought and witnessing rapid desertification, which is advancing toward agricultural lands. This ongoing process is expanding the desert areas, increasing the frequency and intensity of sandstorms. According to the Sixth Global Environment Outlook Report for Western Asia (2015), these factors, along with others, have led to Iraq being listed among the countries most vulnerable to climate change, ranking it among the top five.

Based on the 2020 Ministry of Planning statistics, Iraq's population is 40,222,503 million. The annual population growth rate is 2.58%, with males comprising 50.5% and females 49.5% of the total population. The population growth is continuing at rates that raise concerns and strain the country's budget, which is classified as a high-middle-income country. Iraq's economy is largely based on oil revenues, which constitute the major portion of its gross domestic product. Oil is the primary link connecting the Iraqi economy to the outside world. Consequently, the deterioration of the security situation in most regions of the country has inflicted severe economic losses and drained its resources. Iraq has experienced the devastating effects of terrorism, particularly through the large numbers of displaced and displaced people, with the costs of housing and resettling them amounting to 46 billion dollars, not to mention the losses caused by the rise in unemployment rates, which exceeded 10% at the beginning of 2021.

Moreover, Iraq already faces numerous problems related to climate change and its impacts on various national sectors, particularly water resources, agriculture, and health, as well as other sectors, especially those linked to consumer goods, involving issues that directly affect the country's food, water, and health security.

For all these reasons, Iraq is striving to diversify its economy and lay the foundations for a sustainable, resilient, low-emission, eco-friendly economy, capable of having a decisive and positive impact on economic, social, and environmental growth, and ensuring the sustainability of efforts to achieve Iraq’s Nationally Determined Contributions (NDCs). This requires the establishment of partnerships between the public and private sectors to encourage the private sector to facilitate the achievement of the NDCs, ensuring their continuity and enhancement, enabling multiple sectors to recover and address climate change risks, and boosting non-oil GDP. This transition will only be feasible with the review and development of national sectoral economic strategies to increase national income and improve household revenues.

Therefore, it is crucial for Iraq to enhance the resilience of sectors such as agriculture, which provides the largest share of employment opportunities, especially in rural areas. This sector has also suffered from deteriorating productivity, inefficiency, and outdated infrastructure, which has eroded the competitive ability of farmers in local and international markets and threatens national food security. Iraq has had to import many crops it once produced enough of for self-sufficiency and even exported.

It should be noted that Iraq has been affected by several extreme climate events, such as floods, droughts, and dust storms, caused by fluctuating temperatures and rainfall patterns. Climate change also disproportionately affects women in Iraq compared to men. Adding to this complexity are water policies from neighboring countries that have reduced incoming water volumes, rapid urban and industrial expansion, and the mismanagement of water resources in agriculture and industry, leading to wastage and increasing consumption. A World Bank report has indicated that climate change and the potential risks of future earthquakes suggest that Iraq may experience unprecedented floods, droughts, dust storms, and epidemics in the future. However, what is certain is that climate change indeed threatens to undermine the disaster management efforts aimed at meeting the needs of the most vulnerable populations.

Greenhouse Gas Inventory

In accordance with Decision 17 of the Eighth Conference of the Parties, Iraq has compiled lists of greenhouse gas emissions, including those resulting from deforestation. In the year 2000 – the reference year/baseline year adopted in Iraq's Second National Communication – the total emissions amounted to approximately 87,412.46 Gg CO_2 equivalent. These emissions were derived from the energy sector, industrial processes and product use, agriculture and forestry, and other land use, as well as the waste management and sanitation sectors. The contributions of these four sectors to the total emissions were 7,660.86, 2,218.41, 3,564.36, and 5,023.02 Gg CO_2 equivalent, respectively. In 2000, the per capita share of greenhouse gas emissions in Iraq was approximately 3.7 tons. The share of carbon dioxide emissions for that year amounted to 66,899.306 Gg, representing 76% of total greenhouse gas emissions, followed by methane at 20%, with nitrous oxide emissions totaling around 2,985.53 Gg.

In Iraq's First Biennial Update Report, covering the years 2019-2020 – the baseline year for the biennial emissions update report – the total emissions for 2019 were approximately 177,617.19 Gg CO_2 equivalent. These emissions were the result of gases released from the energy sector, industrial processes and product use, agriculture and forestry, and other land use, as well as the waste management and sanitation sectors. The contributions of these four sectors to total emissions were 150,484.50, 2,414.64, 5,652.37, and 19,065.68 Gg CO_2 equivalent, respectively. In 2019, the per capita share of greenhouse gas emissions in Iraq was approximately 4.5 tons. The share of CO_2 emissions for the year was 133,288.38 Gg, representing 75% of total greenhouse gas emissions, followed by methane at 22% (38,873.82 Gg), and nitrous oxide emissions totaling approximately 5,454.98 Gg.

Assessment of Vulnerability to Climate Change and Adaptation Measures

Studies aimed at assessing the impacts of climate change and strategies for adaptation were conducted based on the guidelines issued by the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Environment Programme (UNEP) manual on climate change impact assessment and adaptation strategies. These studies utilized findings from ICARDA (International Center for Agricultural Research in the Dry Areas) for the Second National Communication of Iraq, covering sectors such as agriculture, water resources, and biodiversity.

Localized-climate trends were analyzed throughout Iraq, specifically in various governorates. Projections from the RCP 4.5 scenario show that temperatures will continue to rise, increasing by approximately 2.5°C by the end of the century in Anbar, Salahaddin, and Baghdad, while rainfall is

expected to decrease in northern Iraq. In Dohuk, the RCP 8.5 scenario indicates that rainfall is expected to decrease by 150 mm by the century's end.

A long-term simulation of wheat crop trends was conducted using the APSIM model, covering the period from 2006 to 2100. The results for the RCP 8.5 scenario show that the current average wheat yield of 4.5 tons per hectare may decrease by 1.5 tons by the end of the century. The study concluded that areas where agriculture depends on rainfall will need to develop climate-smart crop varieties to maintain yield and food security in rainfed farming regions.

The study utilized the SWAT model to evaluate soil and water in the Tigris and Euphrates river basins. The findings indicated that in both basins, there are temporal trends and future periods when conditions will be particularly negative concerning areas that produce high surface runoff, with expectations of a more than 10% decrease in runoff starting from the 1950s through to the end of the century. It was also observed that river inflows from the baseline period (1980-2010) would significantly decrease, and the RCP 8.5 scenario predicts an initial rise in inflow, followed by a decrease of 30%.

A study on biodiversity, which also employed remote sensing techniques, included an analysis of vegetation cover in wetlands using remote sensing technologies to assess the dynamics of vegetation cover and carbon flux in the marshlands. The study found that wetlands have a significant capacity for carbon sequestration, making them critical carbon storage reservoirs, which should be considered in any greenhouse gas inventories and climate adaptation strategies when establishing policy frameworks.

Greenhouse Gas Emission Reduction

The report reviews various greenhouse gas mitigation scenarios at the national level across different sectors. It analyzes the mitigation efforts within each sector individually and assesses whether further mitigation can be achieved in the primary energy, renewable energy, and energy efficiency sectors, using a baseline scenario for reference and another scenario for emission reduction strategies. These two models have been built upon to design mitigation scenarios and steps for the period from 2021 to 2050.

The study's methodology for analyzing the energy sector relied on the Low Emissions Analysis (LEAP) program, a tool for developing integrated models that track energy consumption and production across all economic sectors. It was used for the first time in Iraq to analyze emission mitigation measures in the energy sector and to create various emission reduction scenarios for the years 2030 and 2050, with projected reductions of 324.78 and 2311.12 million tons of CO_2 equivalent, respectively.

CHAPTER 1

NATIONAL CIRCUMSTANCES

1. NATIONAL CIRCUMSTANCES

This chapter briefly presents the political system of Iraq, along with the country's geographical, climatic, demographic, and economic features. It provides a concise description of the current state of sectors such as water, energy, health, industry, agriculture, land use, transport, and waste management. The chapter also reviews achievements in areas including environmental legislation, technology transfer, and education. Furthermore, it highlights the role of awareness and the promotion of gender equality, as well as the involvement of youth in initiatives aimed at mitigating the effects of climate change.

1.1 POLITICAL SYSTEM

The Republic of Iraq is a sovereign, independent federal state that was established in 1921. Its political system is a democratic parliamentary republic, as outlined in Article (1) of the current constitution, which was adopted in 2005. The federal system consists of the capital, regions, decentralized governorates, and local administrations, as stated in Article (116) of the constitution. The Kurdistan Region is a federal region made up of four Iraqi governorates: Erbil, Duhok, Sulaymaniyah, and Halabja. This region enjoys self-governance with semi-independent governmental, legislative, supervisory, executive, and judicial institutions. The governorates that are not part of a region (a total of 15 governorates, including the capital Baghdad) have been granted wide administrative and financial powers, enabling them to manage their financial affairs based on the principle of administrative decentralization (Figure 1-1).

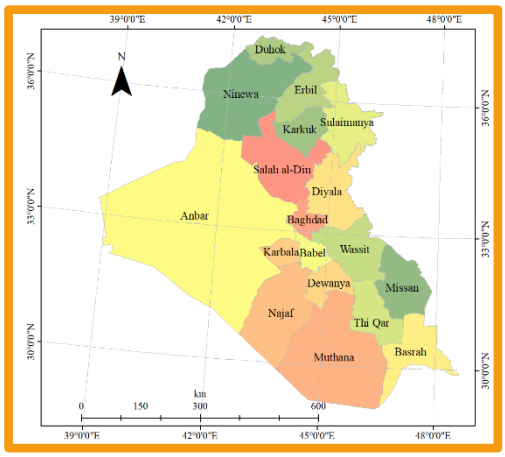


Figure 1-1 Iraqi governorates

1.2 GEOGRAPHY

The Republic of Iraq is in southwest Asia and constitutes the northeastern part of the Arab world. It is bordered by Turkey to the north, Iran to the east, Syria and Jordan to the west, and the Arabian Gulf, Kuwait, and Saudi Arabia to the south. It extends between latitudes 29°5' and 37°22' north and longitudes 38°45' and 48°45' east.

The area of the Republic of Iraq[1] is 435,052 square kilometers, and is divided into four main geographical regions[2]: the mountainous area in the north, which includes the governorates of the

1 Ministry of Planning / Central Statistical Organization / Annual Statistical Report 2021

2 Geography of Iraq - Al-Ma'arifa (The Knowledge) - https://www.marefa.org/%D9%85%D9%84%D9%81:Iraq_Topography.png

Kurdistan Region of Iraq; the undulating region, which lies between the elevated lands in the north and northeast and the lowlands in the south, covering the governorates of Nineveh, Kirkuk, Salah al-Din, and Diyala; the desert plateau in the west, which includes the governorate of Anbar and parts of the governorates of Najaf, Karbala, and Al-Muthanna; and the fertile and vast alluvial plain, which includes the governorates of Baghdad, Wasit, Karbala, Najaf, Dhi Qar, Maysan, Al-Qadisiyyah, and Basra (Figure 1-2).

Figure 1-2 Map of Iraq showing its regions and rivers

1.3 DEMOGRAPHY

The population of Iraq is 40,225,503 million people, according to the Ministry of Planning's statistics for 2020, with an annual growth rate of 2.58%. Population growth in Iraq continues at rates that are alarming and strain the country's ability to provide adequate services. The high population growth rate has led to an increase in Iraq's population from 12 million in 1978 to 38 million in 2018. It is expected to reach 50 million by 2030 if this rate of increase continues without measures being taken to curb it.[3]

Youth represent a large segment of Iraq's population structure, with the age group from 1 to 14 years making up 37.8%, and the age group from 15 to 64 years comprising 65.5%. Meanwhile, the elderly population (65 years and above) accounts for only 3.1%. The younger age groups face significant challenges in accessing education services and reproductive health guidance, and they suffer from a high unemployment rate, which stands at 35%. The growing numbers of young people contribute to rising demands for water and food resources. The situation is further exacerbated by the climate impact and the unilateral actions taken by neighboring countries regarding their water policies, which have disrupted Iraq's ambitious programs and projects related to environmental and economic development.[4] The male population in Iraqi society accounts for 50.5%, while females make up 49.5%. This promotes a societal balance, as the number of women is nearly equal to that of men, highlighting

3The Central Statistical Organization - Ministry of Planning - Iraq Population Estimation
4The Central Statistical Organization - Ministry of Planning - Iraq Population Estimation

the significant role of women in Iraqi society. Population density is higher in major urban centers such as Baghdad, Mosul, Erbil, Basra, and Najaf, as these areas host the majority of intensive economic, commercial, and tourism activities, especially in regions along the banks of the Tigris and Euphrates rivers.

1.4 CLIMATE

Iraq is located in the northern temperate zone, characterized by a semi-arid continental climate influenced by the Mediterranean Sea. The climate has a wide daily and annual temperature range due to the scarcity of water bodies and the low rainfall from the northeast to the southwest. Both the Mediterranean Sea and the Arabian Gulf affect Iraq's climate, with rainfall occurring in winter due to weather systems from the Mediterranean. The rainy season lasts from November to April in the north and northeast, with an average annual precipitation of about 216 mm. Winters are cold and rainy, with daytime temperatures reaching 16°C and dropping to 2°C at night, with occasional frost in the north. Summers are dry and hot, with temperatures exceeding 43°C and reaching up to 50°C in July and August, while nighttime temperatures range between 30°C and 26°C. The prevailing winds in Iraq are northwesterly throughout most of the year.

The climate of the Arabian Gulf region influences most of southern and central Iraq, creating specific weather conditions when low-pressure systems affect these areas. Hot, humid winds from the Gulf bring high temperatures.[5] Iraq's climate is divided into three types:

1. Mediterranean Climate: Dominates the mountainous region of Kurdistan, with cold winters, snow, and rainfall between 400-1000 mm annually, and mild summers with temperatures not exceeding 35°C.
2. Steppe Climate: Transitional between the mountainous region and the desert climate, with annual rainfall between 200-400 mm.
3. Hot Desert Climate: Prevails in the alluvial plain and western plateau, covering 70% of Iraq's area, with annual rainfall between 50-200 mm and temperatures reaching 45-50°C.

1.5 WATER RESOURCES SECTOR

1.5.1 SURFACE WATER

Iraq primarily depends on surface water, with the Tigris and Euphrates rivers and their tributaries being the main sources of surface water. The watershed area of these rivers is shared by five countries: Iraq, Turkey, Iran, Syria, and Saudi Arabia. The amount of water available fluctuates from year to year depending on external water inflows, as well as precipitation and snowfall. The demand for water resources in Iraq continues to rise due to population growth and increased human activities related to water use. Water resources remain crucial for expanding agricultural areas and maintaining the health of ecosystems, especially given the expanding drought conditions caused by unprecedented temperature increases, higher evaporation rates, and decreased rainfall as a result of climate change.

Before 1975, the annual inflow of the Euphrates River was 30 billion m^3, but it decreased to 21 billion m^3 after the construction of the Ataturk and Karakaya dams. Following the construction of other regulating dams, the annual inflow further dropped to 16.6 billion m^3. The average annual inflow of the Tigris River was 44.8 billion m^3 in previous years. Tributaries of the Tigris contribute about 24.78 billion m^3, and there are also side valleys from the eastern border that contribute at least 7 billion m^3, but only in flood years. The flow of these rivers has decreased since the 1970s due to hydrological projects built by neighboring countries and climate change. The annual flow rate passing through

5 Iraqi Ministry of Planning - Annual Statistical Report, 2020-2021.

Baghdad was 460 m³/second for the 2022 water year, while the annual flow rate into the Euphrates River at Husseiba was 220 m³/second for the same water year. [6]

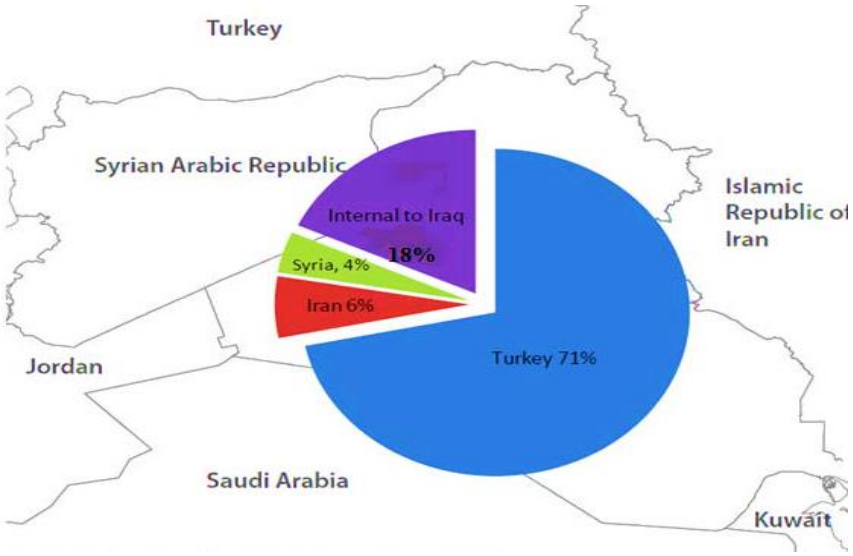


Figure 1-3: Sources of Water for the Tigris and Euphrates Rivers (Ministry of Water Resources, 2010)

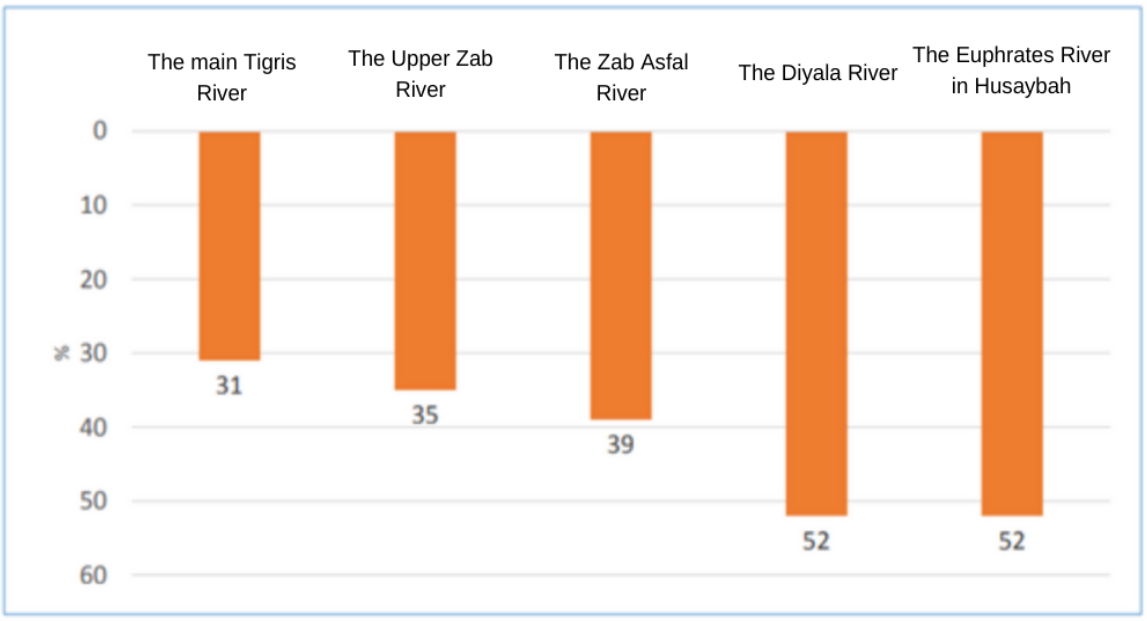


Figure 1-4: Ratios of water inflow deficit for the period 2008-2018 compared to the natural average (Ministry of Water Resources)

1.5.2 GROUNDWATER

Groundwater is a significant source of water in Iraq, with varying quality depending on the region. Iraq withdraws approximately 4 billion cubic meters of groundwater annually, most of which is used to supply the western desert, where there are no nearby surface water sources. However, the groundwater in Iraq is characterized by high concentrations of dissolved solid salts, typically not less

6 Ministry of Water Resources - Planning Department - Environmental Policies Section - 2022

than 1,000 mg/L, especially in recharge areas, and can exceed 20,000 mg/L in the alluvial plains. The Kurdistan Regional Government also relies on groundwater as a major source for water desalination.[7] It is expected that the reliance on groundwater will increase in the near future due to the following reasons:[8]

1. About 90% of irrigation water in Iraq comes from the Tigris and Euphrates rivers, with these activities concentrated in the areas adjacent to these rivers and the Mesopotamian Plain. This leaves approximately 60% of Iraq's total area without access to surface water, causing water shortages. This situation is expected to worsen, increasing reliance on groundwater for food production to meet the needs of the growing population.

2. The pressure on groundwater resources is expected to increase due to the escalating water projects in Turkey and Iran, which impact Iraq's water availability.

3. There are growing difficulties related to the distribution of irrigation water quotas to farmers and determining when it should be discharged to their farms. This has prompted some farmers to drill their own wells to secure the water needed at the required times.

The amount of renewable groundwater has significantly declined due to climate change, especially in the last five years. This is attributed to the recorded decline in groundwater levels and the electronic monitoring wells set up by the General Authority for Groundwater, part of the Ministry of Water Resources.

The negative impact of reduced rainfall and drought has significantly affected groundwater recharge because most of the primary and secondary basins derive their water from rainfall. For example, over the past 30 years, the storage in the Al-Diwaniyah Basin has decreased by 21%. Additionally, some springs in various areas of Iraq have dried up. Groundwater in many central and northern regions, including Nineveh and Salah al-Din provinces, suffers from high salinity due to nitrate accumulation, particularly in desert and alluvial plain areas.

1.5.3 MARSHES

The marshes in southern Iraq are a collection of wetlands covering the lowlands of the southern Mesopotamian plain, forming a triangular shape across the provinces of Basra, Dhi Qar, and Maysan. The area covered by water expands during the flooding period in late winter and spring but shrinks during the dry summer months of intense heat. The tragic situation that emerged in 2022, where the decrease in water levels coincided with upstream water diversion by neighboring countries, coupled with climate and environmental changes, urban expansion, and the intrusion of saline water into freshwater sources, has caused a severe reduction in water flowing into the marshes.

The provinces, among the poorest in Iraq, host many rural communities, particularly buffalo herders who face severe water scarcity. They find themselves in an unprecedented situation as water levels in the areas they inhabit have dropped drastically, threatening their livelihoods and community existence. The water shortage has had catastrophic effects, devastating the lives of over 6,000 rural households

7 National Strategy and Action Plan for Reducing Environmental Pollution (NSEPRAP) (2022-2030) - Iraqi Ministry of Environment.
8 The book "Water Resources in Iraq: Perspectives and Diagnosis" by Dr. Nazir Al-Ansari was published as a special issue in the Geotechnical and Sciences Earth journal, Volume 2, Issue 11, in 2021.

who lost their buffalo herds, their only source of income, and are now burdened with additional challenges due to decreased rainfall and climate change impacts. [9]

The loss of traditional livelihoods in the southern marshlands due to the catastrophic effects of water scarcity and climate change has led to mass displacement of people from the affected areas. The number of buffalo herders leaving these areas continues to rise as they suffer damage to their livestock. Some have been forced to sell their buffalo and other animals at low prices to buy feed for the surviving animals. Others have begun searching for alternative means of livelihood after losing what little they had to survive.

1.5.4 WATER QUALITY

The quality of water flowing through Iraq has deteriorated, especially during years of drought. Salinity levels in the Tigris River increased from 320 to 500 parts per million, while salinity in the Euphrates River rose from 450 to 930 parts per million in 2012. [10] Iraq's surface waters face pollution problems caused by agricultural development activities and wastewater from municipal, industrial, and agricultural uses, which flow into rivers. This wastewater is used for economic development purposes, and due to the increasing population growth, it contributes to the spread of freshwater pollutants. Water quality degradation is exacerbated by drought waves, which are a major factor in the desertification of agricultural lands in Iraq.

To prevent future water quality deterioration and improve it, the following measures are necessary:

- Preventive actions and comprehensive management for effective use of agricultural, municipal, and industrial waters.
- Comprehensive standards for the quantity and quality of surface and groundwater.
- Comprehensive standards for the quantity and quality of discharges into water bodies and soils.
- Appropriate technologies for wastewater treatment.
- Data and tools for monitoring the flow and quality of water entering the rivers from municipal, industrial, and agricultural water users.

1.6 AGRICULTURAL AND ANIMAL SECTOR

The area of arable land in Iraq is approximately 13.4 million dunams, according to a study by the Ministry of Water Resources in 2014. Currently, about 35% of the land is irrigated through surface water, 46% depends on rainfall, and 19% relies on well water.[11] In 2020, the total area suitable for agriculture was about 18 million dunams, with approximately 15 million dunams cultivated[12] (Table 1-1). Rain-fed agriculture is concentrated in northern Iraq, where grains are the main crops. In the central and southern regions, land is irrigated through the Tigris and Euphrates rivers. Mixed farming systems prevail in the central provinces, where fruit trees, date palm orchards, and vegetables such as tomatoes and potatoes are grown. Iraq can be divided into four agricultural ecological zones: the arid and semi-arid regions with a Mediterranean climate, the steppe areas with 200-400 mm of winter rainfall, the desert region with extreme heat and little rain, and the irrigated zone between the Tigris and Euphrates rivers.

9 FAO, 2022. Iraqi marshes cannot wait: FAO. https://www.kurdistan24.net/en/story/28953-Iraqi-marshes-cannot-wait:-FAO
10 Ministry of Water Resources - Planning Department - Environmental Policies Division - 2022
11 Ministry of Agriculture / Planning and Monitoring Department / Statistics Section - Environmental Statistics Section - Central Statistical Organization / Iraq
12 Ministry of Agriculture, 2020

Agriculture is one of the largest sources of employment in rural areas, but it suffers from low productivity due to factors such as wars, deteriorating infrastructure, and climate change. Soil salinity affects 70% of irrigated areas, reducing farmers' ability to compete in local and international markets, turning Iraq into a larger importer of agricultural products to meet local needs after previously being a source of these products.[13]

Agriculture consumes at least 85% of the surface water and contributes a small percentage to Iraq's GDP, but it remains important. Population growth and the need to produce more food depend on limited resources in terms of land and water. Agricultural systems prioritize short-term gains over long-term sustainability. The agricultural economy contributes 9% of the GDP[14] and is the largest source of private sector jobs, employing 20% of the workforce, with women making up more than half of this workforce. The agricultural sector contributes to social integration and has a multiplier effect on other economic activities. An increase of just 1% in agricultural GDP would lead to a 1.2% increase in total employment (compared to only a 0.35% increase in the industrial sector).[15]

Table 1-1- Arable and Cultivated Land by types of irrigation systems for the Year 2020

Governorate	Arable Land* (Donum)	Currently Exploited Land (Cultivated) based on irrigation method (Donum)			
		Irrigated land	Rainfed Land	Groundwater	Total
Nineveh	1,084,600	83,186	6,192,893	403,055	6,679,134
Kirkuk	741,000	433,616	250,911	292,550	977,077
Diyala	1,273,400	394,828	90,250	50,742	535,820
Anbar	476,100	321,028	0	414,555	735,583
Baghdad	998,800	224,407	0	995	225,402
Babylon	1,412,860	354,401	0	0	354,401
Karbala	204,160	35,440	0	94,340	129,780
Wasit	2,039,600	1,292,128	88,248	22,457	1,402,833
Salah al-Din	960,000	76,275	100,000	1,178,800	1,355,075
Najaf	237,280	221,035	0	77,898	298,933
Qadisiyah	1,349,000	595,164	0	10,335	605,499
Muthanna	468,000	125,961	0	224,805	350,766
Thi Qar	737,800	421,795	0	170	421,965
Maysan	791,000	404,222	0	20,871	425,093

13 Irrigation in the Middle East Regions - Part Three - Country Profiles - Iraq / Report by the Land and Water Division of the Food and Agriculture Organization of the United Nations - FAO / Rome 2010
14 Iraq Socio-economic Atlas 2019
15 The joint report issued by the Food and Agriculture Organization (FAO), the World Food Programme (WFP), and the World Bank in 2021.

Basra	220,000	34,532	0	22,675	57,207
Agricultural Research	-	4,234	0	1,405	5,639
Total	12,993,600	5,022,252	6,722,302	2,815,653	14,560,207
Kurdistan Region	-	-	-	-	-
Dohuk	38,200	-	-	-	-
Sulaymaniyah	165,000	-	-	-	-
Erbil	290,900	-	-	-	-
Total	494,100	-	-	-	-
Total Iraq	13,487,700	5,022,252	6,722,302	2,815,653	14,560,207

-Stands for Data not available.
*Agricultural land is all land that was irrigated and had water shares, guaranteed demesne lands, lands irrigated from springs and wells.
Source: Ministry of Agriculture / Planning and Follow-up Department / Statistics Section
Environmental Statistics Department - Central Statistical Organization / Iraq

Livestock production represents one-third of the total value of agricultural output and is a vital source of income and food for rural households. The government supports crops like wheat and barley. However, the sector faces numerous challenges, including poor performance and a lack of trained human resources. The weak performance of the agricultural sector leads to migration to urban areas and an increase in urban poverty. Food security conditions are likely to deteriorate with the rising number of internally displaced persons and the growing pressure on community resources.

The conflict with terrorist organizations has led to the destruction of the agricultural sector and its infrastructure. The World Bank estimates the losses in this sector at $2.1 billion, in addition to losses in agricultural machinery amounting to $590.9 million.

1.7 LAND USE

Land use in Iraq is divided into five main categories[16], which reflect the climate, topography, soil, and availability of water resources. Agricultural land includes areas cultivated with crops such as wheat, corn, and rice, which are replanted after each harvest. 0.5% of the land is designated for permanent crops, such as citrus, which are not replanted after harvest. Permanent pastures, used for growing grass fodder for at least five years or more, whether cultivated or naturally grown, make up 9.2% of the country's area. Forests cover areas of land greater than 0.5 hectares, planted with trees taller than five meters and covering more than 10%. The forested area in Iraq is 2.3 million dunams [17],most of which is located in the Kurdistan region. The remaining land consists of built-up areas, roads, bridges, arid land, and landfill zones (Figure 1-5).

Urban land-use plans in Iraqi cities are traditional and unsustainable, which can have negative impacts on the city from environmental, economic, social, and urban perspectives. Most Iraqi cities suffer from significant urban sprawl, both in reality and in future expansion plans, with numerous violations of

16 Sissakian, V., Al-Ansari, N. and Knutsson, S., 2013. Sand and dust storm events in Iraq, J. Natural Science, 5,10, 1084-1094.
17 Ministry of agriculture, 2020

urban planning regulations and encroachment on agricultural lands. Additionally, most land uses are unsustainable as they focus on reducing agricultural lands and green spaces in the city, while expanding street areas that rely more on conventional transportation rather than sustainable transport.[18] The strategic study of water resources in Iraq confirms that weak urban planning threatens fertile lands and makes agricultural activities excessively costly due to logistical obstacles.[19]

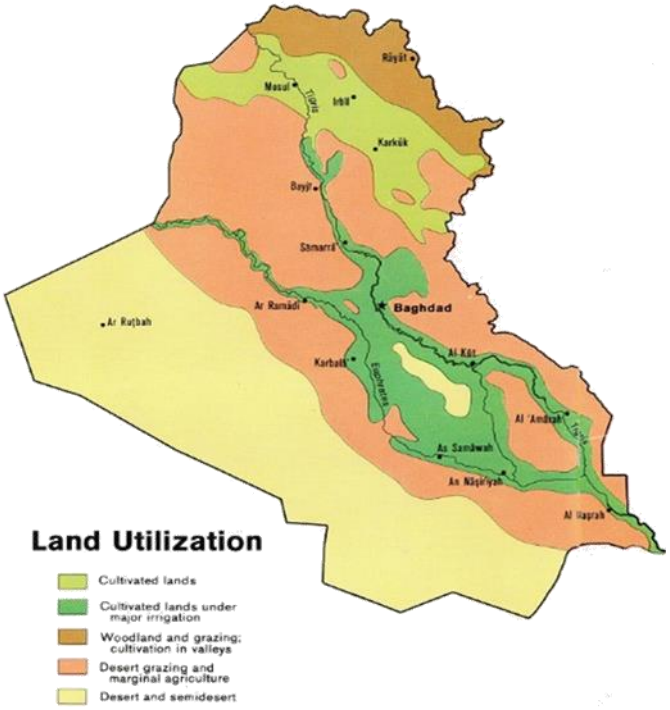


Figure 1-5: Land Use in Iraq (Sissakian et al, 2013)

The area of desert and desertified lands, as well as sand dunes threatened by desertification, is about 121 million dunams. The area affected by soil erosion and desertification reaches approximately 160 million dunams, with 63% suffering from soil hardening, 20% from soil salinization, 12% from water erosion, and 5% from wind erosion.[20, 21]

There are many practices, such as unsustainable agriculture and illegal hunting, that threaten natural ecosystems, leading to land degradation and desertification. These practices have resulted in problems like sand dune movement and dust and sand storms in the central and southern regions of the country, exacerbated by climate change. Other factors contributing to the expansion of desert areas include decreased flow of the Tigris and Euphrates rivers, increased soil salinity, and the deterioration of water quality. Iraq aims to convert 150,000 hectares of sand dune lands into grasslands by 2035.

Large areas of Iraqi land have been affected by desertification, with at least 75% of the country impacted, forcing many farmers and fishermen to abandon their lands, and leaving their villages

18 Study on Land Use Analysis in Iraqi Cities - Nabil Ismail and Areej Muhyi Abdul Wahab, Wasit Journal of Engineering Sciences, Edition (3), Issue (3), 2019.
19 Strategic Study of Water and Land Resources in Iraq (SWLRI) adopted by the Iraqi government in 2014.
20 Strategic Study of Water and Land Resources in Iraq (SWLRI) adopted by the Iraqi government in 2014.
21 Ministry of Agriculture / Planning and Follow-up Department / Statistics Division 2016 Data.

deserted. As a result, dust storms increased, and cultivated areas shrank by 40% between 2007-2009 due to droughts caused by climate change.[22]

Land-use processes were further affected by large-scale displacement after 2014 due to the conflict with ISIS. Many people were displaced to camps in recovered areas, with their return varying based on their material and social conditions.[23]

The International Organization for Migration reported an increase in the number of displaced persons due to climate change and environmental degradation in 12 central and southern governorates of Iraq between 2022 and September 2023, with 21,798 families (130,788 individuals) displaced.[24] The number of displaced persons is expected to increase significantly as environmental changes worsen[25], putting pressure on natural resources and services.

1.8 BIODIVERSITY

Iraq is part of the region called the Palearctic, which is one of the largest of the eight terrestrial biogeographical regions. The World Wildlife Fund (WWF) has identified this region as important for its biodiversity and ecological significance.[26] Five terrestrial biomes in Iraq are represented by the temperate broadleaf and mixed forests (light green), Mediterranean forests of the Mediterranean Basin (red), temperate grasslands, savannas, and shrublands (yellow), deserts and xeric shrublands (pink), and flooded grasslands and savannas (dark green) (Figure 1-6).Figure 1-7 shows nine ecological regions in Iraq, five of which are primary and four secondary.

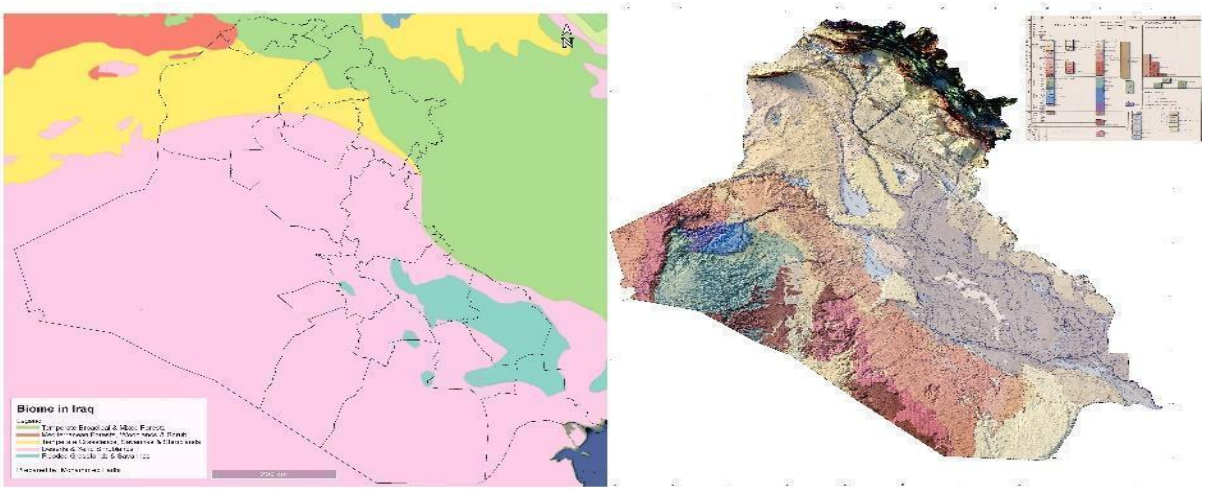


Figure 1-6: Terrestrial Biomes (WFF/TNC, 2008)

22 Al-Ansari, Nadhir & Adamo, Nasrat & Sissakian, Varoujan. (2019). Water Shortages and its Environmental Consequences within Tigris and Euphrates Rivers. 9. 27-56.
23 International Organization for Migration (IOM), November 2023. Periodic Global Report on the State of Solutions to Internal Displacement (PROGRESS). IOM, Geneva.
24 International Organization for Migration (IOM), November 2023. Periodic Global Report on the State of Solutions to Internal Displacement (PROGRESS). IOM, Geneva.
25 IOM Iraq, Migration, Environment, and Climate Change in Iraq
26 WWF- World Wide Fund for Nature 2018

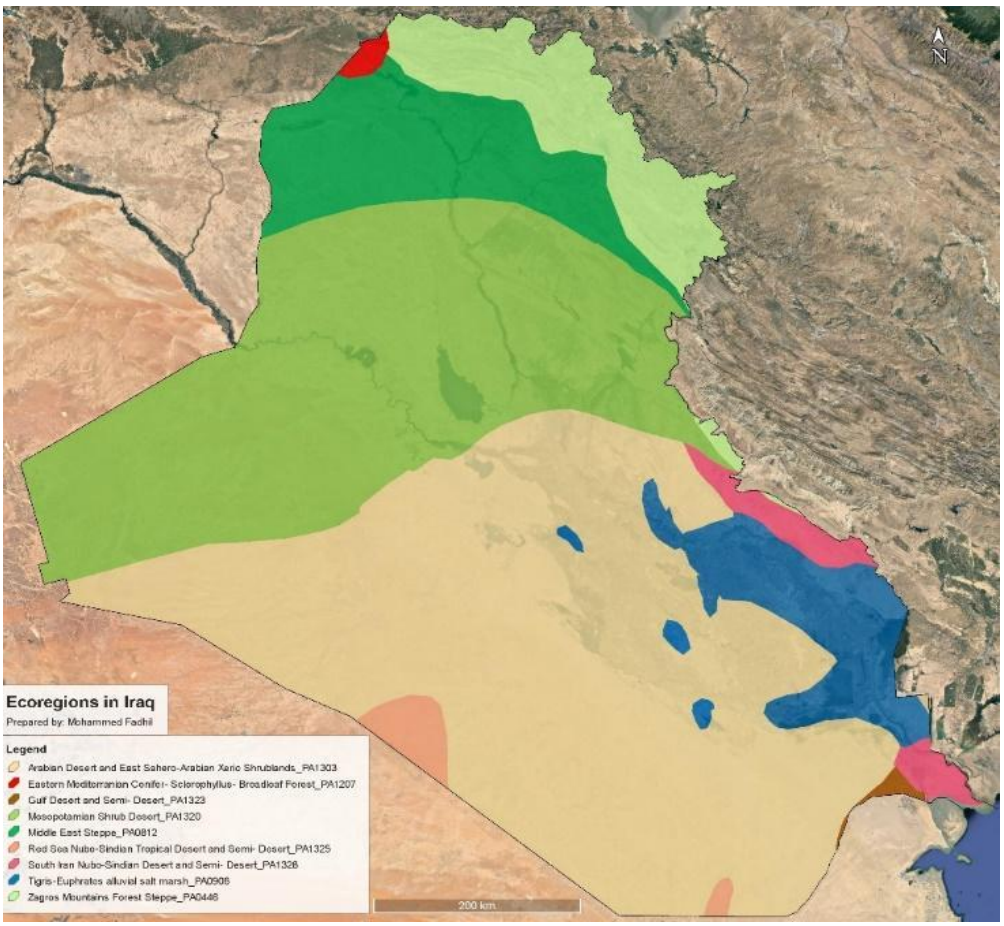


Figure 1-7: Environmental regions in Iraq

According to the Fourth National Report on the Convention on Biological Diversity in Iraq, three freshwater ecological regions were identified: the Inland Arabian region, the Lower Tigris and Euphrates region, and the Upper Tigris and Euphrates region, in addition to one marine ecological region in the Arabian Gulf.[27] (Figure 1-8)

27 The Fourth National Report on the Convention on Biological Diversity in Iraq

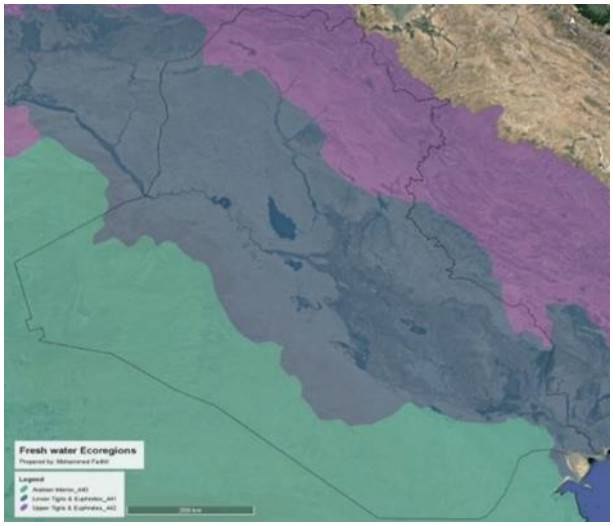


Figure 1-8: Freshwater Environmental Areas (WFF/TNC, 2008)

The Mesopotamian Marshes, known as the Iraqi Marshes, are a wetland area located in central and southern Iraq. The marshes were the largest wetlands in the Middle East and West Asia, covering an area between 15,000 and 20,000 square kilometers of surface water and vegetation in the 1970s.[28] Historically, the marshes consisted of the Central Marshes, the Haur al-Hawizeh, and the Haur al-Hammar, which provided long-term resilience to the unique landscapes of southern Mesopotamia, along with abundant resources for the indigenous populations since the time of the Sumerians.[29] The marshes are home to 165 species of birds and several types of fish, and have served as a stopover for many migratory birds. Iraq is known for its unique biodiversity, especially in the southern region, being home to nine of the most important ecological regions in the Middle East, two of which are threatened with extinction. Iraq is home to 3,300 plant species, 374-413 species of birds, 93 species of mammals, 311 species of fish, and 10 species of amphibians. [30]

Iraq is home to a diverse range of endangered species, with approximately 234 species, including 99 plant species, 59 fish species, 11 reptile species, two amphibian species, 43 bird species, and 20 mammal species. Endemic species include the Iraqi smooth-coated otter and the long-tailed jird, both listed on the Red List of endangered species, as well as the Euphrates spiny-tailed lizard and the Basra reed warbler. The biological value of these species has led to the designation of many areas in southern Iraq as international protection zones under the Ramsar Convention.[31]

Many endangered species are found in the western regions, including two species of blind fish. The northern areas are home to numerous threatened plant and animal species, such as the Kurdistan salamander and the Persian leopard. A range of threatened bird species also reside in these regions,

28 UNEP (United Nations Environment Program). 2001. The Mesopotamian marshlands: demise of an ecosystem, early warning, and assessment. Early warning and assessment. Division of Early Warning and Assessment, United Nations Environment Program, Nairobi, Kenya.
29 Salim, S. 1962. Marsh dwellers of the Euphrates Delta. London School of Economics Monographs on Social Anthropology, Athlone, London, UK.
30 Al-Oufi, Abdul Hadi Ahmed (2021) Guidance Manual on Biodiversity in Iraq, and the Protected Areas of Al-Dalmaj Marsh and Al-Tayyeb. Amman, Jordan: International Union for Conservation of Nature - Regional Office for West Asia and Baghdad, Iraq: Ministry of Health and Environment of Iraq: United Nations Environment Program.
31 Ibid.

including the Egyptian vulture and the horned viper with a spider-like tail found in the foothills of eastern Iraq.[32]

1.9 WASTE AND WASTEWATER SECTOR

Iraq faces significant challenges in managing unregulated solid waste, particularly with the rapid increase in population. According to a study by the Japan International Cooperation Agency (JICA) and the Environmental Protection Agency in the Kurdistan Region, Iraq produces approximately 19.83 million tons of solid waste annually. Baghdad alone produces 9.7 million tons per year, while the Kurdistan Region produces 2.52 million tons annually. The per capita waste generation in Erbil, Sulaymaniyah, and Duhok is estimated at 1.23, 1.14, and 0.92 kg per person per day, respectively. [33]

This rapid increase strains the waste management infrastructure. In 2019, the waste generation rate in Iraq was 1.36 kg per person per day[34] (excluding the Kurdistan Region, where the rate was 1.18 kg per person per day). Organic waste accounted for 42.96% of the total solid waste in Baghdad, while paper and plastic waste made up 22%.[35]

The accumulation of waste in cities and the lack of organized landfills lead to soil contamination in Iraq. The rapid population growth increases waste production, putting strain on infrastructure and forcing households to dispose of waste improperly. The pollution of waste collection sites and unregulated landfills contaminates agricultural land and groundwater. The current waste management system lacks efficiency in collection, sorting, treatment, and disposal. Unsafe, environmentally unregulated landfills are used across Iraq, causing occasional fires, water contamination, and greenhouse gas emissions.

The current waste management system has a limited number of transfer stations, about 77 stations, and 218 waste disposal sites across Iraqi governorates, with 18 sites in the Kurdistan Region. Only about 30% of landfills are regulated. In Baghdad, there are 14 regulated transfer stations, 9 of which are completed and 5 under construction, in addition to two treatment facilities for sorting and recycling waste with a processing capacity of 1,000 tons/day. Organic materials, which account for 42%, are used as compost, while the remaining waste is buried in a regular landfill, with a landfill cell inside the plant.[36]

A waste management development plan was established in Iraq in 2007 and updated in 2021. The plan outlines the creation of 33 waste disposal sites with global environmental standards, with a total capacity of 600 million cubic meters, across all provinces by 2027. A sanitary landfill has been in operation in Kirkuk since 2008, and another in Basra since 2010. Two more sanitary landfill sites in Ramadi and Karbala will be completed by 2024.

32 An overview of biodiversity and endangered species in Iraq with environmental activist Dr. Omar Al-Sheikhly - June 5, 2023. (https://www.undp.org/ar/iraq/stories/glance-iraqs-biodiversity-and-endangered-species-dr-omar-al-sheikhly)
33 A study on data collection about solid waste management in Iraq - Japan International Cooperation Agency (JICA) in collaboration with the Ministry of Reconstruction, Housing, Municipalities, and Public Works, and the Ministry of Municipalities and Tourism in Kurdistan, as well as the municipalities of Baghdad, Basra, and Erbil - 2022.
34 A study on data collection about solid waste management in Iraq - Japan International Cooperation Agency (JICA) in collaboration with the Ministry of Reconstruction, Housing, Municipalities, and Public Works, and the Ministry of Municipalities and Tourism in Kurdistan, as well as the municipalities of Baghdad, Basra, and Erbil - 2022.
35 A Study on the Daily Waste Generation per Capita and Its Components in Baghdad - Baghdad Municipality - Solid Waste and Environment Directorate - 2023.
36 The National Strategy and Action Plan for Environmental Pollution Reduction (NSEPRAP) (2022-2030) - Iraqi Ministry of Environment

Despite the increasing volume of waste due to population growth and lack of awareness, waste collection, transportation, sorting, treatment, and recycling processes have not kept pace with global development, leading to missed opportunities to exploit waste as a resource.[37]

In 2023, the percentage of the population covered by waste collection services in Iraq (excluding the Kurdistan Region) was 65.7%, with 90.7% in urban areas and 12.5% in rural areas. In the Kurdistan Region, 100% of urban areas and 98% of the entire region were covered by waste collection services. However, high coverage percentages do not indicate efficient performance, as waste collection services are also provided in informal settlement areas. The Ministry of Construction, Housing, and Municipalities and the Baghdad Municipality are responsible for waste management, while municipal institutions are not responsible for providing services to rural areas outside the municipality's basic design limits. Nevertheless, campaigns are underway to provide waste collection services and street leveling in rural areas.

A significant portion of environmental pollution in Iraq is attributed to the fragile sewage system and inadequate waste management, including the increased discharge of untreated wastewater and industrial and agricultural effluents into water bodies. There are two projects in Baghdad for sewage water recycling: the Saaqlawea Drainage Project, currently under construction, and the tertiary treatment project, which has not yet entered operational phase.

1.10 HEALTH SECTOR

Climate change is one of the biggest global challenges and a key focus of the Sustainable Development Goals (Goal 13). It affects the social and environmental determinants of health, including clean air, safe drinking water, adequate food, and secure shelter. Climate change impacts health in various ways, such as increasing morbidity and mortality rates due to extreme weather events like heatwaves, storms, and floods, disrupting food systems, spreading food- and waterborne diseases, and exacerbating mental health issues.

Given Iraq's climate conditions, fluctuations, high number of displaced or migrating individuals, and high birth rates, there is an expected rise in heat-related illnesses and deaths, waterborne diseases, mental health disorders, malnutrition, and consequently, mortality—particularly among children under five and other vulnerable populations.

The Iraqi healthcare system has faced significant challenges over the past two decades, including infrastructure damage and the emigration of skilled doctors and specialists, leaving the population with inadequate access to essential healthcare services. Iraq is still recovering from prolonged periods of conflict and political instability. The Ministry of Health is committed to a primary healthcare system and has developed a four-year national health strategy (2022-2025). The healthcare sector focuses on governance, service provision, and increasing the number of doctors and hospital beds to enhance primary healthcare. The availability of healthcare services varies across governorates, with one primary healthcare center serving between 10,000 and 45,000 people, 12 hospital beds per 10,000 people, and 9.68 doctors and 22.4 nurses/midwives per 10,000 people.

In 2022, the number of government hospitals, specialized centers, and primary healthcare centers increased, but Iraq still faces many challenges that heighten the demand for medical facilities and services. Emergency rooms received 70,357 patients in May 2022 due to dust storms, climate change

37 Environmental Statistics of Iraq (Municipal Services Sector) for the Year 2021 - Ministry of Planning / Central Statistical Organization

effects, and climate-induced migration, placing additional strain on healthcare institutions and increasing the spread of communicable diseases in displacement areas.

Iraq's health authorities need clear adaptation measures to mitigate the adverse effects of climate change. These measures include strengthening health systems, providing clean drinking water, monitoring mosquito breeding areas, and improving sanitation to reduce climate-exacerbated diseases such as diarrhea. Public health awareness is also a priority. The Ministry of Health has demonstrated interest in climate change by establishing a Climate Change Division within the Public Health Directorate and appointing coordination points in Baghdad and all governorates. The ministry is currently developing a climate change strategy as part of the National Adaptation Plan and has included a project on climate change and its impact on the health sector in the National Health Strategy (2022-2025). Additionally, the Ministry of Health has prepared a medical waste management guide titled "Environmental Guide for Health Institutions," emphasizing training and hazardous medical waste management. Waste is currently processed through incineration or waste shredding and sterilization devices, with 181 units installed in healthcare facilities across Iraq.

1.11 ENERGY SECTOR

Iraq's energy generation relies heavily on fossil fuels, particularly crude oil and natural gas. Since 2009, gas supplies have increased due to higher associated gas production and efforts to capture rather than flare it, along with increased gas imports. These supplies have helped reduce the use of crude oil for fuel and boosted oil exports. However, shortages persist due to limited gas processing and transportation capabilities for power plants. Coordinated efforts to develop gas resources could narrow the supply-demand gap by 2027.

Iraq possesses massive hydrocarbon reserves, estimated at approximately 300 billion barrels, with 514 geological structures, including 209 confirmed reserves. Iraq is one of the most promising oil-producing nations and could potentially rank first in proven global reserves. The confirmed crude oil reserves are distributed across 73 fields, with five supergiant fields in southern Iraq accounting for 60% of total proven reserves.

In 2013, the National Integrated Energy Strategy was launched to increase power generation from 10-12 GW to 20 GW by 2015. However, challenges limited production to 16.5 GW by 2019. Due to a persistent supply-demand deficit, Iraq has relied on highly polluting and costly private generators, further complicating the electricity crisis, especially amid rising temperatures.

The core issue in Iraq's electricity sector is the gap between supply and demand, exacerbated by increased fuel consumption after 2003, a growing number of vehicles, security challenges, and terrorist attacks on infrastructure. In 2019, peak electricity demand reached 26 GW—58% higher than generation capacity. Factors such as demographic shifts, population growth, migration from rural areas to major cities, increasing air conditioner use, and rising summer temperatures due to climate change are expected to push peak demand beyond 37 GW. Despite the World Bank projecting a 4.7% decline in Iraq's GDP, other studies suggest peak demand could reach 50 GW by 2030, considering the country's rapid population growth. [38]

38 Report on Energy Supply in Iraq - Challenges Facing the Electricity Sector in Iraq, by Robin Mills and Maryam Salman / October 2020. (https://library.fes.de/pdf-files/bueros/amman/16924.pdf)

Iraq has significant potential for both conventional and renewable energy production, particularly solar energy. The Iraqi government aims to increase the share of renewable energy to 6% of total power generation by 2030 while reducing carbon emissions by 53%. Agreements have been signed to develop photovoltaic solar power projects with a total capacity of 12 GW by 2030.

Despite ongoing challenges, the past decade has seen major national and international efforts that have contributed to the reconstruction of the building and energy sectors. These efforts have led to increased electricity generation between 2012 and 2018, according to annual reports from the Ministry of Electricity.[39] In 2018, Iraq's available power generation capacity reached approximately 13 GW, producing a total of 82,130 GWh. However, this increase did not translate into achieving the desired sustainable development goals due to two key issues.

The first issue relates to Iraq's energy mix, which is almost entirely dependent on fossil fuels, particularly oil and natural gas. In 2018, only 1.74% of total electricity generation came from renewable sources (hydropower). As a result, the increased reliance on fossil fuel-based power generation has led to a rise in greenhouse gas emissions from this critical sector.

The second issue is that the increase in generation capacity was not accompanied by improvements in transmission and distribution networks. Official records from the Ministry of Electricity indicate that Iraq has one of the highest transmission losses in the world, reaching 22% of the electricity generated.[40]

These losses represent a technical issue due to the lack of efficient investment in rehabilitating power plants and grid lines. Additionally, weaknesses in electricity management contribute to significant losses, as large areas consume electricity without proper measurement or monitoring, particularly in informal settlements and encroached areas. This unregulated consumption increases the overall losses in the system.

Furthermore, the government subsidizes electricity tariffs for consumers officially connected to the grid with metered connections under the Ministry of Electricity's supervision. However, this complicates the issue, as the electricity produced is insufficient to fund necessary investments. At the same time, widespread poverty makes it impractical to remove government subsidies on energy.

Iraq's energy sectors continue to face major challenges and require large-scale projects for proper development and investment. Aligning with international pathways outlined in the Paris Agreement to address climate change will necessitate international financial and technical support, along with security and stability in the country. Strengthening Iraq's institutional capacities will be essential to facilitate development in the energy sector and help achieve the emission reduction targets outlined in Iraq's Nationally Determined Contributions (NDC), alongside other key sectors.

1.11.1 LEGAL FRAMEWORK

The Electricity Law No. 53 of 2017[41] regulates the use of renewable energy and encourages private sector investment. A draft Renewable Energy Law[42] has been passed through the Ministry of Electricity and is currently undergoing final amendments by the Ministerial Council for Energy—the

39 The Annual Report of the Ministry of Electricity, 2018.
40 Ministry of Electricity - Official Letter
41 Electricity Ministry Law (Law No. 53 of 2017) - Al-Waqa'i Al-Iraqiyah - Issue 4443
42 Regulation of Renewable Energy

highest executive authority for energy in the country. The law was developed with the assistance of the Regional Center for Renewable Energy under the United Nations Development Programme (UNDP) and in coordination with Iraq's Central High Committee for Sustainable Energy. This committee was established under Prime Ministerial Order No. 54 in 2018. The Ministry of Electricity serves as the regulatory authority for the energy sector, while the Ministry of Science and Technology contributes to research and development through the Solar Energy Research Center.

1.11.2 GOVERNMENT OBJECTIVES RELATED TO ENERGY

The Iraqi government has set a target to generate 705 MW between 2023 and 2025, with an increase of 200 MW in 2024 and 505 MW in 2025. The plan includes investments in combined-cycle gas power plants, contributing to emissions reduction in alignment with the Paris Agreement.

The Ministry of Electricity has achieved environmental milestones by adding 3,100 MW by the end of 2023, leading to a reduction of approximately 7 million tons of CO_2 equivalent emissions.

1.11.3 IMPROVING ENERGY EFFICIENCY IN THE ELECTRICITY GENERATION SECTOR

The Ministry of Electricity has enhanced the efficiency of gas power plants by implementing air-cooling systems, with a plan to complete 40 such systems. This initiative is expected to add 792 MW, yielding both environmental and economic benefits by reducing fuel consumption. By mitigating energy losses caused by high temperatures—which typically reduce the efficiency of gas units by 10-15%—this measure helps maintain optimal energy output.

1.11.4 LOW CARBON ENERGY CONTRIBUTION TO TOTAL ENERGY MIX

The Ministry of Electricity has announced its goal to increase Iraq's renewable energy production to 6% of total energy output by 2030. This will be achieved through solar and hydropower technologies while also reducing greenhouse gas emissions by 53% using low-carbon technologies and increasing reliance on natural gas to 55%.

Iraq is actively working to diversify its energy mix and expand renewable energy sources in the medium and long term. The country has developed a plan to enhance its clean, sustainable energy production and replace traditional energy sources. Recently, the Iraqi government signed an agreement to develop a series of photovoltaic solar energy projects across various cities, with a total generation capacity of no less than 2 GW.[43]

Iraq's Nationally Determined Contributions (NDC) document, announced in 2021, highlights the Cabinet's Decision No. 312 of 2021, which mandates the Ministry of Electricity to develop a plan for implementing a solar power project with a production capacity of 7.5 GW. This plan aligns with economic models that consider international standards and rapid technological advancements in solar energy. The solar energy industry is making significant progress in both technology and cost efficiency. The Council of Ministers has also issued a decision to set a roadmap for achieving 12 GW of solar energy between 2020 and 2030.

Iraq aspires to integrate its electricity sector into its national efforts to reduce emissions, as outlined in the NDC. Table 1-2 shows that the country aims to increase the share of clean, sustainable, and

43 Agreement to Implement Solar Power Stations with a Capacity of 2000 Megawatts in Iraq. (solarabic.com)

renewable energy sources in total energy production, with specific targets outlined in its long-term planning.[44]

Table 1-2: Ministry of Electricity's Plan for Transitioning to Clean, Renewable, and Sustainable Energy in Electricity Generation.

Indicators	Basic Values	Roadmap		
		2025	2027	2030
Percentage (%) of renewable energy (solar, hydro) in the total energy mix	2	4.8	5.6	6.3
Percentage (%) dependence on natural gas in the fuel mix in the electricity sector	69*	65	56	55
Percentage (%) of production for both public and private sectors associated with the use of natural gas	59**	72	65	64
Percentage (%) of energy production through low-carbon electricity generation technologies	18***	23	33	53

Base value adopted from 2023*
Base value adopted from 2019**
Base value adopted from 2018***

1.11.5 TOOLS TO ENHANCE THE USE OF SOLAR ENERGY

Iraq enjoys high levels of solar irradiation, reaching up to 1899 kWh/m² in areas like Al-Muthanna and Al-Anbar. With the growing demand for electricity, the Iraqi government is increasingly focusing on solar energy. Since 2019, the government has been developing technical and financial mechanisms to enable citizens to access small loans for purchasing and installing solar power units on their rooftops. Additionally, technical surveys have been conducted on several government buildings to assess their suitability for installing solar panels for energy generation. The Ministry of Finance and the Central Bank of Iraq have also created a mechanism to provide concessional loans with an interest rate of no more than 1% to finance investments in solar energy.[45]The Iraqi government encourages investors in renewable energy through decisions that exempt the import of renewable energy equipment from taxes by 99%. Companies awarded projects are handled according to the Iraqi Investment Law No. 13 of 2006.[46] This allows them to use government land for free and benefit from reduced customs fees. The Ministry of Finance provides credit guarantees to private sector companies, resulting in a total installed capacity of 3000 MW from clean energy projects. Iraq is also prepared to exempt workers in this sector from security service fees to support the production of clean and renewable energy.

1.12 INDUSTRIAL SECTOR

The Ministry of Industry and Minerals classifies its companies and factories into main categories based on their operational status and sector: chemical and petrochemical, engineering, food and

44 The Iraqi Ministry of Electricity Plan in accordance with the National Environmental Protection Strategy until 2030.
45 The Central Bank of Iraq sets the interest rate for solar energy system loans at only 1% (solarabic.com)
46 The Investment Law No amended.docx (investpromo.gov.iq)

pharmaceutical, textile, construction, industrial services, and mixed-sector companies. In 2021, the total number of companies was 42, with 225 factories under its supervision. The engineering sector had the largest share, with 15 companies and 77 factories, of which 31.1% of the factories were non-operational.[47] Iraq suffers from weak infrastructure supporting industry, which has negatively impacted the industrial sector. The technological challenges and lack of alignment with the Paris Agreement require support for the sector's development. The industrial sector can address youth unemployment if it is developed, investments are encouraged, and incentives are provided to investors.

1.13 THE ECONOMIC SECTOR

Iraq is classified as a high-middle-income country, with its economy heavily reliant on oil. Before 2014, the economy grew due to rising oil prices and increased production, with oil accounting for 97% of budget revenues in 2013. However, the decline in oil prices and crises such as ISIS terrorism led to an economic downturn in 2015 and 2016. In 2018, 21% of spending was allocated to security and defense, impacting non-oil infrastructure.

Economic damages in Iraqi cities are estimated at $45.7 billion[48], with $16 billion (35%) in the housing sector and $7 billion (15.3%) in the energy sector. Despite this, GDP grew by 13.3% in 2018 and increased by 1.3% in 2021, driven by the non-oil sector. Iraq suffers from a weak production structure and reliance on oil, requiring diversification of income sources. According to the 2021 report, poverty rates increased due to the devaluation of the dinar and rising food prices, potentially increasing the number of poor people in the country.

The economic situation is witnessing a rise in external debt, reaching $23 billion in 2020, along with an increase in unemployment, surpassing 10% in early 2021 compared to pre-COVID-19 levels. There are growing concerns about food security despite the increase in the number of households benefiting from social welfare provided by the government, as well as efforts to provide vaccines to prevent the spread of COVID-19. The economic situation is also marked by weak technological capabilities, instability, and the lack of a strong private sector that has not fulfilled its role for extended periods.

Countries are moving towards renewable energy and reducing reliance on fossil fuels in response to the UNFCCC and the Paris Agreement, which may lead to a decrease in global oil prices, affecting Iraq's ability to recover and face the risks of climate change. Furthermore, redirecting most resources towards the health sector to combat the COVID-19 pandemic may exacerbate the difficulty of improving the economic situation.

According to a joint report by the World Bank and FAO in 2021, [49] poverty in Iraq increased by 7-14% after the government's decision to devalue the dinar. This decision could raise the number of poor people in the country by 2.7-5.5 million Iraqis, in addition to approximately 6.9 million poor people before the COVID-19 crisis, with the poverty rate in Iraq reaching 40% of the population in 2020. It is clear that the Iraqi economy needs to diversify its income sources and address climate challenges to improve living conditions and economic stability.

47Environmental Statistics for Iraq (Industrial Sector) for the year 2021, Ministry of Planning - Central Statistical Organization 2022.
48 United Nations High Commissioner for Refugees, 2020
49The joint report issued by the Food and Agriculture Organization (FAO), the World Food Program (WFP), and the World Bank in 2021.

1.13.1 DIVERSIFICATION OF NATIONAL ECONOMY SOURCES

Iraq, through its NDCs to the Paris Agreement, aims to achieve economic security by diversifying its economy and creating a resilient, low-carbon, and climate-friendly economy. To achieve this, the government must strengthen real partnerships between the private and public sectors and encourage the private sector to become a partner in achieving national contributions. This requires reviewing and developing economic strategies to increase the income of Iraqi households. Resilient and inclusive economic growth requires structural reforms to improve resource allocation, recover electricity costs, mobilize local revenues, enhance the business environment, and secure private investments. These reforms are essential to mitigate the impacts of climate change and meet Iraq's investment needs. The tourism sector is promising, especially in the Kurdistan Region, thanks to growing tourism and good infrastructure. This sector should be utilized in diversifying the economy and promoting green investments, as the number of tourists has significantly increased in recent years, indicating the growth of this sector.

1.14 TRANSPORTATION SECTOR

The transport sector is one of the main contributors to the national economy in Iraq, as it plays a vital role in achieving economic progress by expanding markets and better utilizing resources. The transport system in Iraq includes railways, highways, waterways, ports, airports, and airlines. The Arabian Gulf is Iraq’s maritime gateway to the world, with a coastline of about 58 kilometers, in addition to the Tigris and Euphrates rivers which run through the country from north to south.[50]

The responsibility for managing transport lies with the Ministry of Transport, which includes several departments and formations. The transport sector suffers from the poor and outdated infrastructure, due to a lack of laws and projects that support the shift toward sustainable and environmentally friendly transport. This sector heavily relies on private transport, and there is no emission testing system for vehicle exhausts.[51] There is a need for actions to develop public transport and reduce pollution and CO_2 emissions, including transitioning to hybrid and electric vehicles as part of Iraq's commitment to the Paris Agreement.[52]

1.15 ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

The Human Development Index (HDI) report ranked Iraq 123rd out of 189 countries in 2020, down from 120th in 2019. This decline in ranking was due to a drop in the Human Development Index from 0.689 in 2019 to 0.674 in 2020. [53] Challenges arising from instability, financial distress, and the COVID-19 pandemic led to setbacks in achieving sustainable development goals.

Iraq’s Vision 2030 aims for future development and includes the implementation of sustainable development goals through investment in national capabilities. Achieving success requires the involvement of the private sector and civil society organizations. A National Committee for Sustainable Development, chaired by the Minister of Planning, was formed to monitor progress and report on the country’s development.

50 The first National Communication report for Iraq submitted to the United Nations Framework Convention on Climate Change for the years 2015-2016.
51 National Strategy and Action Plan to Reduce Environmental Pollution (NSEPRAP) (2022-2030) - Iraqi Ministry of Environment
52 Nationally Determined Contributions (NDCs) for Iraq on Climate Change - 2021
53 Iraq Ministry of Planning (2021). Iraq and the path back to development. The Second National Voluntary Review Report on the Achievement of the Sustainable Development Goals. National Committee for Sustainable Development

Achieving goals related to reconstruction, improving services, and supporting environmental sustainability is critical for sustainable development. The United Nations Country Team assists the government in addressing challenges and aligning national development goals with sustainable development objectives.

Despite some progress in sustainable development indicators between 2018 and 2020, the government faces significant challenges in integrating the sustainable development goals into national development plans and addressing funding gaps. International support remains necessary to combat poverty, unemployment, and climate change risks. Iraq faces major challenges in achieving nine sustainable development goals (2, 3, 5, 8, 9, 10, 14, 15, 16) and significant challenges in three others (4, 6, 11), while challenges persist in achieving five goals (1, 7, 12, 13, 17).[54] The Iraqi National Development Plan includes economic, financial, tax, and trade reforms to achieve decent work, economic growth, industrial development, and responsible production and consumption.[55]

1.16 Environmental Legislation

The Environmental Protection and Improvement Law No. 76 of 1986 is the first environmental law in Iraq. It was followed by Law No. 3 of 1997 and the currently effective Law No. 27 of 2009, which transformed the "Environmental Protection and Improvement Council" into an "Advisory Body" and assigned the environmental protection responsibilities to the Ministry of Environment under Law No. 37 of 2008. The Ministry of Environment has formed ministerial committees to amend the laws and intends to prepare specific legislation on climate change to fill legal gaps.

The new laws under development include:

- Law on the Management of Municipal Solid Waste.
- Law on Sustainable Transport.
- Law on Regulating Renewable Energy.
- Law on the Environmental Protection and Improvement Authority in the Kurdistan Region No. 3 of 2010.
- Law on Environmental Protection and Improvement in the Kurdistan Region No. 8 of 2008.

There is a need to strengthen legal and legislative capacities in Iraq to review and update national laws and incorporate climate change issues within the first five years of implementing the national contribution.

1.17 Education

The COVID-19 pandemic deprived over 11 million children of face-to-face education during 25 weeks between 2020 and 2021. Despite introducing alternative learning methods, many students were unable to benefit due to lack of internet access. To support continued learning, UN agencies collaborated with the Ministry of Education to produce video lectures and broadcast them through the educational television channel. The Ministry of Education in the Kurdistan Regional Government also worked to improve e-learning capabilities, and UNICEF focused on enhancing the quality of remote teaching.
The Iraqi government spends about 9% of government expenditure and 1.3% of GDP on education, which is below international standards. There is a shortage and/or inefficiency in the allocation of

54 The Second Voluntary National Review of Sustainable Development Goals for the year 2021 - Iraq, and Returning to the Development Track - Ministry of Planning - National Committee for Sustainable Development
55 The Iraqi National Development Plan 2018-2022 - Ministry of Planning

teaching staff, textbooks, educational materials, and a reliable education management information system to support ongoing planning .[56]

The education sector suffers from a significant decline in school environments, infrastructure, and a shortage of schools and laboratories, leading to a decline in student performance and some Iraqi universities falling out of global rankings. There is an urgent need to revitalize this sector through:

- Designing plans that align with sustainable development goals.
- Improving school and university infrastructure.
- Increasing spending on education and improving services.
- Incorporating climate change topics into curricula.
- Providing opportunities for graduate students on climate change topics.

1.18 Awareness

Environmental awareness is essential for climate action, aiming to spread and deepen environmental concepts among all segments of society to encourage participation in environmental protection. The impacts of climate change present a significant problem, requiring community actions that support the efforts of the state. The public must be made aware of the importance of the environment, and awareness strategies should be developed to help them face climate change.
The National Human Rights Plan for Iraq (2021-2025) emphasizes the right to a clean and sustainable environment, with a focus on effective water resource management. However, the plan lacks clear references to raising awareness about the risks of climate change. Therefore, it should be updated to include:

- Measuring the impacts of climate shocks on human environmental security indicators.
- Environmental issues and climate action that are human rights-sensitive.
- Linking the strategy to the Sustainable Development Goals and Iraq's Vision 2030.
- Ensuring mechanisms to coordinate institutional efforts and civil society to enhance environmental rights.

1.19 TECHNOLOGY TRANSFER

Addressing climate change depends on economic growth that aligns with environmental standards and international regulations. Green technologies can be utilized to produce alternative energy and use eco-friendly equipment in transportation, agriculture, and other sectors. These technologies contribute to achieving the goals of the United Nations Climate Change Agreement and reducing emissions.

Although Iraq is not historically responsible for climate change, it is significantly affected due to its geographical location and exceptional circumstances, which calls for international support to transfer clean technologies. Iraq has previously presented a list of technologies suitable for reducing greenhouse gas emissions in several key sectors as part of its first national communication. A list of suitable technologies for emission reduction in key sectors has been prepared in collaboration with the United Nations Industrial Development Organization and the Climate Technology Centre and Network. The project is in its final phase and will influence policies and investments to achieve climate goals for the period 2020-2030.

56 United Nations Common Country Analysis for 2022 - UN in Iraq.

Priorities have been set for four sectors: energy, industry, agriculture, and water resources, to develop the necessary technologies. The technological needs assessment process will result in concrete proposals to strengthen national programs and achieve sustainable development. Engaging the private sector is crucial to establishing a circular green economy based on the recovery and recycling of natural resources.

1.20 EQUALITY BETWEEN MEN AND WOMEN

The 2005 Iraqi Constitution guarantees equality for all Iraqis before the law and prohibits discrimination based on gender. The constitution provides guarantees for women's rights, including the right to vote and run for office, and Iraq has ratified the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) with some reservations. Iraqi women make up half of the population, with one in every ten households being headed by a woman. They face poverty, lack of access to education, and decent employment opportunities. According to World Bank data, women's representation in the workforce in 2017 was 2% in sectors related to the oil industry compared to 21.7% for men. Additionally, 18.1% of economically active females were under the age of 15, compared to 74.1% for males. Furthermore, only 3.9% of women work outside the industrial sector, mostly in oil-related industries, compared to 23.4% for men. Women are more active in agriculture, but they mostly work in informal sectors with weak social coverage, which constitutes 43.9%, compared to 12.3% for men. The unemployment rate for young women is double that of young men, with 56% of young women being unemployed in 2017, compared to 29% for young men. Displaced women in Iraq, in particular, face domestic violence and are often in vulnerable positions. Female-headed households make up approximately 13% of displaced families, and this demographic is highly exposed to risks, as they must manage household responsibilities and engage with men outside the family or sectors traditionally dominated by men. [57]

Women are also among the most vulnerable groups to the effects of climate change, as they are disproportionately affected due to gender inequality. Equality between men and women is a key factor in achieving sustainable development goals, the Iraqi constitution emphasizes this, necessitating its inclusion in national development documents, which all stress the principle of eliminating all forms of discrimination against women and promoting equality.

Iraq was the first country in the region to develop a plan to implement UN Security Council Resolution 1325 on the empowerment and protection of women. The national strategy to combat violence against women (2013-2017) included increasing women's participation in decision-making and aligning legislation with international standards. The Human Rights Plan (2021-2025) emphasizes women's participation in climate-related legislation. In 2017, the Directorate for Women's Empowerment was established to coordinate with government institutions and support equality between men and women. The 2018 elections saw unprecedented participation from women, with women winning 25.5% of the seats. In the Kurdistan Region, the "Women's Peace Group" was established to promote women's participation in decision-making. The Ministry of Environment established the "Women for a Safe and Green Iraq" group in 2018 to ensure an environment that responds to women's needs. Iraq has issued a comprehensive document on the role of women in climate action, accompanying it with a nationally determined contributions document towards the Paris Agreement, and has developed a plan to achieve equality between men and women in addressing the impacts of climate change.

57 The Joint Country Analysis Report - United Nations Mission 2021 - CCA

1.21 YOUTH INVOLVEMENT

Climate change has significant impacts on Iraq's economy, water security, and food security. The climatic effects affect various segments of society, including the youth, which is the largest demographic group. As a result, individuals in this group, along with those below the age of youth, will face challenges imposed by climate change, which will make it harder for them to secure their livelihood, maintain their health, and protect their rights, growth, and development. The situation is further worsened by rising poverty rates and widespread unemployment among these two groups. Iraq is working to strengthen its efforts to empower youth and encourage investment in environmentally friendly technology. The number of young people is expected to increase from 8 million in 2021 to 11 million in 2050.[58]

The Iraqi Youth Vision for 2030, developed by the Ministry of Youth and Sports in September 2021, emphasizes that the state guarantees the development and implementation of sustainable national policies and effective programs to manage environmental changes and address their environmental and health impacts, with broad institutional and community participation from the perspective of sustainable development. It also aims to promote a culture of environmental preservation and enhance volunteer work in these areas, incorporating environmental topics into youth interests. [59]

Strategic plans must be developed to build the capacities of young people and encourage them to adopt environmentally friendly technologies. Iraq is working on a comprehensive plan to integrate youth into climate action. It was decided to form a national youth team for climate change and select 1,000 young volunteers to support efforts to combat climate change. The Ministry of Environment, in cooperation with international organizations, is involving Iraqi youth in the COP28 conference. A national competition for youth programs will be launched to select 100 programs and initiatives. The Ministry of Environment plans to organize a simulation of the COP29 conference in Baghdad to activate youth participation.

1.22 FINANCIAL NEEDS

Addressing climate change requires developed countries to reduce their emissions to achieve the goals of the Paris Agreement and prevent global temperature rise by more than 1.5°C. In this context, Iraq seeks to achieve its climate goals by prioritizing the development of the electricity sector and investing in renewable energy worth up to 12,000 megawatts based on the economic decisions of the Cabinet in 2021. Iraq cannot achieve the goals outlined in its Nationally Determined Contributions without[60]

- Achieving comprehensive and complete peace across the nation, enabling companies and individuals to invest in Iraq without obstacles.
- International financial support of $100 billion according to the timeline indicated in this document in the form of grants and localization of sustainable investment in both the public and private sectors.
- Supporting innovation and the transfer of environmentally-friendly technologies that align with national needs.
- Stabilizing the oil market in particular to ensure the national economy is not volatile, enabling the achievement of development plans in line with sustainable development goals and contributing to diversifying the economy’s sources.

58 Ali Abdulameer Sajit, Shakir Mahmoud Ayal, Youth Unemployment in Iraq - Disparity and Analysis - Geographic Research Journal - College of Education - University of Kufa - Issue (27) 2018 - United Nations - ESCWA
59 Vision of Iraqi Youth 2030 - Ministry of Youth and Sports - September 30, 2021.
60 Iraq's Nationally Determined Contributions (NDC) document on Climate Change - 2021.

- Building the capacity of national human resources to enable them to keep pace with modern and environmentally-friendly technological developments.
- Supporting efforts to reduce emissions in sectors and technologies that are suitable for the national circumstances and interests in a balanced manner, without discrimination between technologies or sectors in terms of international financial and technical support.
- Supporting the institutional structures working on climate change issues to enable them to formulate and implement climate policies and make national decisions that align with international requirements to ensure the transparent implementation of this document.

The priorities outlined in the National Contribution Document include capacity building, developing institutional structures, and joining carbon markets to achieve sustainable development. The Technology Needs Assessment document identifies Iraq's financial needs at $70 million across four sectors: energy, industry, water, and agriculture, to ensure a secure technological shift towards modern, environmentally-friendly, and low-carbon technologies.[61] The World Bank report for 2022 states that Iraq needs $233 billion by 2040 to address urgent development gaps and ensure a green and inclusive growth path as outlined in Table 1-3.

The green transition[62] requires institutional capacity building, financial sector support, gap analysis in institutional capacities and governance, developing a climate finance strategy, intensive training for personnel working on these files, and capacity building for market participants, including banks and financial institutions. It also requires the issuance of a national guideline and regulatory framework for determining and monitoring climate-related risks. Moreover, innovative financial instruments need to be strengthened, and renewable energy sources must be diversified.

Iraq's financial needs will exceed $100 billion, as announced in its National Contribution Document, to implement the policies and strategies outlined within it. This takes into account the needs for basic infrastructure, technological transformation, capacity building, and legal and institutional frameworks to create a conducive and enabling investment environment for the transition to a sustainable green economy. In this context, a study on public spending was prepared by the UNEP in collaboration with the Ministry of Environment and relevant ministries, within the framework of the activities listed in the ongoing National Adaptation Plan. The aim is to evaluate the effectiveness of adaptation solutions to climate change impacts and understand the roles assigned to each entity, identifying the allocated spending to address climate change impacts across various sectors. This also aims to enlighten decision-makers on the best ways to finance climate action and establish a baseline and a starting point for enhancing efforts to implement climate change adaptation measures.

To view the allocated spending for adaptation in the overall national budget, Table (1-3) shows the expenditures related to adaptation in the agriculture and water sectors over three years.[63]

61 Document of Technological Needs Assessment (to be issued soon after approval).
62 Climate and Development Report - World Bank Middle East and North Africa Region - Iraq - December 2022.
63 Climate Public Expenditure and Institutional Review conducted by the United Nations Environment Program in collaboration with the Ministry of Environment and related ministries - 2022.

Table 1-3: Summary of Financial Needs for Implementing the National Contributions Document (World Bank, 2022)

Safe and high-impact investments	Billions of Dollars by 2040
Rehabilitation of water infrastructure and irrigation network	42
Non-infrastructure investment in agriculture and water sectors	6
Reducing gas flaring and its utilization in energy production	29
Adopting a cost-effective carbon removal scenario in the energy sector	63
Repairing the electricity grid	52
Adopting an ambitious high-carbon transport path	31
Total	233

Table 1-4 illustrates the expenditures related to adaptation in the agriculture and water sectors over three years.[64] Despite the economic challenges, the 2023-2025 national budget has allocated funds to address water scarcity and develop renewable energy. However, international financing and support are crucial to implement the NDCs document and achieve the transition towards a low-carbon economy.

Table 1-4: Total Expenditure on Climate Change Adaptation during the Years 2017, 2018, and 2019

Actual Spending (Million IQD)	2017	2018	2019
Agriculture Sector	5.784	3.757	7.830
Water Sector	166.303	105.802	233.644

64 Climate Public Expenditure and Institutional Review conducted by the United Nations Environment Program in collaboration with the Ministry of Environment and related ministries - 2022.

CHAPTER 2

INVENTORY OF GREENHOUSE GASES

2. INVENTORY OF GREENHOUSE GASES

Greenhouse gas (GHG) inventories and their removals were prepared for the year 2000 in accordance with Decision No. 17 of the Eighth Conference of the Parties. This chapter addresses emissions of carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), sulfur hexafluoride (SF6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs).

2.1 METHODOLOGY

National emissions for the year 2000 were estimated using the guidelines of the Intergovernmental Panel on Climate Change (IPCC) for 2006 and the 2019 revision, along with the programming for parties not included in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC), as well as a working paper on the use of the Excel program to calculate volatile emissions. Indirect GHG emissions resulting from various sectors were estimated using the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019.

National experts used Tier 1 for all sectors due to the unavailability of necessary data for higher tiers. The sectors and sub-sectors considered include:

1. Energy:
    - Combustion in stationary and mobile sources
    - Volatile emissions
2. Industrial Processes and Product Use (IPPU):
    - Mining, chemical, and metal industries
    - Non-energy products and solvent use
3. Agriculture, Forestry, and Other Land Use (AFOLU):
    - Livestock
    - Land
    - Total sources and non-CO2 emissions sources
4. Waste Management and Sewage (Waste):
    - Solid waste disposal
    - Systematic and open waste burning
    - Wastewater treatment and discharge

Emissions from all sectors for 2000 were estimated using the guidelines, with an inventory for each gas separately using mass units. Estimates of GHG emissions directly resulting from human activities were evaluated for carbon dioxide, methane, and nitrous oxide, according to sources and removal points. Indirect greenhouse gases, such as non-methane volatile organic compounds, nitrogen oxides, and carbon monoxide for the energy sector, were estimated using the guidelines outlined in the EMEP/EEA 2019 document. The codes NO (Not Occurring), NE (Not Estimated), and NA (Not Applicable) were used in the reporting tables of the inventory results. Emissions were estimated in gigagrams for all direct and indirect gases, and in gigagrams of CO_2 equivalent for direct gases. To convert between these units, the global warming potential values from the second assessment report of the IPCC (100-year time horizon) were used, as per Decision (8/COP 17).

2.2 GREENHOUSE GAS INVENTORY BY SECTOR

According to the total GHG inventory estimates, Iraq contributed 87,412.64 gigagrams of CO_2 equivalent in 2000. The energy sector was the main source, accounting for 87.64% of total emissions, followed by the waste management and sewage sector at 5.75%. Figure 2-1 shows the national GHG emissions by sector in 2000.

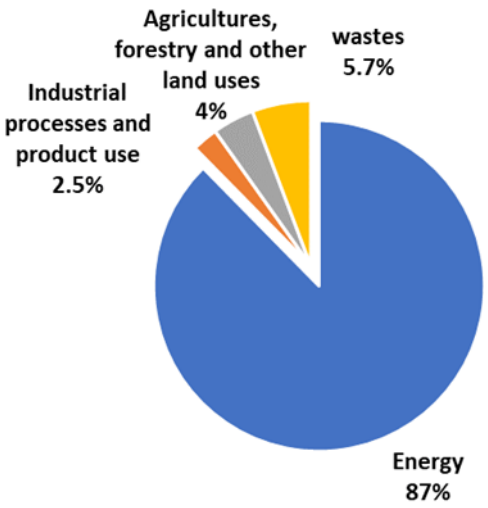


Figure 2-1: Net Greenhouse Gas Emissions (%) by Sector, 2000

2.3 ENERGY SECTOR

Energy-related activities accounted for the largest share of GHG emissions in Iraq, classified into emissions resulting from fuel combustion and volatile emissions (non-combustion). The total emissions from the energy sector were 76,606.86 gigagrams of CO_2 equivalent in 2000, with 79% resulting from fuel combustion and 21% from volatile emissions (oil and natural gas), as shown in Table 2-1. Within fuel combustion activities, the main emissions came from the energy industries and manufacturing and construction sectors, contributing 38% and 24%, respectively. Emissions from other sectors (household, commercial, agricultural) and the transport sector accounted for 20% and 18%, respectively.

Table 2-1: Net emissions for the energy sector, 2000 (gigagrams of CO_2 equivalent)

Categories	CO_2	CH_4	N_2O	Total Energy Sector Emission	NO_x	CO	NMVOC
	gigagrams	Gigagrams of CO_2 equivalent				gigagrams	
Energy Sector	66859.67	9465.63	6281.5	76606.86	156.74	300.73	259.86
1. Fuel Combustion Activities	59785.23	128.56	249.05	60162.84	156.74	300.73	148.1
- Energy Industries-	223089.3	215.4	40.92	23145.66	24.97	5.44	0.48
-Manufacturing Industries and construction	114172.1	4.21	433.6	614209.9	92.55	12.25	4.86
-Transportation	910318.4	79.38	153.06	310550.9	39.09	275.21	42.54
-Other sectors (Residential)	12205.32	729.5	321.4	212256.3	0.13	7.83	0.22
-Unspecified	NE	NE	NE	NE	NE	NE	NE
2 .Volatile emissions (oil and natural gas)	47074.4	9337.07	32.51	16444.16	NA	NA	211.75

2.4 INTERNATIONAL NAVIGATION

According to decision 8 at COP 17 (to the extent possible), and if detailed data is available, non-Annex I parties should report their emissions arising from international aviation and maritime sectors separately in their inventories. Emission estimates from these sources should not be included in national totals and should only be reported as informational items. The estimated emissions are shown in Table 2-2.

Table 2-2: Emissions Reported under note 5, year 2000

Emissions	Net CO_2 gigagrams	CH_4	N_2O	Total Emissions
		(gigagrams of CO_2 equivalent)		
International Navigation (Maritime)	9.66	0.02	0.08	9.75
International Aviation	NE	NE	NE	NE

2.5 INDUSTRIAL PROCESSES AND PRODUCT USE

The emissions from the industrial processes sector in 2000 amounted to approximately 2,218.41 gigagrams of CO_2 equivalent, representing 2.54% of total GHG emissions. These emissions were primarily generated by the chemical and mining industries within the public sector only, due to the lack of data from the private sector, as shown in Figure 2-2.

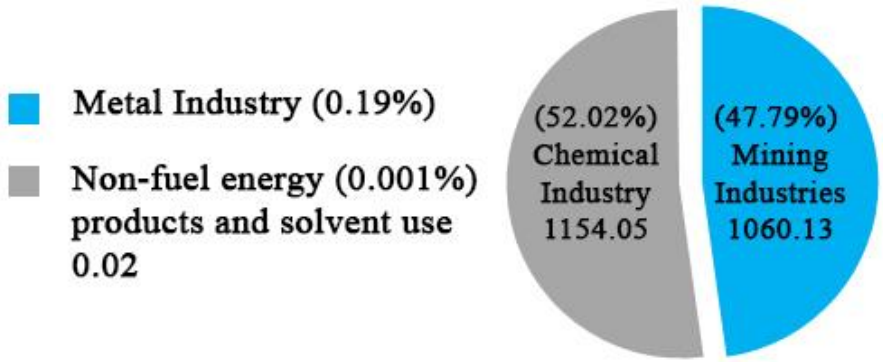


Figure 2-2: The emissions from industrial sub-sectors in 2000 in gigagrams of CO_2 equivalent

2.6 AGRICULTURE, FORESTRY, AND OTHER LAND USE SECTORS

GHG emissions from activities in agriculture, forestry, and other land use sectors accounted for 4.08% (3,564.42 gigagrams of CO_2 equivalent) of total GHG emissions in 2000, making it a significant source of emissions. The emissions consist of methane and nitrous oxide, generated by different sub-categories as shown in Table 2-3.

Table 2-3: Emissions from the agriculture, forestry, and other land use sectors in 2000 (gigagrams of CO_2 equivalent)

Sector	Net CO_2	CH_4	N_2O	Total Sector Emissions
	Gigagrams	Gigagrams of CO_2 equivalent		
AFOLU	-2630.63	3806.55	2388.44	3564.42
Livestock and Manure Management	NA	3681.65	644.69	4326.34
Land Use	-2598.57	NA	NA	-2598.57
Total Sources and Non-CO2 Emissions on Land	164.54	124.90	1743.75	2033.19
Other Sources	-196.6	NO	NO	-196

2.7 WASTE MANAGEMENT AND WASTEWATER SECTORS

GHG emissions from the waste management and wastewater sectors in 2000 totaled approximately 5,023.02 gigagrams of CO_2 equivalent, representing 6% of total GHG emissions. Most of these emissions were due to municipal solid waste, which accounted for 87% of the sector's total emissions, while wastewater treatment contributed 12% of the sector's total emissions, as shown in Table 2-4.

Table 2-4: Emissions from the waste management and wastewater sectors in 2000 (gigagrams of CO_2 equivalent)

Sector	CO_2	CH_4	N_2O	Total Emissions	%
	Gigagram	Gigagrams of CO2 equivalent			
Waste management and wastewater	11.61	4695.87	315.54	5023.02	100
Solid Waste Disposal	NA	4344.92	NA	4344.92	87
Open Waste Burning	11.61	35.12	9.33	56.06	1
Wastewater treatment and Disposal	NA	315.82	306.21	622.03	12

2.8 INVENTORY OF GREENHOUSE GASES CLASSIFIED BY GAS TYPE

2.8.1 GREENHOUSE GAS EMISSIONS

The share of CO_2 emissions was 66,457.94 gigagrams of CO_2 equivalent in 2000, representing 76% of all GHG emissions, followed by methane at 21% (Table 2-5). In 2000, the majority of net CO_2 emissions came from the energy sector at 100.6%, followed by the industrial processes and product use sector at 3.34%, while the agriculture and forestry sector contributed -3.96%. The highest methane emissions were in the energy sector, followed by the waste management and wastewater sectors, with their contributions being 52.68% and 26.13%, respectively. Nitrous oxide emissions were highest in the agriculture sector, followed by waste management and sanitation, with contributions of 80% and 10.57%, respectively (Table 2-6).

The primary emissions in the form of CO_2 were from the energy sector and the industrial processes sector, accounting for 87.28% and 99.95%, respectively. In the agriculture, forestry, and waste management sectors, methane emissions were highest due to livestock, manure management, and solid waste.

Table 2-5: National Emissions Classified by Gas Type in the Year 2000 (gigagrams of CO_2 equivalent)

GHG	Total Net GHG Emissions (Gigagrams of CO_2 equivalent)	% emissions
Carbon Dioxide	66,457.94	76
Methane	17,969.18	21
Nitrous Oxide	2,985.53	3
Net Emissions	87,412.64	

Table 2-6: Greenhouse Gas Emissions (+) and Removal Processes (-) in Gigagrams of CO_2 Equivalent by Sector and Gas in 2000

Sector	CO_2	CH_4	N_2O	Net emission
	Gigagrams	Gigagrams of CO_2 equivalent		
total net national GHG emissions	66457.94	17969.18	2985.53	87412.64
Energy Sector	66859.67	9465.64	281.56	76606.87
IPPU	2217.29	1.12	NA	2218.41
AFOLU	-2630.63	3806.55	2388.44	5782.77
Waste	11.61	4695.87	315.54	5023.02

2.8.2 TOTAL NATIONAL NET EMISSIONS

Table 2-7 shows the total emissions from all sectors and sub-sectors in 2000, according to the outputs of the IPCC software.

Table 2-7: Total emissions from all sectors and sub-sectors in 2000.

GHG source and sink categories: Inventory Year: 2000	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	CO Gg	NO_x (Gg)	NMVOCs (Gg)	So_x (Gg)
Total Net emissions	66501.22	855.68	9.63	NE	NE	211.76	NE
1 - Energy	66870.73	450.74	0.91	NE	NE	211.76	NE
1A - Fuel Combustion Activities	59796.29	6.12	0.80	NE	NE	NE	NE
1A1 - Energy Industries	23100.38	0.73	0.13	NE	NE	NE	NE
1A2 - Manufacturing Industries and Construction (ISIC)	14172.11	0.20	0.11	NE	NE	NE	NE
1A3 - Transport	10318.49	3.78	0.49	NE	NE	NE	NE
1A4 - Other Sectors	12205.32	1.41	0.07	NE	NE	NE	NE
1A5 - Other	NE	NE	NE	NE	NE	NE	NE
1B - Fugitive Emissions from Fuels	7074.44	444.62	0.10	NE /NO	/NO NE	211.76	/NO NE
1B1 - Solid Fuels	NO	NO	NO	NO	NO	NO	NO
1B2 - Oil and Natural Gas	7074.44	444.62	0.10	NE	NE	211.76	NE
2 - Industrial Processes	2217.46	0.05	NA	NE	NE	NE	NE
2A - Mineral Products	1060.12	NA	NA	NA	NA	NA	NA
2B - Chemical Industry	1153.10	0.05	NA	NE	NE	NE	NE
2C - Metal Production	4.22	NA	NA	NA	NA	NA	NA
2D - Other Production [1]	NA	NA		NA	NA	NA	NA
2E - Production of Halocarbons and Sulphur Hexafluoride				NO	NO	NO	NO
2F - Consumption of Halocarbons and Sulphur Hexafluoride				NO	NO	NO	NO
2G - Other (please specify)	0.02	NA	NA	NA	NA	NA	NA
3 - Solvent and Other Product Use	NO	NO	NO	NO	NO	NO	NO
4 - Agriculture		175.32	7.70	NA	NA	NA	NA
4A - Enteric Fermentation		168.80		NA	NA	NA	NA
4B - Manure Management		6.52	3.05	NA	NA	NA	NA
4C - Rice Cultivation		NO		NO	NO	NO	NO
4D - Agricultural Soils			4.65	NA	NA	NA	NA
4E - Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO
4F - Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO
4G - Other (please specify)				NO	NO	NO	NO
5 - Land-Use Change & Forestry	-2598.57	NO	NO	NO	NO	NO	NO
5A - Changes in Forest and Other Woody Biomass Stocks	-2598.57			NA	NA	NA	NA
5B - Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO

GHG source and sink categories: Inventory Year: 2000	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	CO Gg	NO_x (Gg)	NMVOCs (Gg)	So_x (Gg)
5C - Abandonment of Managed Lands	NO			NO	NO	NO	NO
5D - CO_2 Emissions and Removals from Soil	NO		NO	NO	NO	NO	NO
5E - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
6 - Waste	11.61	223.61	1.02	NE	NE	NE	NA
6A - Solid Waste Disposal on Land		206.90		NE	NE	NE	NA
6B - Wastewater Handling		15.04	0.99	NE	NE	NE	NA
6C - Waste Incineration	NE	NE	NE	NE	NE	NE	NA
6D - Other (please specify)	11.61	1.67	0.03	NE	NE	NE	NA
7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
Memo Items							
International Bunkers	9.66	0.00	0.00	NE	NE	NE	NE

2.9 THE REFERENCE APPROACH

The reference approach was used to calculate the emissions from the energy sector in 2000, and its results were compared with the sectoral approach. The gap between the two approaches was expected to be relatively narrow (5% or less), but in Iraq's case, the gap reached 16.75%, which is higher than the acceptable margin due to the country's conditions and instability following the 2003 war, leading to the loss of some data and difficulty in verifying its accuracy (Figure 2-3).

GHG emissions were estimated using the reference approach for the time series (2000-2004), resulting in varying trends. In the years prior to 2004, there was a noticeable increase in emissions due to the unavailability of data on oil stock quantities, which led to considering the stock as fully consumed. However, in 2004, it was found that emissions significantly decreased after data on oil stock levels became available, with the Ministry of Oil reporting a stock of 1,768,467,000 barrels (Figure 2-4).

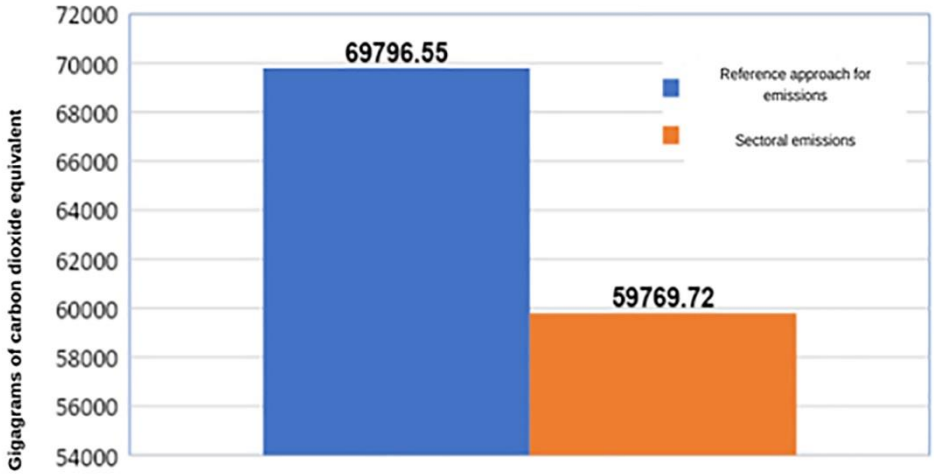


Figure 2-3: Reference Approach versus Sectoral Approach, 2000

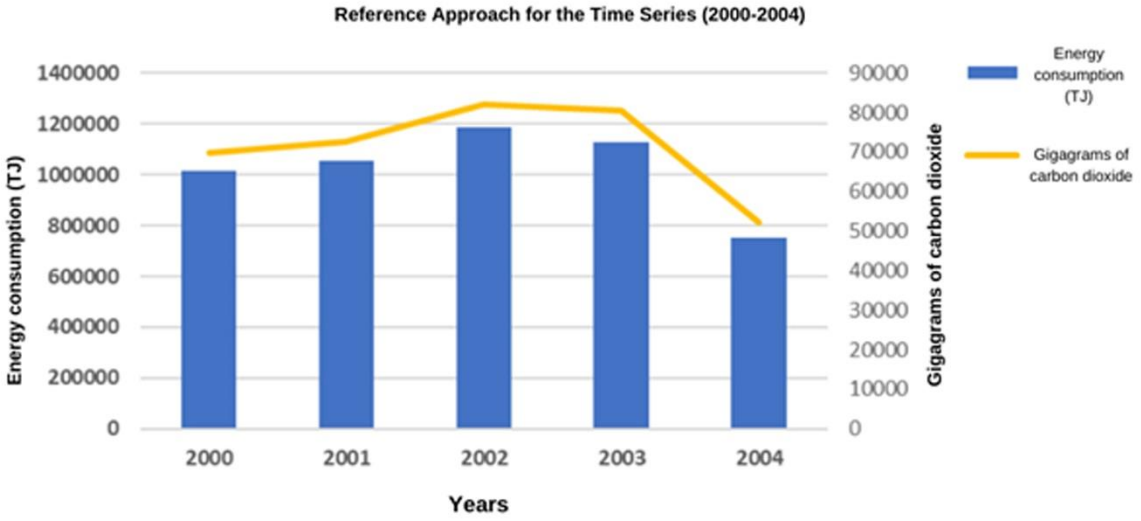


Figure 2-4: Reference Approach for the Time Series (2000-2005)

2.10 ANALYSIS OF MAJOR CATEGORIES

The analysis of key categories is a fundamental element for developing the inventory and a crucial factor for improving its quality. The analysis was conducted based on the IPCC 2006 Guidelines, where Iraq used the "Level Assessment" methodology to calculate the contribution of each category from a source or sink point to the total national inventory. According to the guidelines, the key categories are ranked in descending order based on the amount of emissions, accounting for 95% of the total levels included in the assessment. Iraq aims to establish an integrated data system in collaboration with sectoral ministries to find alternatives for estimating the quantity of emissions from key categories using Tier 2 methods, within the available resources and national circumstances.

In the total national GHG emissions for 2000, various subcategories of fuel combustion activities were among the top five sources, accounting for about 76.81% of the total emissions. These include: energy industries (liquid and gaseous fuels), road transport, liquid fuel combustion in manufacturing and construction industries, and other sectors (residential, commercial, and agricultural). The subcategories of industrial processes and product use, agriculture and forestry, and waste and sewage management were the dividing point that brought Iraq to 95% of the total emissions (Table 2-8).

Table 2-8: Analysis of Main Categories (Level Assessment) for the Year 2000

A	B	C	D	F	G
category code in the IPCC guidelines	specific category from the IPCC guidelines	GHG	Emissions 2000 Gigagrams CO_2 equivalent	Emission level from a specific category 2000	Cumulative total % from the column F
1.A.1	Energy Industries - Liquid Fuels	CO_2	14777.17	0.19	19.30
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	13187.94	0.17	36.52
1.A.4	Other Sectors - Liquid Fuels	CO_2	12205.32	0.16	52.46
1.A.3.b	Road Transportation	CO_2	10318.37	0.13	65.94
1.A.1	Energy Industries - Gaseous Fuels	CO_2	8323.20	0.11	76.81
4.A	Solid Waste Disposal	CH_4	4344.92	0.06	82.48
3.A.1	Enteric Fermentation	CH_4	3544.74	0.05	87.11
3.B.1.a	Forest land Remaining Forest land	CO_2	-2598.57	0.03	90.50
2.A.1	Cement production	CO_2	1031.46	0.01	91.85
2.B.1	Ammonia Production	CO_2	1023.86	0.01	93.19
3.C.4	Direct N_2O Emissions from managed soils	N_2O	1017.92	0.01	94.52
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	984.17	0.01	95.80

2.11 UNCERTAINTY ANALYSIS

Uncertainty analysis was conducted based on the 2006 IPCC guidelines. The first approach, "Propagation of Error," was used in this analysis, which estimates the margin of uncertainty for each category by analyzing the error in trends for the 2019 data compared to the reference year of 2000. The uncertainty analysis applied the first-tier approach, which applies to all source categories and all direct greenhouse gases. The uncertainty estimation related to activity data and emission factors was based on the typical values in the IPCC guidelines.

The results of the uncertainty analysis in the software indicate that the net emissions in 2000 were 87,240 gigagrams of CO_2 equivalent, with an uncertainty range of ± 3.38%, meaning the 95% confidence interval is between (84,280.57) and (90,177.34) gigagrams of CO_2 equivalent.

2.12 QUALITY CONTROL AND AUDIT

The Royal Scientific Society of Jordan provided technical support for the preparation of the GHG inventory through training workshops, providing guidelines, and reviewing studies and reports. Support was also provided through in-person and remote meetings. The Society's team of experts, in collaboration with the project management team at the Directorate of Climate Change, conducted a comprehensive review of the sectoral reports and adjustments, ensuring accuracy, consistency, and

avoidance of double counting. They also ensured the accuracy of data, emission units, and the emission factors used, and guaranteed proper documentation and archiving of data for future review.

2.13 RECOMMENDATIONS FOR INVENTORY DEVELOPMENT IN THE COMING YEARS

The technical team of the Royal Scientific Society outlined the following recommendations according to priority:

- Short-term: Add references, documentation, and any important notes within the program.
- Short to long-term: Improve the activity data used in the estimation and provide national emission factors for the main subcategories, enhance the estimation and reporting of precursor emissions and indirect gases across all sectors, establish an integrated data system with sectoral ministries, include data from the Kurdistan region in the calculations, and improve industrial sector emissions inventory data by including both public and private sector data.

CHAPTER 3

VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

3 VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

Climate change presents a global environmental challenge and is a significant issue for a developing country like Iraq[65], which faces potential threats to food production, increased water stress, rising sea levels that could flood fields and coastal settlements, and a higher incidence of diseases. Due to a lack of resources, technology, and funding, Iraq struggles to develop strategies to reduce its exposure to climate change. In this context, the Iraqi government has identified four key sectors to assess vulnerability and determine adaptation measures: agriculture, water resources, biodiversity, and health.

This chapter evaluates the impacts of climate change on Iraq, complementing the information provided in Chapter 1, and focuses on adaptation measures in line with the United Nations Framework Convention on Climate Change and the Paris Agreement.

The study relied on the technical guidelines for assessing the impacts of climate change and adaptation issued by the Intergovernmental Panel on Climate Change (IPCC) [66], along with multiple reports and studies such as those from the International Center for Agricultural Research in the Dry Areas (ICARDA) and the Walker Institute. The results of meetings and assessments from key stakeholders in the sectors most vulnerable to climate impacts were also included.

3.1 CLIMATE TRENDS AND CLIMATE CHANGE SCENARIOS

The sixth Global Environmental Outlook report for West Asia[67] ranked Iraq as the fifth most vulnerable country in the world to climate change due to the shrinking and scarcity of its water resources, food shortages, and rising temperatures. At the level of the Middle East and North Africa, it ranked third in this regard according to a study conducted on climate change and vulnerability.[68] As a developing country, Iraq is vulnerable to the impacts of climate change, evident through its economic fragility, excessive reliance on natural resources, and severe adaptation challenges due to its security situation, poverty, instability, as well as geopolitical complexities

According to the World Bank, Iraq is more vulnerable to floods, droughts, dust storms, and climate-related epidemics. It is now widely accepted that climate change has a significant impact on disaster management efforts and poses a major threat to the efforts aimed at meeting the growing needs of the most vulnerable populations.[69] For example, women and girls are disproportionately affected by the harmful effects of climate change compared to young people and men. Additionally, the water policies of neighboring countries have exacerbated the problem by reducing the flow of water sources into Iraq. Moreover, rapid population growth, urban expansion, and inefficient water use in the agriculture and industrial sectors are increasing the demand for water.

Climate change has become a tangible reality in Iraq, and its effects are likely to be devastating unless Iraq takes the necessary measures to prevent population displacement. By the end of 2021, the International Organization for Migration reported around 20,000 displaced individuals due to water

65 Early Warning: How Iraq can adapt to climate change, Nussaibah Younis, July 2022, European council on foreign relations
66 IPCC, 1994. Technical Guidelines for Assessing Climate Change Impacts and Adaptations, University College London and Center for Global Environmental Research, London
67 Report on the Sixth Global Environmental Outlook for the West Asia Region - 2015
68 Study on Climate Change and Vulnerability Assessment - Case of Middle Eastern and North African Countries published in the International Journal of Geographic Information Science ISPRS, 2021
69 Iraq - Vulnerability | Climate Change Knowledge Portal (worldbank.org)-The World Bank (1980-2020)

scarcity, rising salinity, and deteriorating water quality across Iraq.[70] A study by the Norwegian Refugee Council also revealed that one in every 15 families in drought-affected areas of Iraq was forced to migrate in search of work.

3.1.1 CLIMATE CHANGE TRENDS ANALYSIS IN IRAQ

To describe the nature of climate change trends, a study was conducted in collaboration with ICARDA and supported by UNEP. This study utilized several types of gridded climate data. Table 3-1 and Figure 3-1 show some of the key datasets used, which vary in spatial resolution, temporal range, and temporal resolution (daily or monthly). These datasets generally consist of two types:

- Current gridded climate data, which is more reliable and developed through intensive use of monitoring data.
- Long-term gridded climate data, which was adopted to make future projections.

Considering the differences in spatial and temporal resolutions, comparisons revealed that these datasets generally agree with each other, although some inconsistencies related to the scale exist.

Table 3-1: Some of the key datasets used

Climate Data Source	Spatial Resolution	Temporal Range	Description
ERA5-ECMWF	0.25 degree	1958-2020	Available variables, monthly, and daily
TerraClimate	0.041 degree	1978-2020	Highest resolution, monthly
RICCAR	0.5 degree	1058-2100	3 GCMs daily, 2 RCPs
NASA-NEX-GDDp	0.25 degree	1958-2100	21 GCMs daily, 2 RCPs

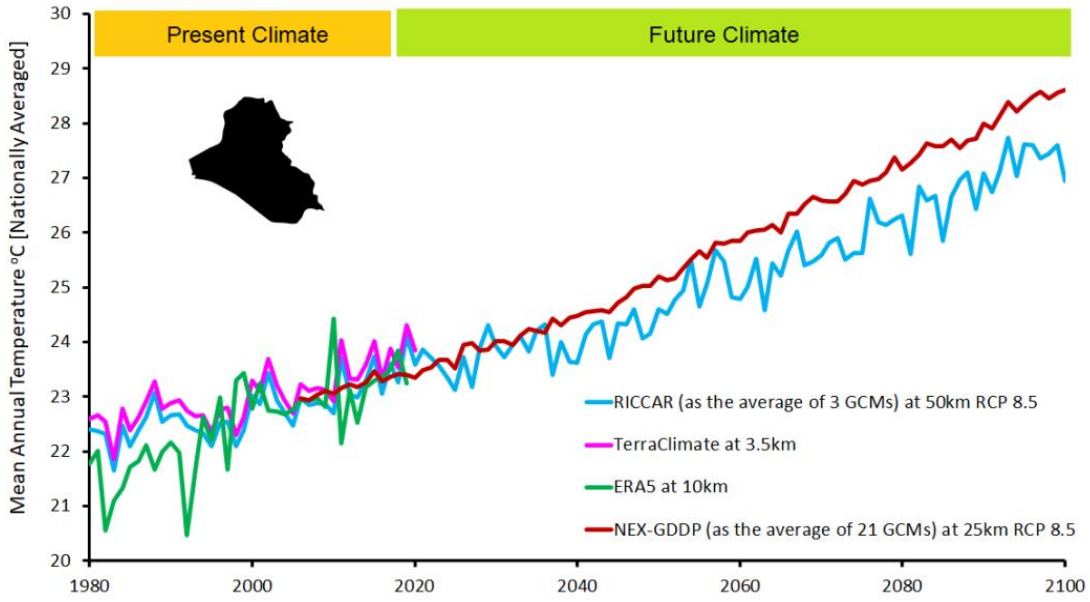


Figure 3-1 Main datasets used in this study

3.1.2 ANALYSIS CLIMATE CHANGES IN THE PRESENT TIME

The appropriate time frame to understand current climate change is relatively shorter compared to long-term climate change analysis. To understand how climate is changing currently, the European

70 https://iraqdtm.iom.int

Centre for Medium-Range Weather Forecasts (ECMWF) reanalysis product was used, which is a global model considered one of the most reliable.

Figure 3-2 shows the climate change trends in Iraq for the period 1980-2020 using ECMWF/ERAS data. It demonstrates trends in annual mean temperature (MAT, °C/decade) and annual precipitation (PPT, mm/decade) calculated as the average from January to December. The average annual temperature shows the rise in temperatures that Iraq has experienced during the years 1980-2020, especially in northern Iraq. It also shows the spatial variation in annual precipitation rates. There is a clear trend of decreasing precipitation in the eastern parts of Sulaymaniyah. Figure 3-3 reviews the nature of climate change trends across the four seasons as the average seasonal temperatures (MST) for winter(DJF) for spring(MAM), for summer(JJ), and for fall(SON)

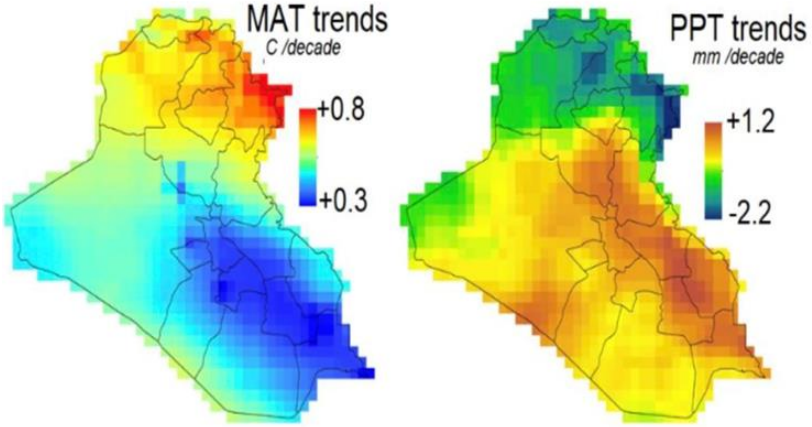


Figure 3-2: Nature of Climate Change Trends in Iraq for the Period (1980-2020)

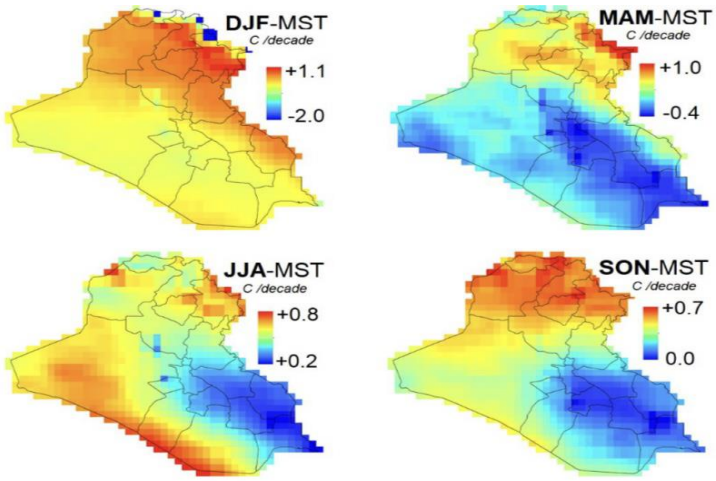


Figure 3-3: Nature of Climate Change Trends during the Four Seasons for the Period (1980-2020)

3.1.3 FUTURE CLIMATE CHANGE ANALYSIS (TEMPERATURE AND PRECIPITATION)

For the analysis of long-term future climate change (2006–2100), projections from NASA's NEX-GDDP (NASA Earth Exchange Global Daily Downscaled Projections) were used. These projections are based on 21 General Circulation Models (GCMs) for two different climate change scenarios (RCP4.5 and RCP8.5) at daily time steps. These scenarios represent the two main pathways used by the Intergovernmental Panel on Climate Change (IPCC).

- RCP8.5 represents a business-as-usual scenario, where CO_2 emissions continue to rise throughout the 21st century, forming the basis for worst-case climate change projections.
- RCP4.5 represents a moderate scenario, where emissions start declining around 2045, reaching half of their 2050 levels by 2100.

The climate projections include daily maximum temperature, daily minimum temperature, and daily precipitation for the period 1950–2100, with a spatial resolution of 0.25 degrees (~25 km × 25 km) .[71] Table 3-2 presents the NEX-GDDP models used in this analysis, based on the average of the 21 models applied.

Table 3-2: NEX-GDDP Models Used in this Analysis (Average of 21 Models Used)

ACCESS1-0	CSIRO-MK3-6-0	MIROC-ESM
BCC-CSM1-1	GFDL-CM3	MIROC-ESM-CHEM
BNU-ESM	GFDL-ESM2G	MIROC5
CanESM2	GFDL-ESM2M	MPI-ESM-LR
CCSM4	INMCM4	MPI-ESM-MR
CESM1-BGC	IPSL-CM5A-LR	MRI-CGCM3
CNRM-CM5	IPSL-CM5A-MR	NorESM1-M

Microclimate trends have been analyzed across Iraq, with a more detailed focus on its different governorates. Figure 3-4 presents temperature trends (2006–2100) based on long-term climate projections of Mean Annual Temperature (MAT) under the two adopted climate scenarios. Figure 3-5 illustrates the variation between the two scenarios across all governorates.

71 Thrasher, B., Maurer, E. P., McKellar, C., & Duffy, P. B., 2012: Technical Note: Bias correcting climate model simulated daily temperature extremes with quantile mapping. Hydrology and Earth System Sciences, 16(9), 3309-3314. doi:10.5194/hess-16-3309-2012

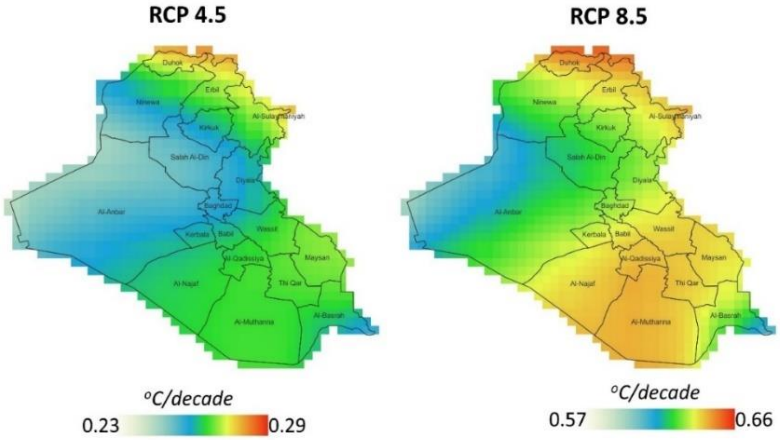


Figure 3-4: Temperature Trends (2006-2100) Based on Long-Term Climate Projections

Projections indicate that by the end of the century, temperatures are expected to rise by approximately 2.5°C in Anbar, Salah al-Din, and Baghdad under the RCP4.5 scenario. However, under the RCP8.5 scenario, the increase could reach up to 6.5°C in northern Iraq (Duhok), as shown in Figure 3-5. Figure 3-6 presents the average precipitation for both climate scenarios, while Figure 3-7 illustrates the variation across different governorates. According to the RCP8.5 scenario, precipitation is projected to decrease, particularly in northern Iraq (Duhok), by approximately 150 mm by the end of the century (Figure 3-7).

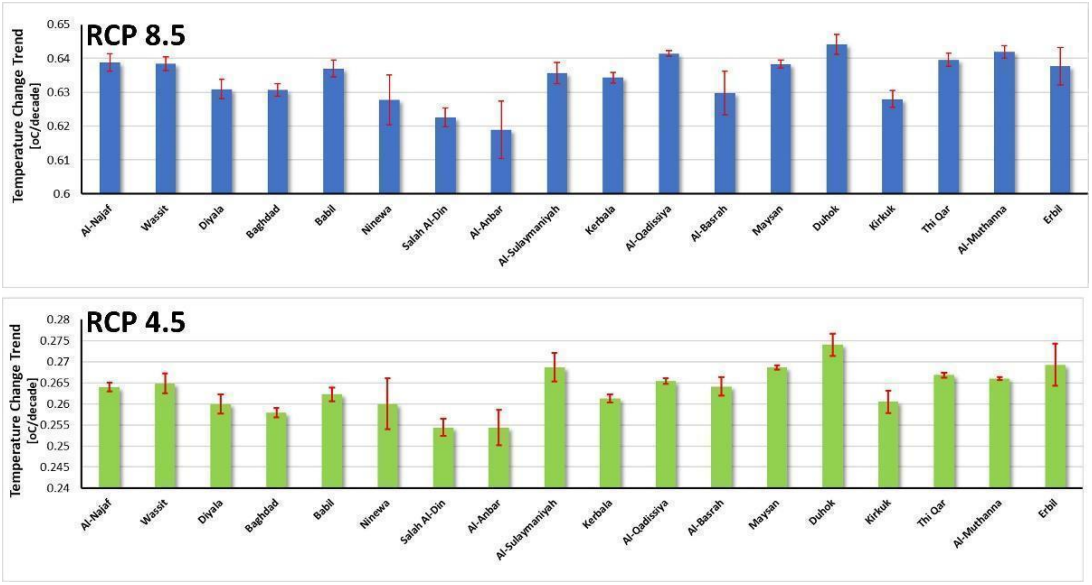


Figure 3-5: Trends in Average Temperatures in Provinces Based on Long-Term Climate Projections

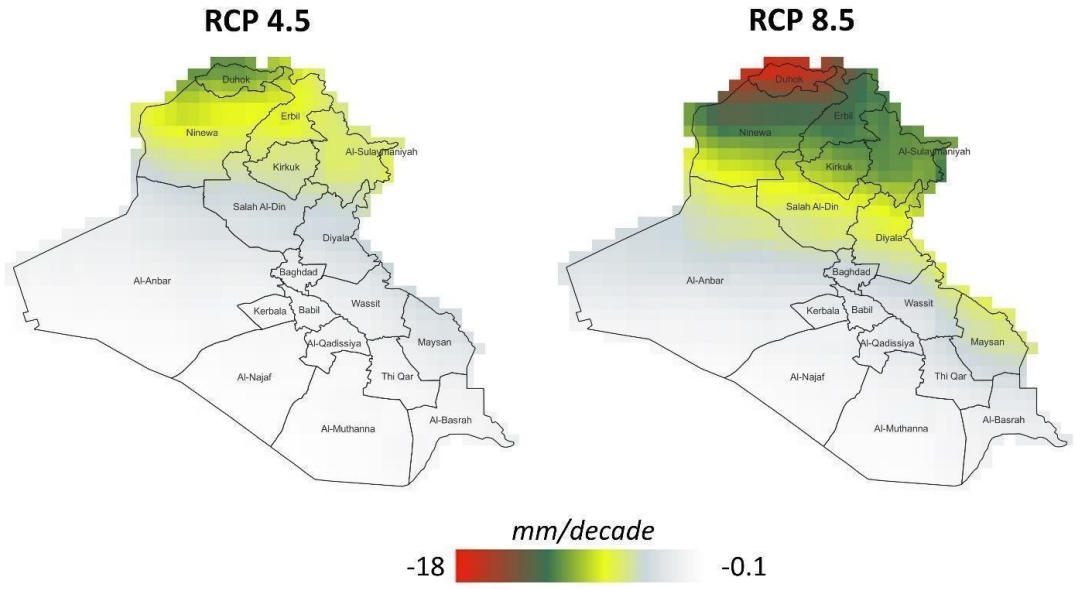


Figure 3-6: Trends in Precipitation (2006-2100) Based on Long-Term Climate Projections

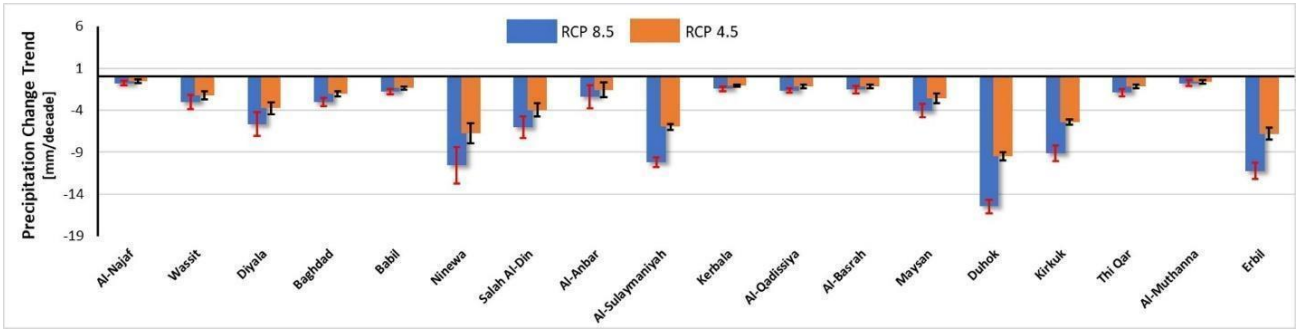


Figure 3-7: Trends in Average Precipitation in Provinces Based on Long-Term Climate Projections

3.1.4 ANALYSIS OF FUTURE CLIMATE CHANGE (HEAT STRESS AND WARM, DRY, DAYS)

A technical report from the Walker Institute was used to support UNEP's contribution to climate change adaptation in Asia, as part of Iraq's National Adaptation Plan (NAP) project funded by the Green Climate Fund (GCF) .[72] The core data was sourced from a selection of CORDEX Regional Climate Models (RCMs) chosen using a statistical downscaling technique known as Self-Organizing Maps (SOMs), which was applied to Global Climate Models (GCMs). The total number of SOMs for the RCP4.5 scenario is two (S1 and S2), while for the RCP8.5 scenario, it is three (S1, S2, and S3). The expected changes by 2085 (2072-2097) were calculated in comparison to historical levels (1978-2002).

Air temperatures exceeding 32°C are considered a threshold for heat stress, requiring extreme caution, as prolonged exposure can lead to heat strokes, heat cramps, or heat exhaustion. Figure 3-8 illustrates the increase in the number of annual days where the heat index surpasses 32°C (shown in orange),

72 Cornforth, R. J., Saggioro, E., Petty, E. C., Pope, H., Tarnavsky, E. (2022). 'Climate Risk Assessments for Iraq: Southern Marshes and Persian Gulf & Shatt Al ', -Arab Briefing Note WIBN0222/01, Walker Institute, University of Reading, 6 April 2022

while the number of days where the heat index remains below 32°C is indicated in purple. Both RCP4.5 and RCP8.5 scenarios show an increase in the number of days with a heat index above 32°C. The most severe increase is projected under the RCP8.5 model, reaching up to +80 additional days per year. Even under RCP4.5, the increase is significant, reaching up to +50 additional days per year. The areas most exposed to extreme heat are northwest of the southern desert, extending northward not far from Mosul.

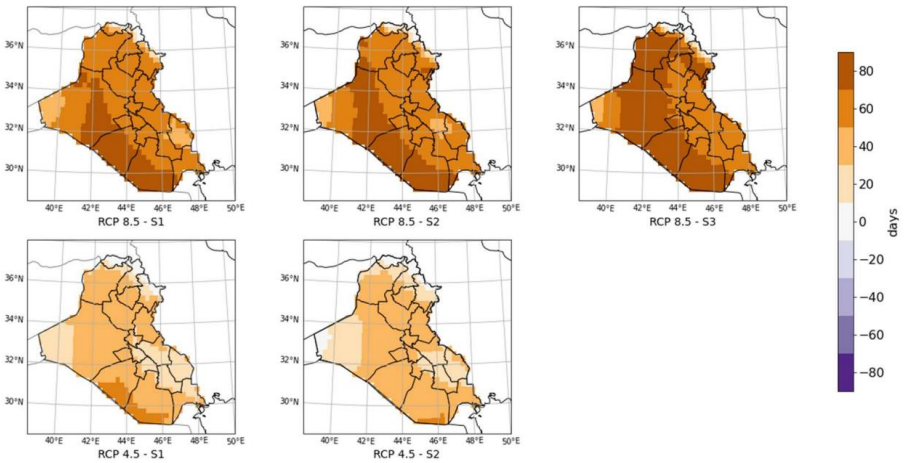


Figure 3-8: Change in the Number of Annual Days with a Temperature Index Above 32 ℃ by 2085 in Selected Regional Climate Models (SOMS) for RCP8.5 and RCP4.5 (Walker Institute 2022)

Figure 3-9 shows the change in the number of warm and dry annual days compared to historical averages in the two models for RCP4.5 and RCP8.5. It indicates an increase in the number of warm and dry annual days in orange and a decrease in purple. Similar to the temperature index, the frequency of warm and dry days fluctuates significantly, with a higher increase according to the RCP8.5 model (+40 to +60 days per year) compared to the RCP4.5 model (+20 to +40 days per year). The temperature increase in southern regions greatly exceeds that in northern regions.

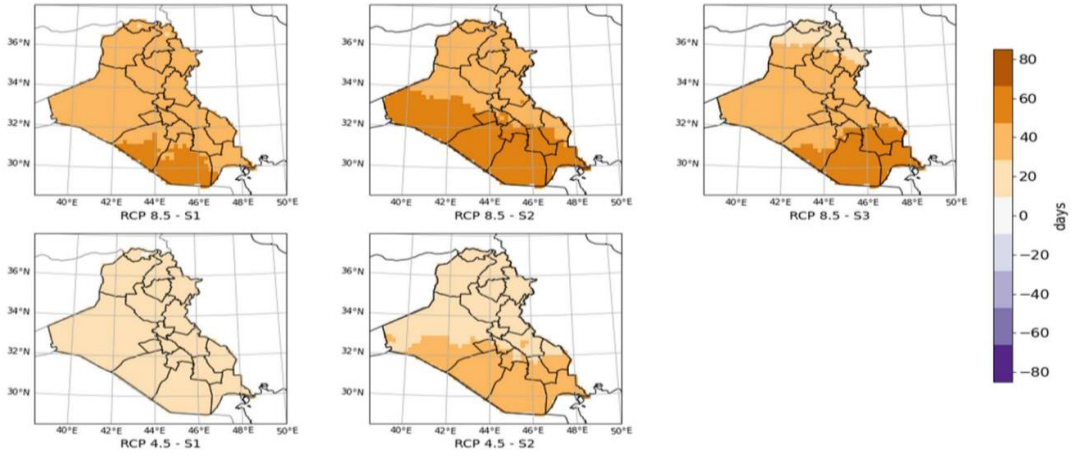


Figure 3-9: Change in the Number of Warm and Dry Annual Days by 2085 in Selected Regional Climate Models (RCP8.5 and RCP4.5).

A web application has been developed for downloading and analyzing high-quality historical climate data from an advanced climate dataset, with a focus on non-expert users. Risk maps have been compiled, uploaded, and are available for exploration through the UNEP Iraq Climate GIS data portal.[73] Through this web platform, general users can download climate data covering a wide range of variables. Users must zoom in on the Iraq map and click on a location of interest, where time-series data for selected variables can also be downloaded. This dataset includes monthly climate data and global land surface climate water balance data for the period from 1958 to 2019. The background climate product, TerraClimate, is an advanced climate dataset and one of the best available sources for primary climate change data, including maximum temperature, minimum temperature, vapor pressure, precipitation accumulation, downward shortwave radiation, and wind speed.

3.2 CLIMATE CHANGE RISKS TO THE MOST VULNERABLE NATIONAL SECTORS AND ADAPTATION MEASURES

Given the synergistic relationship between national sectors, the preparation and implementation of an adaptation action plan that delivers benefits to each sector affected by climate change, as outlined in the national strategies related to agriculture, water, and biodiversity, will enhance the national capacity to cope with the impacts of climate change.

This chapter presents an assessment of the vulnerability of the sectors identified by the Iraqi government (agriculture, water resources, biodiversity), and also includes a review of the health sector, which is classified as a priority, along with a list of proposed measures to mitigate the impact of climate change on each sector.

3.2.1 VULNERABILITY OF THE AGRICULTURAL SECTOR TO CLIMATE CHANGE

Agriculture in Iraq is the most affected by climate change, making food security a constant concern. Estimates indicate that 1.77 million people in Iraq are threatened by food insecurity. The broader population segment most affected consists of the poorest individuals who rely on government food rations and cannot supplement the provided food items with fresh alternatives that ensure they receive the necessary calories for a healthy and balanced diet. Consequently, they are increasingly at risk of health issues due to malnutrition. Climate change is likely to exacerbate these challenges, leading to extreme weather phenomena resulting in rising temperatures, changing precipitation patterns, and crop productivity.

Conducting a modeling study on the agricultural sector, using wheat as a model crop, aims to analyze the extent of the impact of external (climatic) factors such as temperatures, precipitation rates, carbon storage, nitrogen levels, and soil moisture, alongside internal (agricultural) factors such as irrigation water quantities, fertilizers, and farming methods allows identifying agricultural and hydrological patterns that can be relied upon to enhance wheat cultivation and adapt to future climate scenarios. The study utilizes a simulation model for agricultural production systems (APSIM), which specializes in simulating biophysical, economic, and environmental processes in agricultural systems to address the risks of climate change. This process involves three steps as follows:

- Simulating wheat yields over long periods from 2006 to 2100 within the context of two common climate change scenarios (RCP4.5 and RCP8.5) and land uses, using a localized climate product

73 Climate Portal UNEP IRAQ

from the Greater Kirkuk area, which has a closed watershed with limited water resources unaffected by the actions of neighboring countries, ensuring that the results and conclusions are not contaminated.

- Studying the dynamics of gaps in crop growth rates and the underlying mechanisms causing thermal and water stress, as well as sharp changes in CO_2 emissions.
- Mapping climate change trends in Iraq and using hotspots of biotic stress as a means to decode site-specific adaptation goals.

3.2.1.1 STUDY AREA

The Lower Mesopotamian Plain (LMP) was chosen as the study area mentioned above. This plain was historically known as the Mesopotamian plain between the Tigris and Euphrates rivers, or Mesopotamia, before it became commonly referred to as "Al-Sawad" (meaning "the black lands") due to its high agricultural productivity. The plain is located in central and southern Iraq and is characterized by many scenic landscapes, with rolling hills in the north, the western plateau to the west, the Zagros Mountains to the east, and the Arabian Gulf to the south. The Lower Mesopotamian Plain (including marshes and lakes) covers an area of 132,500 km², accounting for 30.2% of Iraq's total area.

The dominant regional climate is the hot desert climate[74], characterized by extremely hot and long summers, mild to cool spring seasons with slight humidity, and short winters. In summer, from June to August, the average maximum temperature reaches 44 degrees Celsius, accompanied by intense sunlight. Even at night, temperatures rarely drop below 24 degrees Celsius during the summer.

3.2.1.2 LONG- TERM CLIMATE DATA FOR PRELIMINARY ASSESSMENT

Weather is a key factor in understanding crop responses to climate change through biological and environmental interactions. To study the effects of weather on crops, specific data for the APSIM model were developed, adopting a daily time step for the period 2000-2100 for the scenarios RCP4.5 and RCP8.5. The study utilized a climate product from the RICCAR initiative, which includes outputs from three bias-corrected GCMs for the period 1980-2100.

Given that the climate product (RICCAR) has a resolution of approximately 50 km, it may not be sufficient to understand the local dynamics of crop applications at the land scale in APSIM. Although the resolution can be reduced to 1 km, the precise variation at the plot scale cannot be captured. The data used reflects a larger area rather than the plot itself. Figure 3-10 shows the downscaled climate product, which focuses on Iraq and illustrates the overall impact of climate change on regional yields without accurately capturing local dynamics.

74 Köppen climate classification - Wikipedia

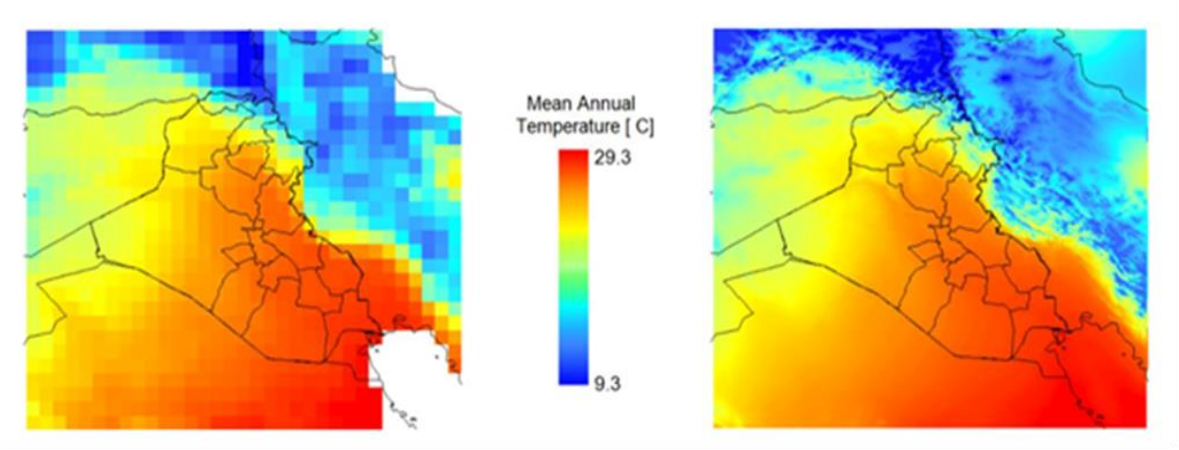


Figure 3-10: A snapshot of the downscaled and bias-corrected climate product (RICCAR), focusing on the region of Iraq

3.2.1.3 CLIMATE CHANGE NATURE IN SOUTHERN MESOPOTAMIA PLAIN

Climate change trends in the Southern Mesopotamian Plain were analyzed using long-term climate data for two scenarios, RCP4.5 and RCP8.5. Figure 3-11 illustrates the long-term trends in various meteorological variables. It shows that the average annual temperature increases by 3-5 degrees compared to current climates by the end of the century. However, there is no statistically significant trend in annual precipitation in the study area under RCP8.5 or RCP4.5.

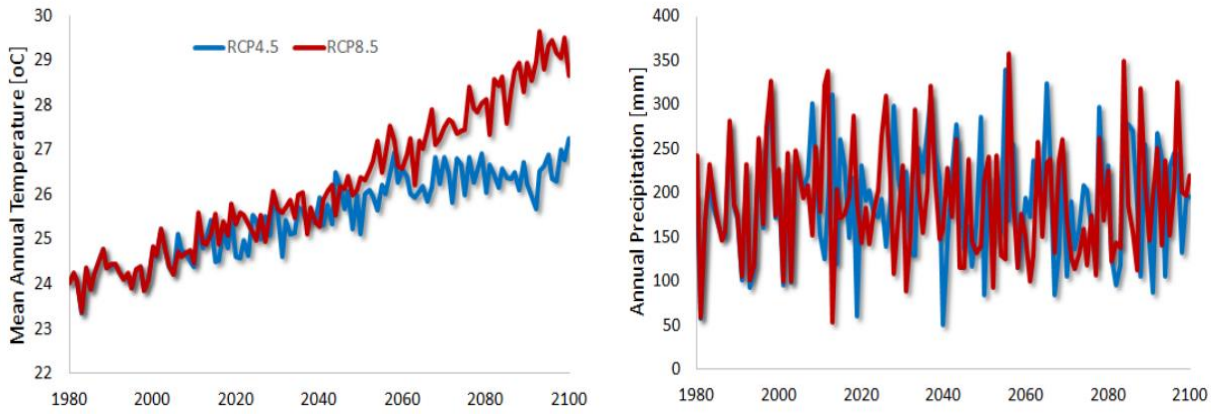


Figure 3-11: Temporal dynamics of average annual temperature and average precipitation in LMP under RCP4.5 and RCP8.5 scenarios

3.2.1.4 IMPACT OF CLIMATE CHANGE ON WHEAT CROP IN THE LONG TERM

A long-term simulation of wheat crops was conducted from 2006 to 2100 using the APSIM Agricultural Production Systems Simulator, considering daily weather conditions and appropriate CO_2 concentrations to simulate the effects of climate change, including heat stress, water stress, and CO_2 fertilization. Additionally, long-term daily simulations were aggregated with annual yields and compared. The results showed that under the RCP8.5 scenario, wheat yields could decline sharply due to the exacerbating effects of heat and water stress, with production potentially dropping from 4.5 tons/hectare to 3 tons/hectare by the end of the century. In contrast, under the RCP4.5 scenario, the decline was less severe, suggesting that strong climate change mitigation efforts could be effective. There is a clear need to develop climate-resilient crop varieties and adopt modern irrigation

technologies, such as fixed and mobile sprinkler irrigation, drip irrigation, and subsurface irrigation systems, to ensure good productivity for various crops, as shown in Figure 3-12.

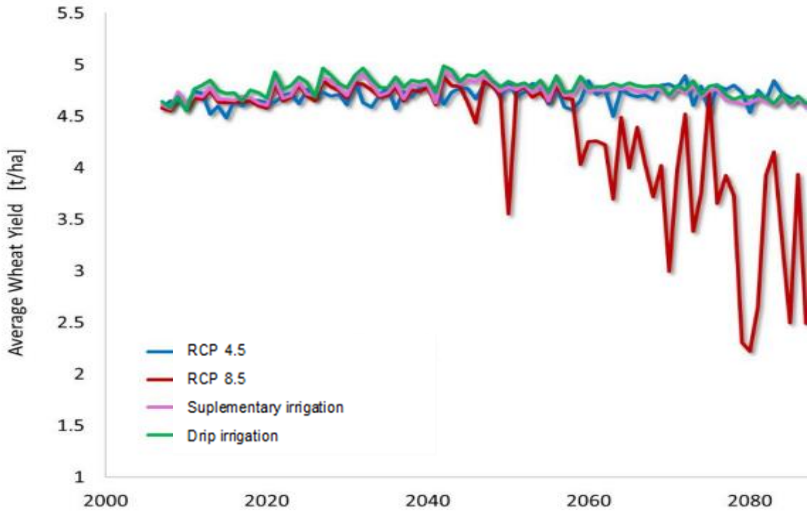


Figure 3-12: Long-term trends in wheat production in LMP for two climate change scenarios and two adaptation scenarios

3.2.1.5 PHYSIOLOGICAL MECHANISMS OF CROP GROWTH AND CROP CHANGE

Heat stress showed a significant increase under the RCP8.5 scenario starting from 2072. Wheat is a C3 annual plant, and its photosynthesis process occurs under optimal conditions, with carbon uptake primarily regulated by the plant's water relationship. The movement of enzymes in the photosynthesis mechanism is affected by leaf temperature, which rises under conditions of soil moisture deficiency and high air temperature, impacting the activity of the Rubisco enzyme. Water stress was observed annually in Iraq with fluctuating levels from year to year, and a significant increase in water stress was noted under the RCP8.5 scenario compared to RCP4.5, starting from 2050. Heat stress also showed an exponential increase in the RCP8.5 scenario beginning in 2072, while it remained relatively absent in RCP4.5. Additionally, the flowering process was affected, as the number of days required for flowering increased under the RCP8.5 scenario, indicating a tendency for wheat to remain in the vegetative stage without flowering in a changing climate. This is clearly illustrated in Figure 3-13, where the days required for anthesis increased significantly from 2060 onwards, reaching up to 80 days (2.5 months).

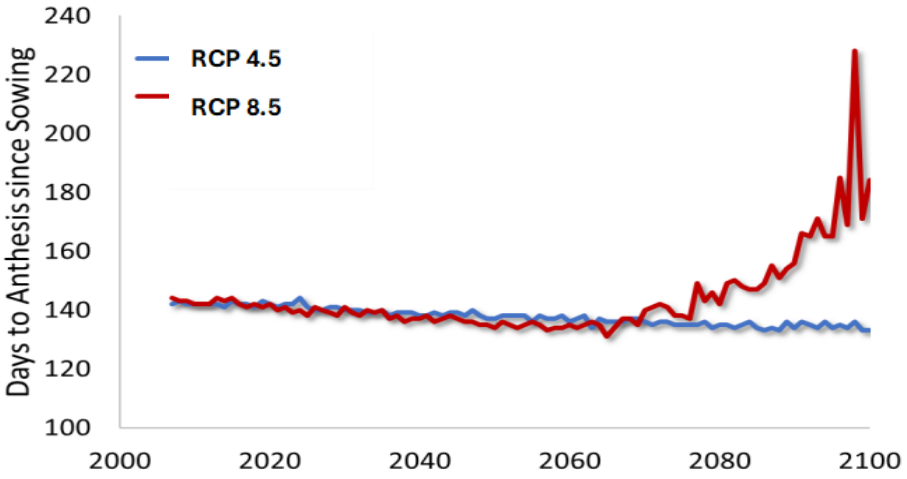


Figure 3-13: Changes in the flowering initiation date since wheat sowing day

The potential yield gap for the robust wheat varieties currently in use was analyzed under the RCP4.5 and RCP8.5 scenarios. Overall, it was observed that the yield gap would not change significantly under the RCP4.5 scenario. However, under the RCP8.5 scenario, the yield gap increases, necessitating adaptation efforts to mitigate the impacts of climate change (Figure 3-14). Therefore, Iraq needs to develop climate-smart wheat varieties capable of efficiently extracting soil moisture, exhibiting higher transpiration efficiency, and having lower sensitivity to heat stress. Most importantly, these varieties should be less affected by temperature regulation during anthesis and grain filling. Site-specific plant breeding and regional hotspot analysis of climate change could contribute to the development of future climate-smart wheat varieties.

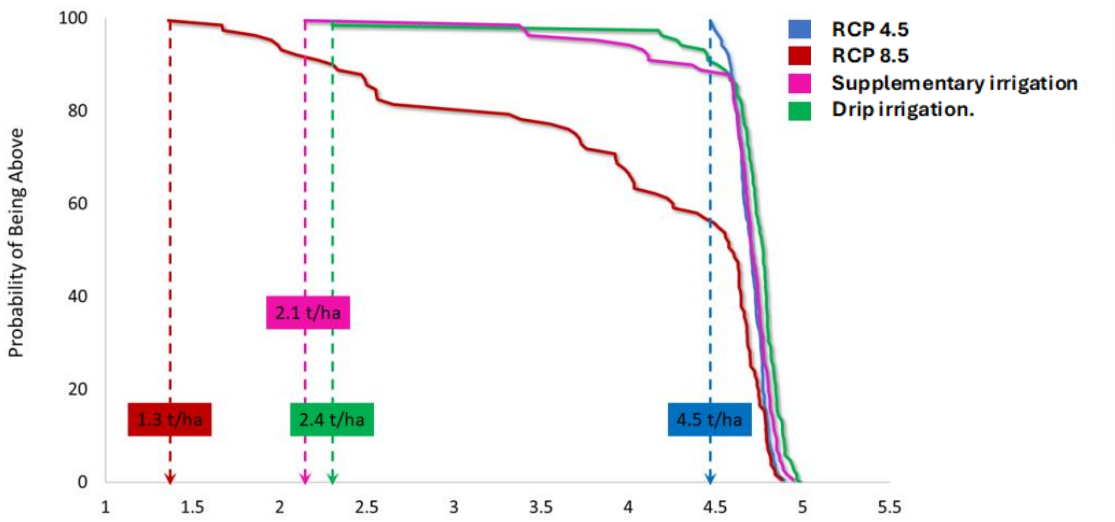


Figure 3-14: Yield gap analysis for wheat in the Lower Mesopotamian Plain simulated using the APSIM model under the RCP4.5 and RCP8.5 scenarios.

3.2.2 Conclusions, Proposed Adaptation Solutions, and Key Priorities for Enhancing Agricultural Sector Resilience

The study examined the evolution of the yield gap for commonly grown wheat varieties under climate change by utilizing weather variables and robust soil property data from the Lower Mesopotamian Plain. The APSIM model was used to simulate wheat crops, analyzing yield gap dynamics to understand the fundamental impacts of heat stress, water stress, and changes in CO_2 on crop growth under two climate change scenarios. The findings indicated that shifts in wheat production patterns had a direct impact on yield, highlighting the need for climate-smart varieties to sustain crop productivity and food security. Irrigation remains crucial for agricultural sustainability, and with climate change, additional water resources will be needed to enhance system resilience. This modeling study proposed targeting wheat crop development patterns as smart climate adaptation criteria, along with agricultural interventions.

Proposed Adaptation Measures for Climate Change Impacts:

1. Mitigating and restoring soil degradation using remote sensing techniques and Geographic Information Systems (GIS).
2. Addressing land degradation and improving land management in agriculture and forestry.
3. Adopting and promoting climate-smart agricultural practices while facilitating technology transfer and fostering innovation and entrepreneurship in the agricultural sector.
4. Enhancing agricultural practices by utilizing drought- and salinity-resistant crops, developing strategic crop varieties with high tolerance, and improving post-harvest processes such as product transportation, packaging, storage, and marketing.
5. Building the capacity of agricultural workers, empowering rural women, and supporting families and youth in rural areas.
6. Encouraging research and studies on climate change and developing scientific atlases.
7. Supporting the post-harvest agricultural sector through better transportation, packaging, and storage solutions.
8. Promoting research and developing specialized atlases to combat desertification.
9. Ensuring sustainable water management through water conservation, modern irrigation techniques, and water harvesting while promoting their adoption among farmers.
10. Establishing model farms and field schools to facilitate technology transfer and dissemination among farmers.
11. Developing greenhouse farms and laboratories for tissue culture propagation.
12. Setting up tissue culture laboratories for various crops and providing advisory services for their commercialization.
13. Introducing modern agricultural extension methods, including digital extension services and field advisory schools.

3.2.2.1 Vulnerability of the Water Resources Sector to Climate Change

With significant climate change, Iraq's water resources are at risk, directly impacting sectors such as agriculture, energy, industry, and related fields. The 2022 World Bank report on climate change and development in Iraq predicts that the gap between water supply and demand will widen from approximately 5 billion to 11 billion cubic meters by 2035, accounting for more than 15% of total demand. Climate change further degrades water quality and reduces crop yields, negatively affecting GDP and social stability.

The following section of the report examines Iraq's projected water deficit and the Ministry of Water Resources' adaptation measures to address climate change and achieve sustainable development. It also presents findings from ICARDA's study assessing soil and water quality in the Tigris and Euphrates basins using the SWAT model, along with proposed adaptation solutions for mitigating climate change impacts on the water resources sector.

3.2.2.2 EXPECTED WATER DEFICIT IN IRAQ

The 2014 Strategic Study of Water and Land Resources in Iraq estimates that internal freshwater resources will not meet future needs under the current operational model. Freshwater availability has already begun to decline, and water scarcity levels are expected to worsen by 2035, reaching approximately 1,000 cubic meters per person annually. This is due to the inability of renewable water resources to keep pace with demographic growth and the demands of various sectors, in addition to the exacerbation of the deficit by climate change. Increasing water withdrawals by neighboring countries to meet their own needs and adapt to climate change further strains Iraq's water resources. By 2050, a 1°C rise in temperature and a 10% decrease in rainfall could reduce freshwater availability by 20%. Under these conditions, Iraq may be unable to provide water for irrigating one-third of its rain-fed agricultural lands by 2050. The strategy indicates that Iraq's only viable solution lies in water conservation, internal water distribution system reforms, and cooperation with riparian countries of the Tigris and Euphrates rivers.

Figure 3-15 presents a comparison of available freshwater and projected water demand in Iraq through 2035, assuming no water sector reforms are implemented, according to the strategic study of water and land resources. Iraq relies on approximately 63% of its available freshwater, which flows into the country through the Euphrates, Tigris, Zab, and other rivers. Excess water is stored in reservoirs to meet year-round needs. Due to this dependency, reductions in river inflows—caused by agricultural expansion, population growth, industrial development, dam construction, and water diversions upstream—place Iraq in a vulnerable position. This situation is further aggravated by the absence of permanent agreements governing water allocation from major rivers or the quality of water entering Iraq's borders. Climate change, reduced snowfall, and increased evaporation add further risks. Even without climate change impacts, Iraq's demand for freshwater is expected to exceed its available supply by 2035. If 100% of irrigation and water diversion projects from neighboring countries are implemented, Iraq's water availability could decline by 24.5% by 2035 compared to current levels. The country faces severe water shortages, affecting multiple water usage sectors.[75]

Table 3-3 outlines indicators and risks associated with water scarcity. The primary causes of water shortages include dam construction and upstream water projects, climate change, increased evaporation and drought, rising consumption, and water wastage due to aging infrastructure.

75 Strategic Study of Water and Land Resources in Iraq 2015

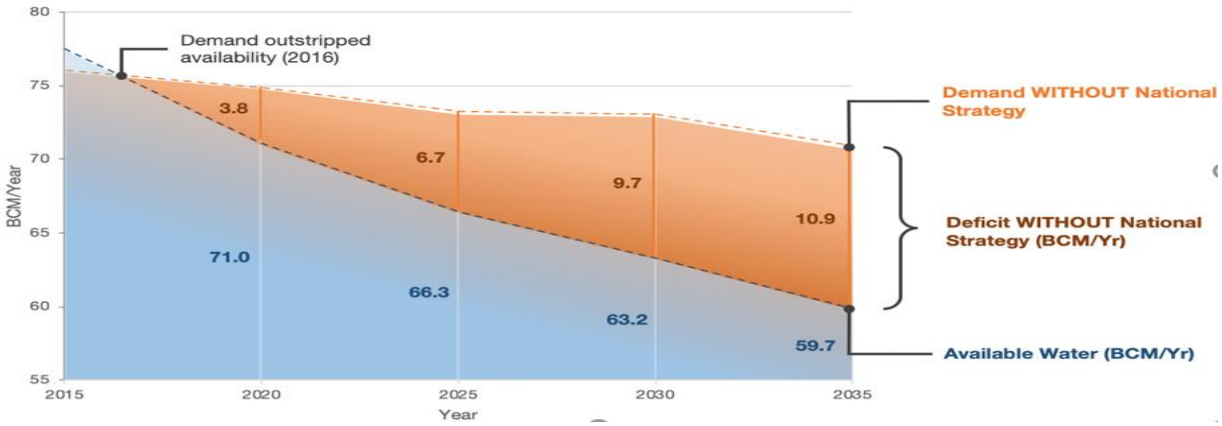


Figure 3-15: projected water deficit in Iraq until 2035 in case the strategy was not implemented

It is worth noting that the impact of reduced water inflows between 2008 and 2018 due to climate change and upstream development projects included a decline in dam storage from 73% to 32%, a reduction in agricultural land area, a decrease in marshland inundation to 30%, a drop in per capita water availability to 1,250 m^3/year, increased violations of water quotas and rising river pollution, and an escalation in desertification and dust storms.

Table 3-3 Indicators and Risks of Water Scarcity

Water Scarcity indicators	Water Scarcity Risks
- The shutdown of the Darbandikhan Dam. - Filling the Ilisu Dam in Turkey on the Tigris River during the same storage season as the Mosul Dam. - Low natural inflows and releases from neighboring countries. - Reduced current storage in Iraqi dams. - Drought conditions and elevated temperatures above normal levels.	- The shutdown of some water desalination stations due to low water levels. - Inability to deliver drinking water to villages. - Inability to implement agricultural plans. - Increased violations and social and political tensions. - Risks of shutdown and malfunction of hydroelectric stations in dams. - The shutdown of the Nasiriyah power plant. - Drying of the marshes in the south. - Deterioration of the waters of Shatt al-Arab. - Spread of harmful aquatic weeds. - Risks to public health, increased pollution, and the potential spread of diseases. - Impact on food security and fish wealth, leading to displacement.

3.2.3 PROCEDURES OF THE IRAQI MINISTRY OF WATER RESOURCES FOR CLIMATE CHANGE ADAPTATION, ACHIEVING SUSTAINABLE DEVELOPMENT, AND REQUIRED INVESTMENTS

The Iraqi Ministry of Water Resources has completed the strategic study of water and land resources for the period 2015-2035, which analyzed data related to water, land, and the impacts of climate change. The study included a comprehensive plan for the operation and management of water resources, as well as scenarios for managing floods and water shortages in the event of not reaching an agreement with neighboring countries that may implement future projects on the Tigris and Euphrates rivers.

Within the framework of water and land resource strategies, Iraq has completed several water plans and studies, including:

- Comprehensive planning for water resources and land development in Iraq (water budget 1978-1982).
- Strategic study of water and land resources (2011-2015).
- Roadmap for water policy in Iraq for the next twenty years.
- The strategic study identified measures for managing water shortages, focusing on the irrigation and agriculture sectors and improving the quality of freshwater:
- Irrigation and Agriculture Sector Measures:
- Rehabilitation of irrigation system infrastructure and increasing irrigation efficiency.
- Rehabilitation of flood control infrastructure.
- Reducing water waste.
- Exploiting unconventional water resources.
- Developing sustainable use of groundwater resources.
- Reclamation of undeveloped projects.

These measures aim to achieve irrigation efficiency of no less than 60% and agricultural density reaching 110%. These measures include updating old irrigation projects, replacing traditional irrigation methods with modern ones, and lining canals to reduce losses.

Measures to Improve Irrigation System Infrastructure:

- Rehabilitation of the Mosul Dam to raise storage levels to 330 meters.
- Implementation of the Badush Dam as an alternative if the Mosul Dam is not rehabilitated.
- Rehabilitation of the irrigation canal (Tigris-Euphrates) to increase its capacity to 250 m^3/second.
- Rehabilitation of storage and control facilities (dams and reservoirs).
- Rehabilitation of developed irrigation projects.

Measures to Improve Freshwater Quality:

- Implementation of drainage networks to transport saline water away from freshwater sources.
- Installation of 103 hydrological stations out of a planned 182 stations to monitor the quantity and quality of water.
- Delivering a flow of no less than 75 m^3/second from the Tigris River to Basra to improve the quality of Shatt al-Arab water.
- Reducing violations related to water resources.
- Increasing the number of water treatment and wastewater treatment plants.
- Contributing to the implementation of the national water monitoring project in Iraq.

Minimum water discharges have been established to ensure water supply for various municipal, industrial, and environmental uses. Points along the rivers have been identified to ensure adequate water discharge, especially in Shatt al-Arab to prevent saline water intrusion from the Gulf. The plan also included the construction of a dam on Shatt al-Arab if it is not possible to guarantee the required minimum flow.

Finally, a plan has been developed to address the anticipated water shortage, covering the drinking water, agriculture, energy, and media sectors, as presented in Table 3-4.

Table 3-4: Ministry of Water Resources Plan to Address Water Scarcity in Collaboration with Relevant Sectors

Sector	Measures
Drinking Water	- Extension of water intake pipes for desalination plants - Construction of reservoirs at intake sites to supply citizens with water - Provision of reservoirs for drinking water delivery - Drilling wells near desalination plants - Scheduling of water releases for drinking water - Directing ministries and institutions involved in water treatment to apply approved environmental standards - Regulating domestic water usage
Agriculture	- Restricting summer agriculture - Implementing a strict system for irrigation management and preventing encroachment on river and pond quotas - Campaign for maintenance, repair, and installation of pumping stations - Campaign for cleaning and purifying rivers and ponds in various areas - Dredging the Tharthar regulator to raise sedimentation. - Using modern methods for water transportation in irrigation projects being designed to control the quantity of water through a gradual shift to modern irrigation (water transport by pipelines) to rationalize water consumption and reduce losses from leaching and evaporation in surface irrigation. - Lining irrigation canals with concrete blankets while adopting and promoting the use of sprinkler and drip irrigation technologies in cooperation with the Ministry of Agriculture and according to government directives and priorities to mitigate the effects of water scarcity, as well as using remote control technology in some pioneering projects. - Conducting an extensive campaign to remove encroachments, particularly fish ponds, where all unlicensed fish ponds have been drained and filled.
Energy	- Preparing relief supplies for the residents of the marshes. Separating agricultural nutrients (pumps) from residential areas. - Providing the necessary fuel to operate pumps, machinery, and equipment working in the drought mitigation program. - Ensuring water allocation for power stations. - Exempting the transmission lines for the main pumping stations from scheduled cuts. - Securing an emergency line for the hydroelectric station at Haditha Dam and to the district of Haditha. - Adopting closed cooling system operation for gas stations. - Switching the fuel type in gas stations to natural gas, as gas stations represent about 60% of their participation, which leads to a significant reduction in water requirements
Media	- Conducting awareness campaigns to promote consumption rationalization and prevent pollution

Table 3-5 illustrates the amounts of investment required to enable the Ministry of Water Resources to implement its strategic plan for preserving the quantity and quality of water, ensuring the protection of the Iraqi people and their livelihood sources, including enabling both the biodiversity sector and the agricultural and industrial sectors to continue.

Table 3-5: Investments Required to Implement the Strategic Plan of the Ministry of Water Resources in Iraq Until 2035 (Ministry of Water Resources, 2022)

Sector	Amount in Million USD ($)
Dam Construction and Rehabilitation	10,097,200
Dam and Weir Rehabilitation	985,588
Construction and connection of main drains to the public outlet	966,409
Irrigation Projects Rehabilitation	12,475,155
Operation and Maintenance of Irrigation Projects	20,344,150
Reclamation of New Irrigation Projects	33,068,275
Total	77,936,777

3.2.3.1 Assessment of Soil and Water in the Tigris and Euphrates Basins

The dynamics of water resources under climate change are affected by biophysical, climatic, and socioeconomic factors, complicating the issue. To understand these dynamics, Soil and Water Assessment Tool (SWAT) [76] models were used to study the effects of water and land management on the hydrology of watersheds and agricultural yields in Iraq. The SWAT model requires spatially explicit data on climate, topography, soil, and land use. The model divides watersheds into sub-basins and analyzes the dynamics of water, sediment, and nutrients.

To assess the effects of weather on hydrological response, daily weather data for the period from 2000 to 2100 was used under two scenarios, RCP4.5 and RCP8.5, relying on RICCAR, focusing on the Tigris and Euphrates basins. These scenarios were simulated over a complete time series (1980-2100), and the results were analyzed in four time periods: baseline, (2020-2050), (2050-2080), and (2080-2100). The study area includes the Tigris and Euphrates basins, covering an area of 900,000 square kilometers distributed among several countries, with a specific analysis of four key sites in Iraq: Haditha (Euphrates), Mosul (Tigris), Kirkuk-Dokan, and Kirkuk-Al-Azim (Figure 3-16).

76 SWAT ؛ Arnold et al. ، 1998 ؛ Arnold et al. 2012

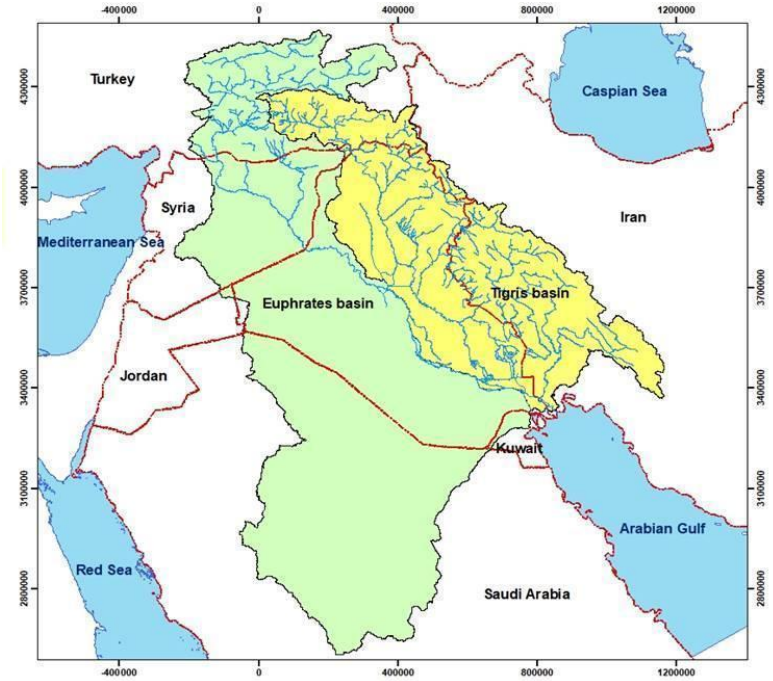


Figure 3-16: Tigris and Euphrates River Basins (Ministry of Water Resources)

3.2.4 SIMULATION RESULTS: SURFACE FLOW IN THE TIGRIS AND EUPHRATES RIVER BASINS

The spatial maps of the Tigris and Euphrates region show that surface runoff generation in the highlands largely reflects spatial rainfall patterns (i.e., average annual rainfall distribution) but also less so the land use and cover types. The main sources of surface runoff contributing to the flow of the Tigris and Euphrates rivers come from the high northern and eastern elevations of the basins, particularly Turkey and the bordering Iraqi and Iranian areas.

Trends in both scenarios and future time periods show a sharp decline in surface runoff in areas that generate high runoff, with the reduction exceeding 10% from the 1950s until the end of the century (Figure 3-17). The RCP4.5 predictive pathway shows a steady decrease of 30% in surface water inflows to the Tigris and Euphrates rivers compared to the baseline reference period (1980-2010), while the RCP8.5 predictive pathway indicates a significant increase followed by a decrease of the same percentage to 30% (Figure 3-18).

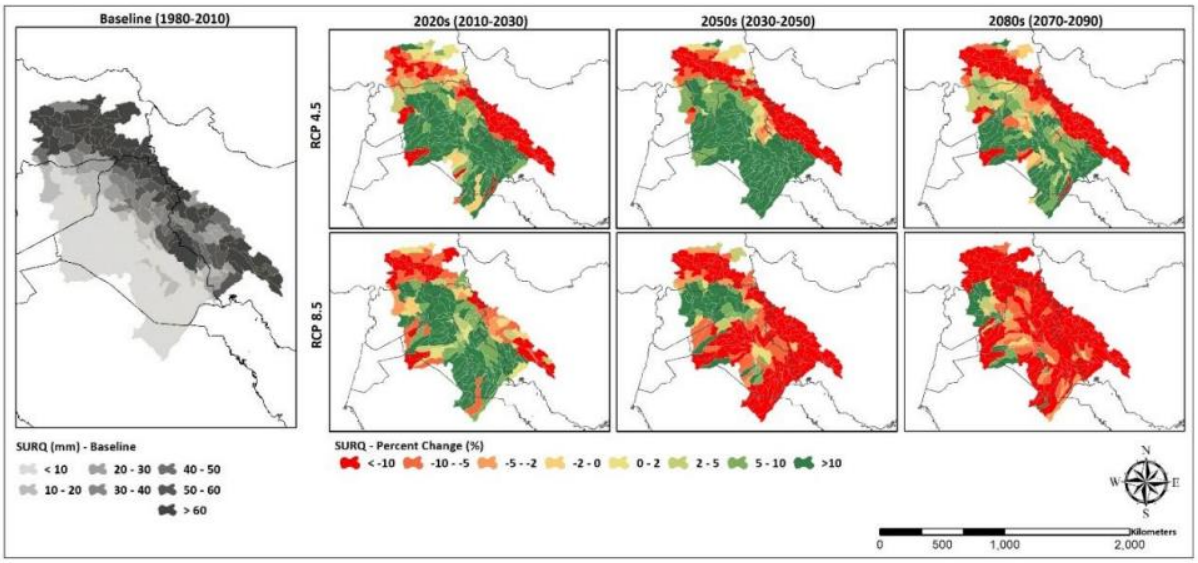


Figure 3-17: Surface Runoff Map for the Tigris and Euphrates Basins for the Baseline and Future Scenarios for RCP 4.5 and RCP 8.5

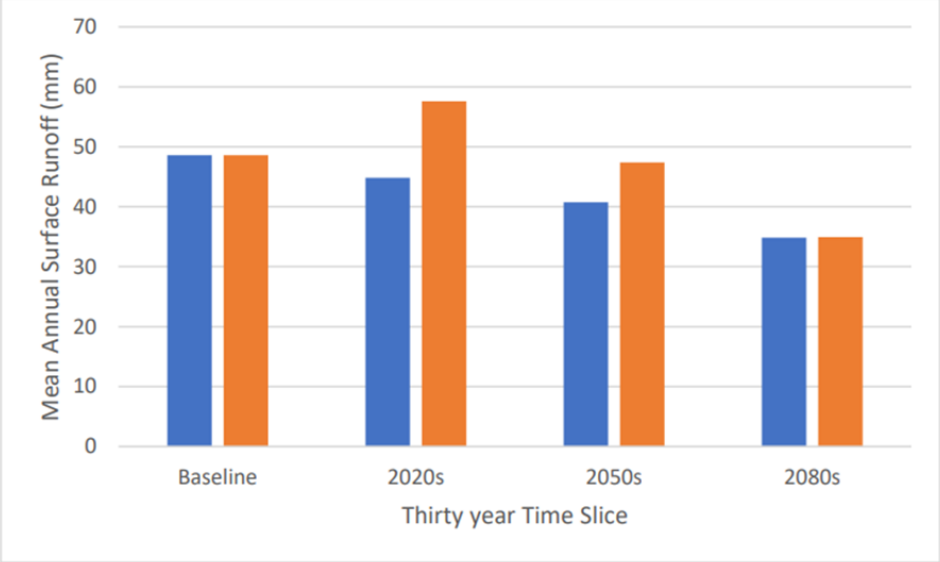


Figure 3-18: Surface Runoff for the Tigris and Euphrates Basins for the Baseline and Future Scenarios for RCP 4.5 (blue) and RCP 8.5 (orange)

To measure the water flow rate and annual discharge of the Tigris River for the same baseline period and in the medium to long term, three key sites were selected: Mosul, the Dokan Dam in Kirkuk, and the Al-Azim site in Kirkuk. The results showed a significant decrease in water flow according to the RCP8.5 model, greater than what was expected in the RCP4.5 model, with the lowest decrease recorded at the Kirkuk/Al-Azim site (Figures 3-19, 3-20, and 3-21). Additionally, modern sites were chosen to study water flow in the Euphrates River during the same reference period, where the results indicated a greater decrease in the RCP8.5 model compared to the RCP4.5 model (Figure 3-22).

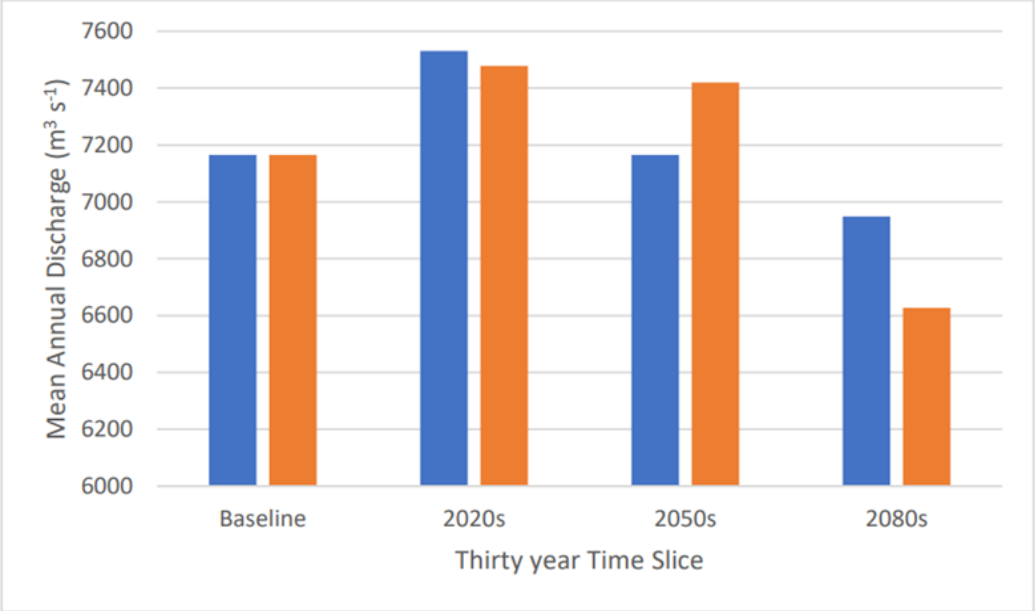


Figure 3-19: Annual Discharge Average in Mosul (Tigris) during the Reference Period indicated for RCP 4.5 (Blue) and RCP 8.5 (Orange) Models.

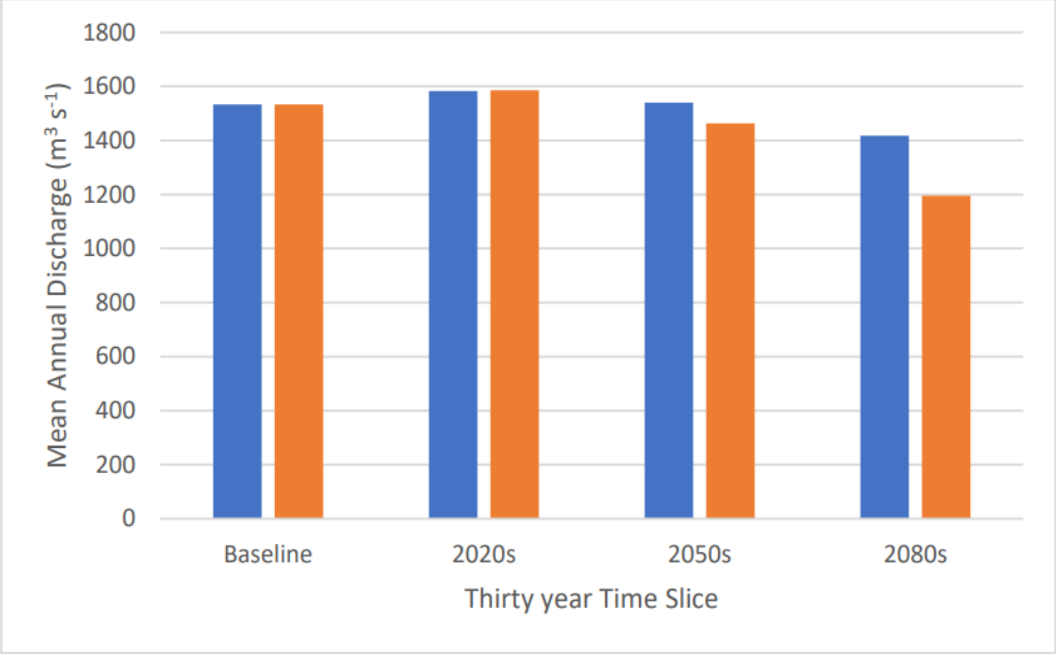


Figure 3-20: Annual Discharge Average in Kirkuk - Dokan Site during the Reference Period Indicated in RCP 4.5 (Blue) and RCP 8.5 (Orange) Models

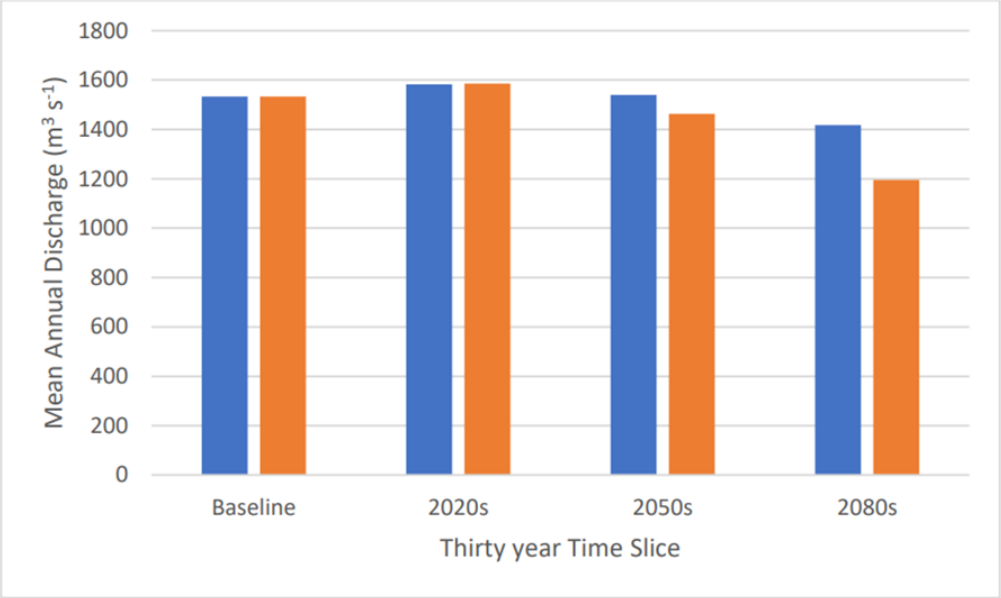


Figure 3-21: Annual Discharge Average in Kirkuk - Al Azeem Site during the Reference Period indicated for both RCP 4.5 (Blue) and RCP 8.5 (Orange) Models.

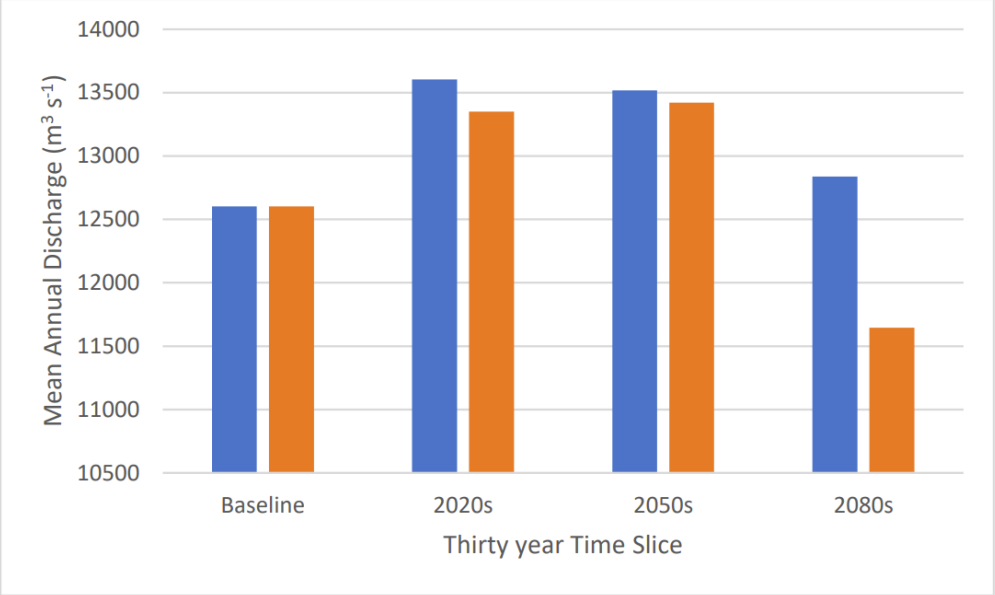


Figure 3-22: Annual Discharge Average in Al Haditha during the Reference Period indicated for both RCP 4.5 (Blue) and RCP 8.5 (Orange) Models

3.2.4.1 SIMULATION RESULTS: EVAPORATION IN THE TIGRIS AND EUPHRATES BASINS

The decrease in surface water inflows to the Tigris and Euphrates rivers is accompanied by a sharp rise in potential evapotranspiration (PET), especially according to the RCP 8.5 predictive pathway, which is significantly higher than RCP 4.5 due to the expected increase in temperatures. However, Figure 3-23 shows that actual evapotranspiration (AET) decreases in areas with increasing trends in PET, indicating reduced water availability, which impacts future rainfed agricultural production (Figure 3-23). The decline in actual evapotranspiration is noted in eastern and southern Iraq around Basra. When considering all climatic factors and conditions, the overall trend continues to rise, with the RCP 4.5 predictive pathway showing a higher increase than the RCP 8.5 pathway (Figure 3-24).

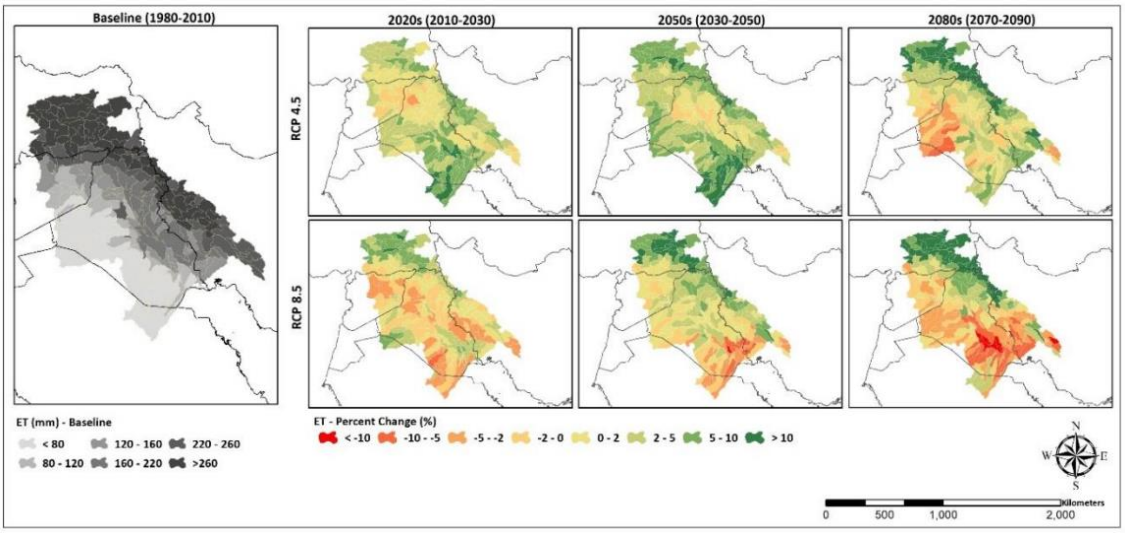


Figure 3-23: Evaporation map for the basins of the Tigris and Euphrates rivers for the baseline and future scenarios of RCP 4.5 and RCP 8.5

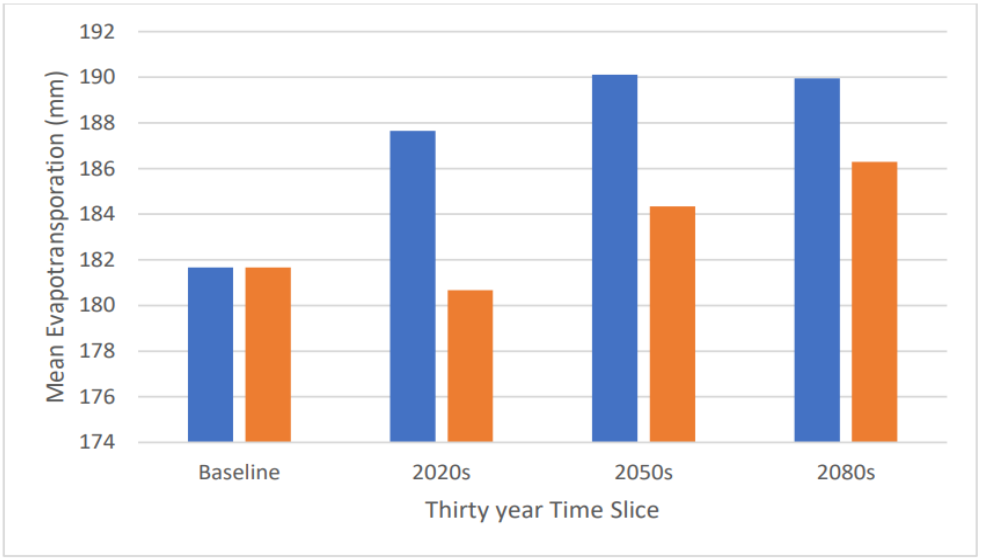


Figure 3-24: Actual Evaporation Average for the Tigris and Euphrates Basins indicated for Baseline and Future Scenarios of RCP 4.5 (Blue) and RCP 8.5 (Orange)

3.2.4.2 SIMULATION RESULTS: SEDIMENTS IN THE TIGRIS AND EUPHRATES BASINS

The transport of sediments resulting from erosion is prevalent in the steep northeastern areas of the Tigris and Euphrates basins. Generally, sediment quantities are low across Iraq in the baseline scenario. However, future trends show variability, with a slight increase in most areas of Iraq in the future scenarios, particularly in RCP 4.5 (Figure 3-25), which may lead to sediment accumulation in large reservoir channels and reduce their storage capacity. The rate of sedimentation is closely related to flow velocity and river inflows, as increased flow leads to higher expected sediment quantities, especially in southern regions with lower gradients. Both RCP 4.5 and RCP 8.5 show a decrease in sediment quantities, with only a slight difference between them (Figure 3-26).

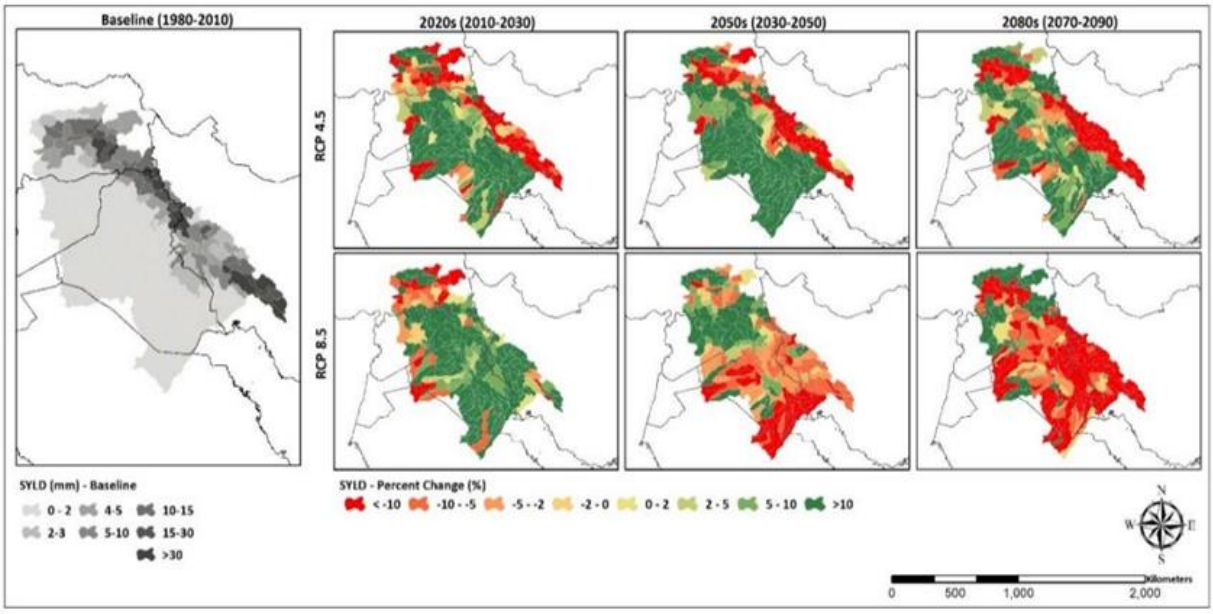


Figure 3-25: Map of Clay Sediments for the Tigris Basin indicated for Baseline and Future Scenarios of RCP 4.5 and RCP 8.5

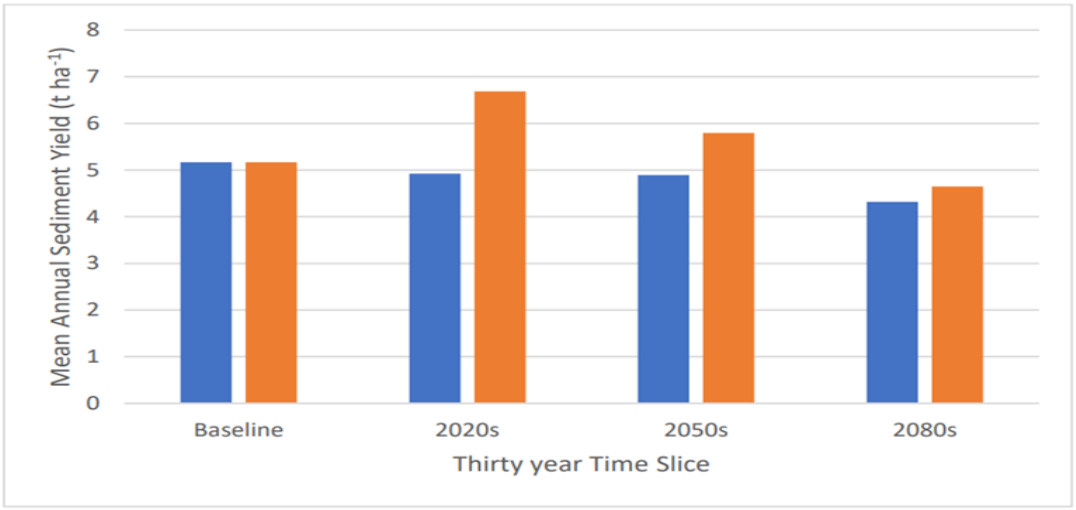


Figure 3-26: Rate of Clay Sediments in the Tigris and Euphrates Basins for Baseline and Future Scenarios of RCP 4.5 (Blue) and RCP 8.5 (Orange)

3.2.5 PROPOSED ADAPTATION SOLUTIONS AND KEY PRIORITIES TO INCREASE RESILIENCE IN THE WATER RESOURCES SECTOR

Significant attention should be given to this sector due to the risks facing Iraq, including climate change threats and its impact on water, health, food, and economic security, as the amounts of water reaching Iraq as a downstream country are decreasing. Future means to enhance the resilience of this sector include:

- Utilizing groundwater and rainwater harvesting and reducing water losses from irrigation channels through lining and infrastructure development.
- Supporting groundwater recharge projects and rehabilitating springs.
- Using modern technologies to monitor groundwater locations and their relationship with surface water.
- Developing water infrastructure, including reservoirs, dams, and water treatment facilities.
- Desalinating seawater using renewable energy and developing new technologies for that.
- Constructing dams for water harvesting and generating clean energy, improving irrigation efficiency, and adopting modern irrigation methods.
- Activating policies that encourage water conservation and penalize deliberate wastage.
- Rehabilitating drainage projects and linking them to major water disposal areas.
- Using alternative water sources such as greywater and treated water for agricultural and industrial purposes.

3.3 VULNERABILITY OF BIODIVERSITY SECTOR TO CLIMATE CHANGE

There are 82 important biodiversity areas in Iraq, including 44 sites in the Kurdistan Region (Figure 3-27), which represent potential future protected areas. The area of these regions is estimated at approximately 28,388 km² and includes a wide range of biological species and diverse and unique habitats at both global and regional levels. [77]

This chapter reviews biodiversity in Iraq and the key actions taken by the government to protect it. It also presents a study by ICARDA on land cover, dynamics of vegetation in the marshes, carbon flows, and proposes solutions for adaptation and increasing the resilience of this sector.

77 KBA,2017

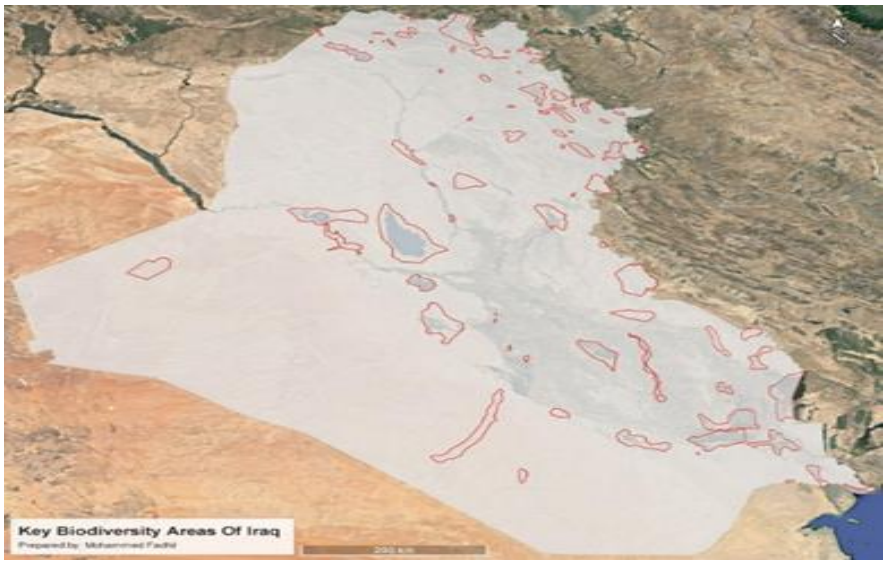


Figure 3-27: Important biodiversity sites (KBA, 2017)

3.3.1 BIODIVERSITY AND MEASURES TAKEN BY IRAQI GOVERNMENT

The International Union for Conservation of Nature (IUCN) [78] Red List of Threatened Species serves as a starting point for assessing biodiversity threats in Iraq. According to this list, 648 species of organisms in Iraq are threatened with extinction due to biological resource use, pollution, human development, and climate change (Figure 3-28).

Coral reefs in Iraqi waters are among the most vulnerable habitats, located in a narrow range (58 km²) in the northern Arabian Gulf at the mouth of the Shatt al-Arab, in an area characterized by poor visibility and rapid changes in conditions (temperature and salinity) due to strong currents. These coral reefs adapt to a harsh marine environment where water temperatures range from 14 to 34 degrees Celsius. Protecting these reefs could increase the catches of Iraqi fishermen, as 49% of local fish species depend on them.[79] Professionals in this field suggest that the health of Iraqi coral reefs be assessed, as they could serve as a valuable bioindicator as the impacts of climate change become more pronounced. [80]

78 The Sixth National Report on Biodiversity Convention in Iraq.
79 The Sixth National Report on the Convention on Biological Diversity in Iraq
80 Pohl, T., Al-Muqdadi, S., Ali, M. *et al.* Discovery of a living coral reef in the coastal waters of Iraq. *Sci Rep* **4**, 4250 (2014).

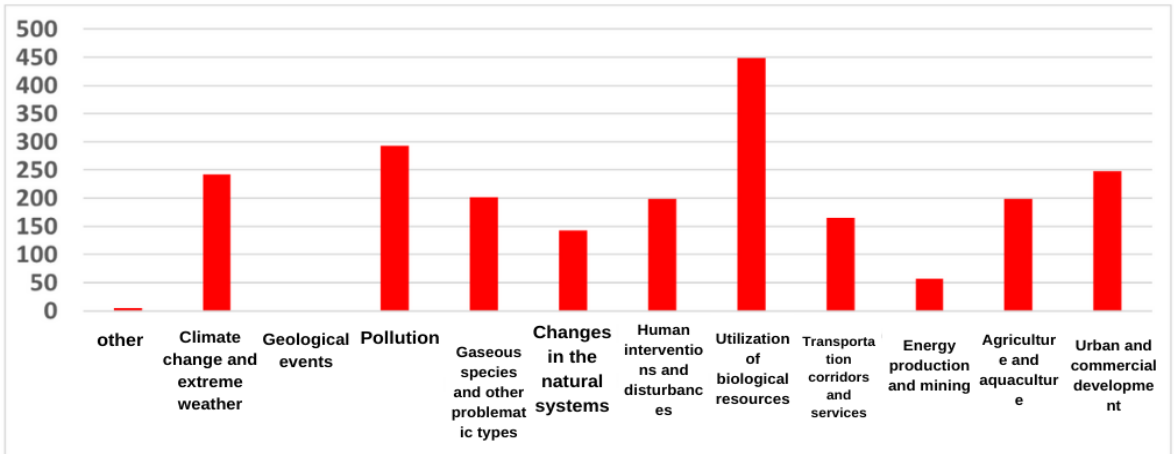


Figure 3-28: Major threats associated with 648 species assessed according to the IUCN Red List (Sixth National Report of the CBD in Iraq)

The Ministry of Environment is making significant efforts to protect the marine environment, identifying two important biodiversity sites: Khor Al-Zubair (105 km²) and the Al-Faw area (91.9 km²). These sites have been prioritized in conservation and protection plans[81], as illustrated in Figure (3-29).

Figure 3-29: Important biodiversity sites within the marine environment, including Khor Al-Zubair and Al-Faw (KBA report, 2017)

Iraq is committed to protecting ecosystems by establishing a network of protected areas. This includes four sites listed under the Ramsar Convention on Wetlands: the Central Marshes, Haur Al-Hawizeh, Haur Al-Hammar, and Lake Sawa, as well as four UNESCO World Heritage Natural Sites: Haur Al-Hawizeh, the Central Marshes, Eastern Hammar, and Western Hammar.

81 Key Biodiversity Areas of Iraq- KBA report ,2017

Additionally, Iraq has two nationally designated protected areas: Jabal Sakran (approved by the Kurdistan Regional Government) and the Central Marshes (approved by the federal government). Several other sites have been proposed and approved by the National Committee for Protected Areas and are awaiting official designation as natural reserves, including: Badra and Zurbatiyah, Al-Tayeb, Haur Al-Dalmaj, Al-Qadiriya, Bahr Al-Najaf and Al-Tarat, Hadaniya, Al-Rifaiya, Fawara Al-Zahra, Sawa, and Jabal Sanam. Barzan has already been approved as a protected area by the Kurdistan Regional Government.

Moreover, additional sites are under study for nomination, such as Lake Razzaza and Khor Al-Zubair (Figure 3-30). Two key biodiversity sites—Lake Razzaza and Lake Sawa, along with their surrounding lands—have been nominated for funding under the Global Environment Facility (GEF-7). The goal is to enhance integrated biodiversity conservation and combat land degradation caused by climate change, extreme weather, and desertification.

In 2013, Iraq's Council of Ministers (Resolution No. 289) declared the Central Marshes as a protected natural area under the name Mesopotamian Marshlands National Park, making it Iraq's first national park. In 2015, Al-Tayeb and Al-Dalmaj (Figure 3-31) were designated as pilot sites under the GEF-funded project for protected areas in Iraq. A significant milestone was reached in 2016, when Iraq's marshlands were recognized as a UNESCO World Heritage Site, acknowledging their natural, cultural, and archaeological importance.[82]

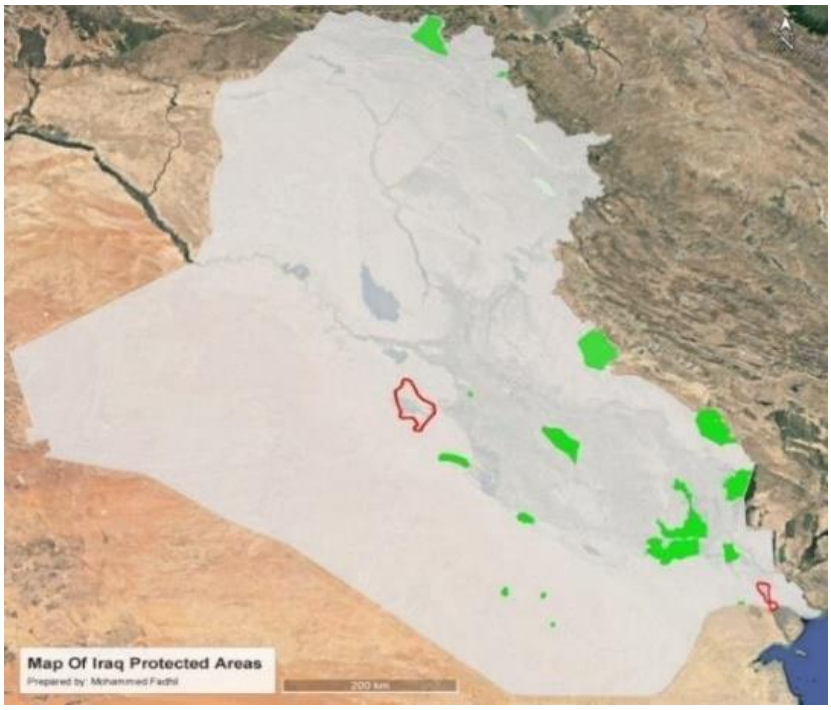


Figure 3-30: Locations of protected areas in Iraq

82 Database for the Marshes and Sustainable Management of Natural Environmental Systems in the Ministry of Environment

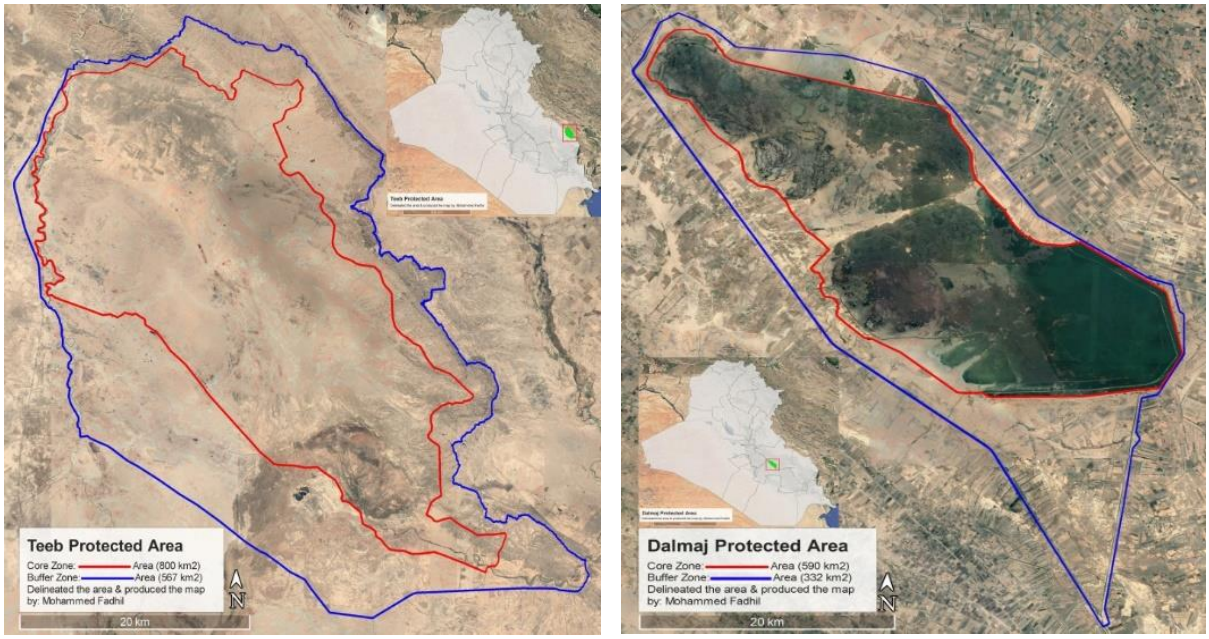


Figure 3-31: Location of Al-Dalmaj and Al-Tayeb Reserve (Ministry of Environment).

To restore the ecosystem in the marshlands and biodiversity areas of Iraq, the Iraqi government has revitalized the marshlands, with 50% of their area being re-flooded after 2003, leading to increased biodiversity and ecosystem services. These efforts have also enhanced the resilience of the region and carbon stocks, contributing to climate change mitigation. A precise calculation of carbon reductions has not yet been conducted, but they are expected to be significant. The government's measures to protect this area include:

- Protecting the Iraqi marshlands as a World Heritage Site, which is one way to increase ecosystem resilience.
- Issuing the Natural Reserves Regulation No. 2 of 2014, followed by the designation of several sites as protected areas.
- Establishing regulations on hunting and fishing in the marshlands under Regulation No. 2 of 2017.
- Maintaining a solid legal framework regarding land and water use and the protection of natural resources such as forests in both the federal government and the Kurdistan Regional Government, which prohibit the exploitation of agricultural land and deforestation.
- Regular monitoring of water flows, levels, and quality at the inlets and outlets of the marshlands and their feeder rivers.
- Removing encroachments and excessive water consumption along the feeder rivers to ensure water shares reach the marshlands.
- Carrying out dredging operations and clearing deep stream channels and rivers feeding the marshlands.

Examples of conservation measures taken by the Iraqi government:

- Reforestation efforts in Sulaymaniyah Governorate: The Ministry of Agriculture and Water Resources in the Kurdistan Region, with support from the German Agency for International Cooperation and a German company, implemented 24 small-scale projects over four months starting in October 2016. These projects aimed to rehabilitate natural and artificial forests at risk of wildfires in Sulaymaniyah, reduce mountain erosion into forest areas, and establish nurseries for tree collection, protection, and maintenance, including trees sourced from other provinces. Such projects also contribute to job creation for local communities.
- "Tamkeen" Project for Vegetation Development: In 2019, the Ministry of Agriculture launched a tree-planting campaign in 10 provinces (Baghdad, Wasit, Anbar, Diwaniyah, Dhi Qar, Salah al-Din, Nineveh, Maysan, Babylon, and Basra). This two-year project was funded by the Iraqi Bank with a budget of one billion Iraqi dinars under an initiative called "Tamkeen", aiming to plant 200,000 saplings of different tree species (such as eucalyptus, casuarina, cypress, dodonaea, oleander, and olive trees). The initiative is accompanied by training courses, meetings, and media campaigns targeting agricultural departments in the provinces, farmers, and agricultural employees.

3.2 LAND COVER STUDY USING REMOTE SENSING

Parts of the marshlands have been drained since the 1950s, with the process continuing throughout the 1970s for land reclamation and oil exploration purposes. During the 1980s and 1990s, the marshland ecosystem suffered widespread destruction, with more than 90% of the wetlands being drained. This led to the displacement of the Marsh Arabs, forcing them to migrate internally or seek refuge in other countries. [83]

After 2003, the marshlands experienced partial recovery; however, drought conditions upstream and the construction of dams in Turkey, Syria, and Iran slowed this recovery. Figure 3-32 shows the marshlands in southern Iraq in 1973 compared to 2000, indicating the location of the Iraqi marshes near the Iranian border. The right-side map illustrates the damage inflicted on the Iraqi marshlands (by 2000) due to drainage operations.[84]

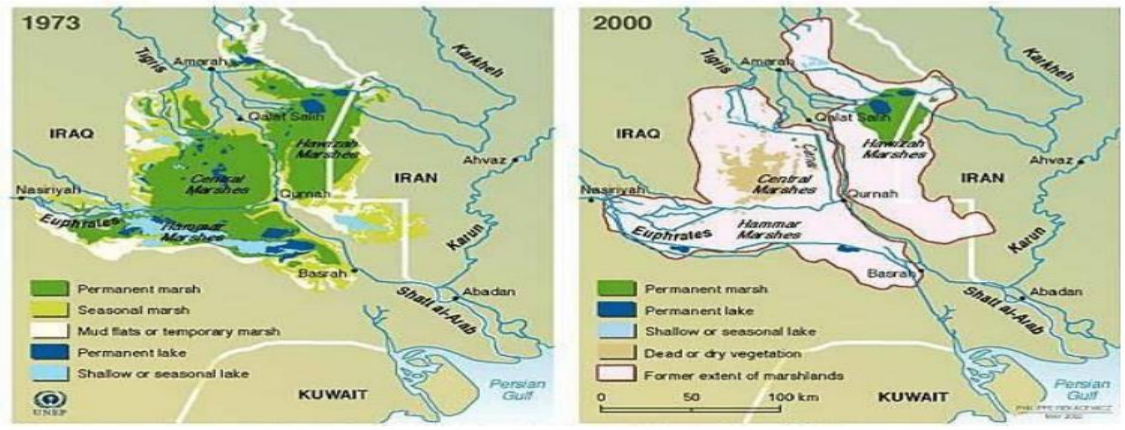


Figure 3-32: Marshes Map in Southern Iraq in 1973 Compared to 2000 (UNEP, 2001)

83 UNEP. 2001. The Mesopotamian marshlands: demise of an ecosystem, early warning, and assessment. Early warning and assessment. Division of Early Warning and Assessment, United Nations Environment Program, Nairobi, Kenya.
84 Ibid.

The Central Marshes in Iraq cover an area of up to 20,000 square kilometers and are divided into three main regions located between the Tigris and Euphrates rivers. Meanwhile, the Hammar Marshes are situated south of the Euphrates River, and the Hawizeh Marshes lie east of the Tigris River. To understand the historical changes affecting the marshlands due to various policies, climate change, and its impacts on the ecosystem, it is essential to analyze land cover dynamics with high spatial accuracy. High-resolution and long-term remote sensing data were used to study land cover, relying on the Landsat satellite series (Landsat 4, Landsat 5, and Landsat 8), which are equipped with different sensors. The study focused on the following time periods:1980-1990, 1990-2000, 2000-2010, and 2010-2020. The month of March was chosen as the optimal time for the study since vegetation is in full bloom during spring, and atmospheric haze is relatively low.

Figure 3-33 presents the land cover classification results over the Iraqi marshlands across the decades. The maps illustrate the wetland boundaries established by the United Nations Environment Programme (UNEP) in 2010. The land cover classification reveals that the area covered by "marsh vegetation" exceeded the official boundaries in the past. The 1990-2000 decade witnessed a significant decline in vegetation cover due to government policies that reduced water inflows to the Central Marshes and Hammar Marshes, leading to a retreat of "water bodies". Later, during the 2000-2010 period, policy changes allowed water flows to return, promoting vegetation regrowth. The marshes showed some recovery, but they did not fully regain their previous state due to environmental imbalances.

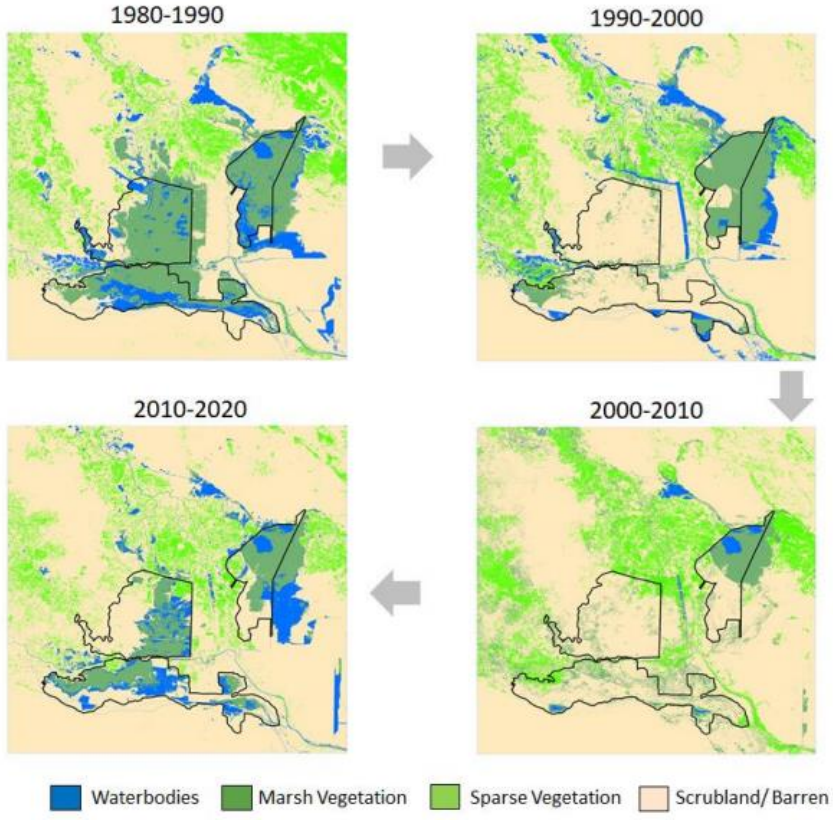


Figure 3-33: Multi-Decadal Land Cover Classification Results for the Iraqi Marshes Using High-Resolution Landsat Data (1980-2020)

It's evident that the vegetation cover of the marshes experienced a significant decline compared to the pre-1990s period, but it has shown a slight and steady recovery. On the other hand, open water areas decreased but have shown renewal in recent years. Figure 3-34 illustrates the rapid decrease in water surfaces from 1,750 km^2 during the decade from 1980 to 1990 to as low as 600 km2 during the

subsequent decade (1990-2000), then further down to 135 km2 for the period from 2000 to 2010. This dynamic change in land cover is immense and wouldn't typically occur under natural conditions (even with climate change). This indicates a deep-rooted impact on the regional environment, primarily through vegetation cover dynamics, and the interconnected water nourishment system influenced by many internal factors, suggesting a high likelihood of disrupting the environmental balance in the area concerning the region's specific flora and fauna.

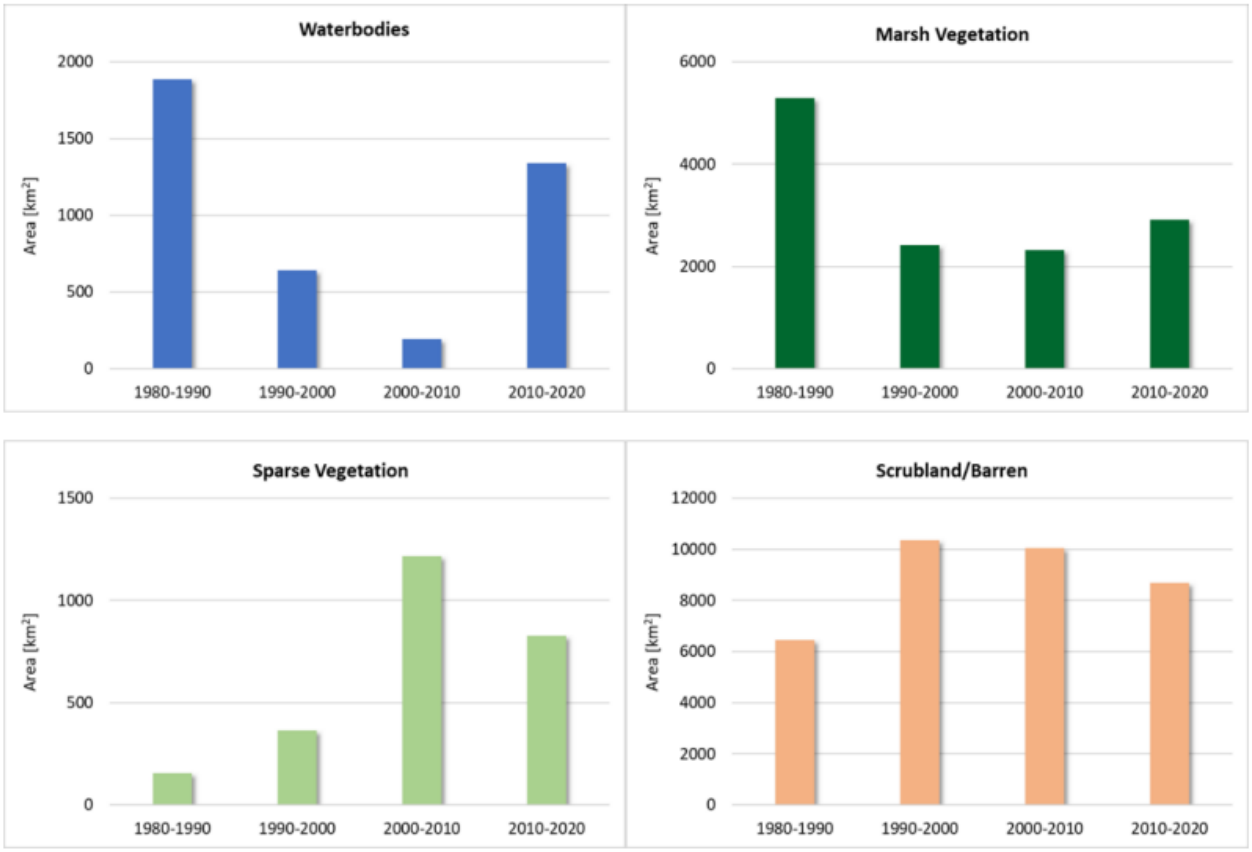


Figure 3-34: Changes between decades in land surface areas for different types of land cover in the Iraqi Marshes as inferred from remote sensing analysis

3.4.1 MARSH VEGETATION DYNAMICS

Vegetation cover is the primary indicator of environmental changes within an ecosystem and can be accurately monitored from space. Changes in the regional hydrological system are reflected through the dynamics of vegetation abundance and quality. The Enhanced Vegetation Index (EVI) is a tool designed to improve the accuracy of vegetation measurements, especially in areas with high biomass, and to enhance monitoring while minimizing atmospheric interference.

Analysis of vegetation trends across the three major marshlands (Central Marshes, Hammar Marshes, and Hawizeh Marshes) using the MODIS 16-Day L3 Global 250m EVI (MD13Q1) product shows that the Hawizeh Marshes experience greater vegetation growth compared to the other regions.

Figure 3-35 presents an analysis of vegetation pattern trends, with average values calculated across the marshes. Temporal trends indicate a slight increase in vegetation, with a significant decline between

2007 and 2012. This trend aligns with observations from spatial analysis using Landsat data. This period can be considered a rapid regeneration phase for the marshlands, as rehydration efforts began after 2000 to compensate for scattered vegetation that started emerging once rehydration took place, particularly after 2003, when the arid land surface began to regain water.

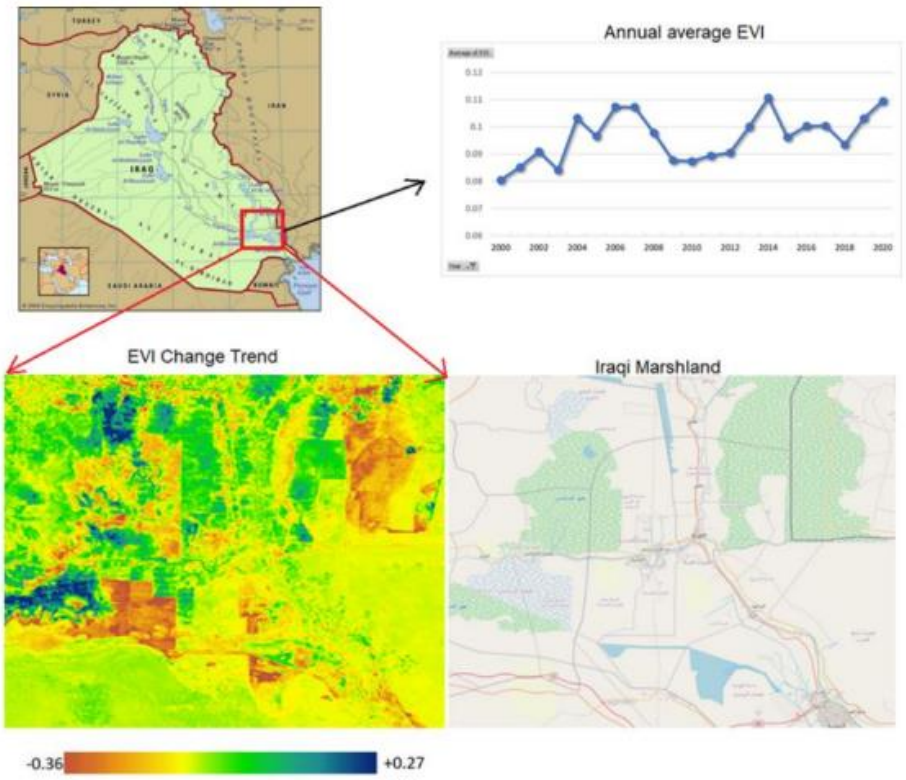


Figure 3-35: Temporal trends of vegetation cover dynamics (average annual change in EVI with year) as an average for the marsh's region

During the post-2000 period, when the marsh drainage policies ceased and the rewetting process began, vegetation trend maps can reflect the stages of renewal in these wetlands. Areas of increased vegetation activity appear either as locations that have not fully regained their vitality or as regions experiencing abundant growth of wetland plants. The Enhanced Vegetation Index (EVI) was analyzed for each of the three marshes: Hammar Marshes, Central Marshes, and Hawizeh Marshes:
Hammar Marshes: The Euphrates River primarily feeds the Hammar Marshes, which extend southward to Nasiriyah and the eastern border of Shatt al-Arab and the southern stretch of Basra. The marshes range in area from 2,800 km² under normal conditions to 4,500 km² during floods. Hammar Lake is the largest water body within the marshes, with a depth ranging from 1.8 to 3 meters in summer. Figure 3-36 shows that vegetation proliferation is concentrated in the central part of the western section of the Hammar Marshes, while the central area around the Rumaila oil fields shows a contrasting vegetation trend due to increased rehydration.

Central Marshes: The Central Marshes receive water from the branches of the Tigris River, such as the Al-Batira, Al-Areidh, and Dhanaib rivers, south of Amarah. This ecosystem covers an area of 3,000 km² and includes reed beds and several permanent lakes, such as Lake Umm al-Binni. Figure 3-37 shows slight vegetation proliferation, particularly in the north-central part of the marshes, reflecting a decrease in water flow from the Tigris River compared to historical rates, which reduces the ability to

maintain pond-like conditions. In contrast, vegetation decline is observed in the southern boundaries of the Central Marshes due to increased instances of stagnant water.

Hawizeh Marshes: The Hawizeh Marshes are located east of the Tigris River and along the Iraq-Iran border. The Iranian side of the marshes, known as Hoor Al-Azim, is fed by the Karkheh River, while the Iraqi side is supplied with less water from the Musharah and Kahla rivers, which are branches of the Tigris River. During spring flooding, the Tigris River can directly flow into the marshes, playing a vital role in maintaining the Hawizeh Marshes as a flowing water system and preventing it from becoming a closed saline basin, as shown in Figure 3-38.

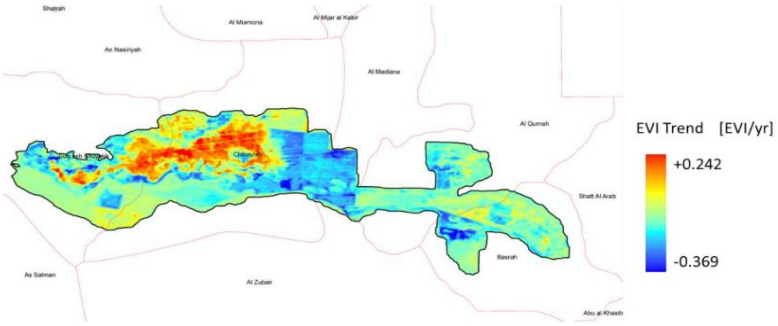


Figure 3-36: Vegetation cover trends across the Hammar Marshes

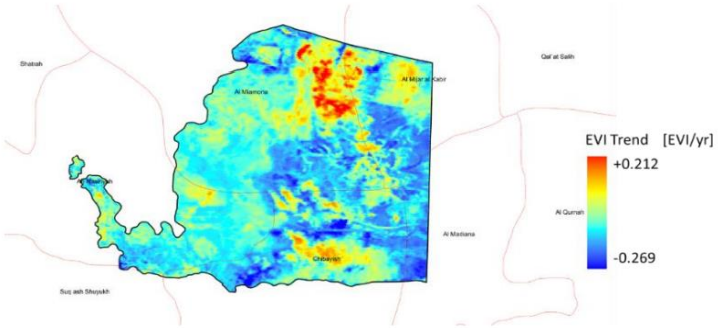


Figure 3-37: Vegetation cover trends across the Central Marshes

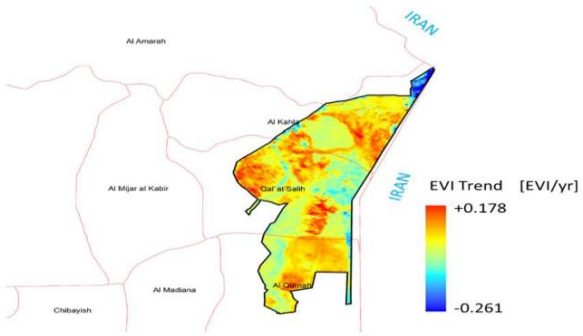


Figure 3-38: Vegetation cover trends across the Hawizeh Marshes

3.4.2 TEMPORAL- SPATIAL DYNAMICS OF CARBON FLUXES

The marshes are considered large carbon reservoirs due to their water-saturated soils and low-oxygen conditions, which delay chemical reactions, making them a major source of carbon sequestration. The increasing trends in carbon flow (NPP) in the marshes (Figure 3-39) demonstrate the ability of these wetlands to function as significant carbon reservoirs, despite the annual variability resulting from fluctuations in precipitation and surface runoff (Figure 3-40). This report indicates that NPP is part of the carbon balance and requires a comprehensive monitoring and modeling program to track carbon flows in these wetland ecosystems.

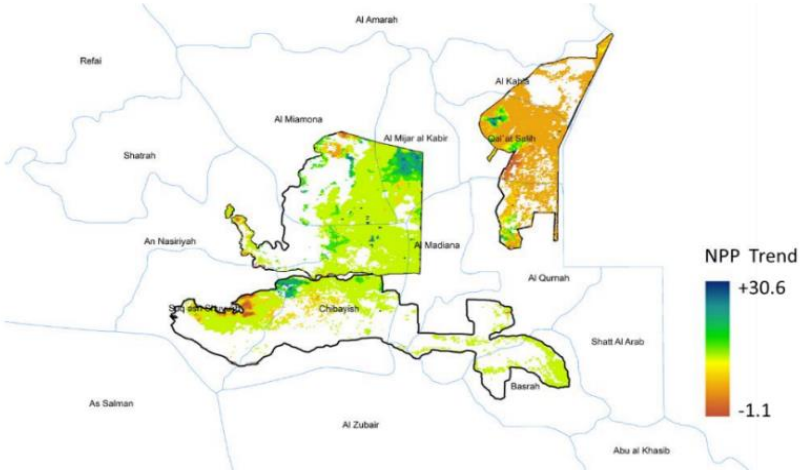


Figure 3-39 : Carbon flux trends across Iraqi marshes

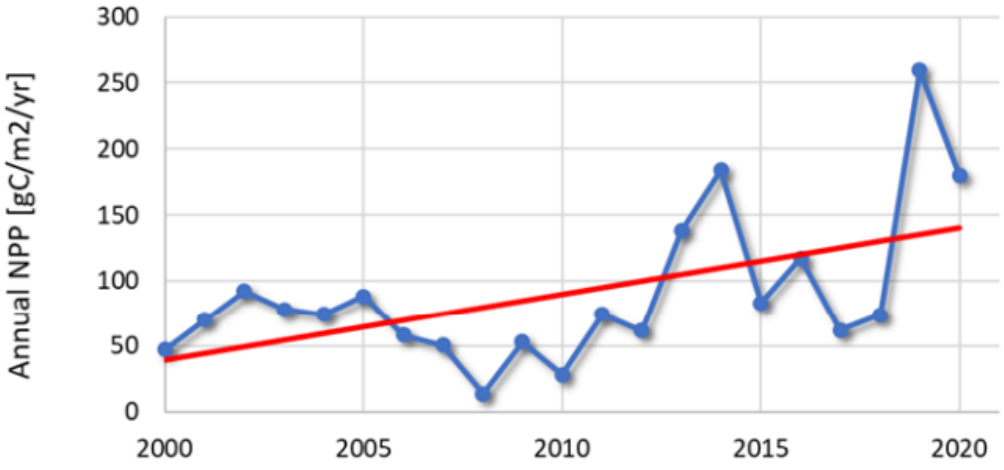


Figure 3.40: Long-term average trends of the annual primary production plan across the Iraqi marshland's regions

3.4.3 PROPOSED ADAPTATIONS SOLUTIONS AND KEY PRIORITIES FOR ENHANCING THE RESILIENCE OF BIODIVERSITY SECTOR

To enhance the resilience of the biodiversity sector and adapt to the impacts of climate change, it is suggested to adopt nature-based solutions to protect fragile environments, including:

- Increasing the number and diversity of protected areas to safeguard threatened species and vulnerable ecosystems, along with enforcing relevant laws.
- Restoring and sustainably managing forests to enhance their role in carbon sequestration and environmental protection.
- Preserving ecosystems that provide essential environmental services and are used to mitigate environmental hazards.
- Implementing genetic improvement for plant species to achieve high-yield varieties that can withstand harsh conditions.
- Creating oases in desert ecosystems to protect biodiversity.
- Bridging legal gaps to protect this vital sector.
- Protecting coastlines from erosion by planting suitable vegetation and trees.
- Developing programs for coral reef rehabilitation and coastal natural resource protection.

3.5 VULNERABILITY OF THE HEALTH SECTOR TO CLIMATE CHANGE

Climate change affects human health both directly and indirectly. Changes in rainfall patterns and rising sea levels contribute to increased pollution and the spread of waterborne diseases. Additionally, rising temperatures and increased humidity provide suitable environments for the transmission of infectious diseases through insects like mosquitoes. Scientific evidence suggests that climate change may lead to genetic developments in some viruses and bacteria, resulting in the emergence of more harmful strains, such as malaria parasites and the avian influenza virus.[85]

The World Health Organization considers climate change to be the greatest threat to global health in the 21st century due to its impact on air and water quality and food security. Scientific evidence links climate change to diseases such as heatstroke, heat stress, cardiovascular diseases, and respiratory diseases. Climate factors also affect workforce productivity. According to the International Labour Organization's 2019 report, heat stress could reduce working hours by 2.2% and decrease global output by $400.2 billion by 2030. The greatest threat is the decline in labor productivity due to heat stress, particularly among construction workers.

Under a scenario of a 1.5°C increase in temperature, Figure 3-41 shows that the percentage loss in GDP due to heat stress will double in Iraq by 2030 compared to 1995. Rising temperatures and a lack of water and food resources have led to significant health risks in Iraq.[86] The country has experienced increasing climate changes in recent years, such as drought and a higher frequency of dust storms associated with environmental degradation, which have negatively impacted the fragile health system. Furthermore, the rise in temperatures and dust storms has led to an increase in respiratory diseases such as allergies and asthma, especially among children and the elderly, along with a noticeable rise in the incidence of diseases such as cancer, and increased rates of mortality and illness from waterborne

85 National Strategies for Mitigating the Effects of Climate Change and its Impact on Achieving Environmental Security in Iraq - Master's Thesis - by Ali Dhafer Mohammed Al-Abbadi - 2020
86 Sixth Global Environment Outlook Report for the West Asia Region - 2015

and contaminated food diseases like cholera, malaria, and typhoid, in addition to non-communicable diseases such as heart attacks and malnutrition. [87]

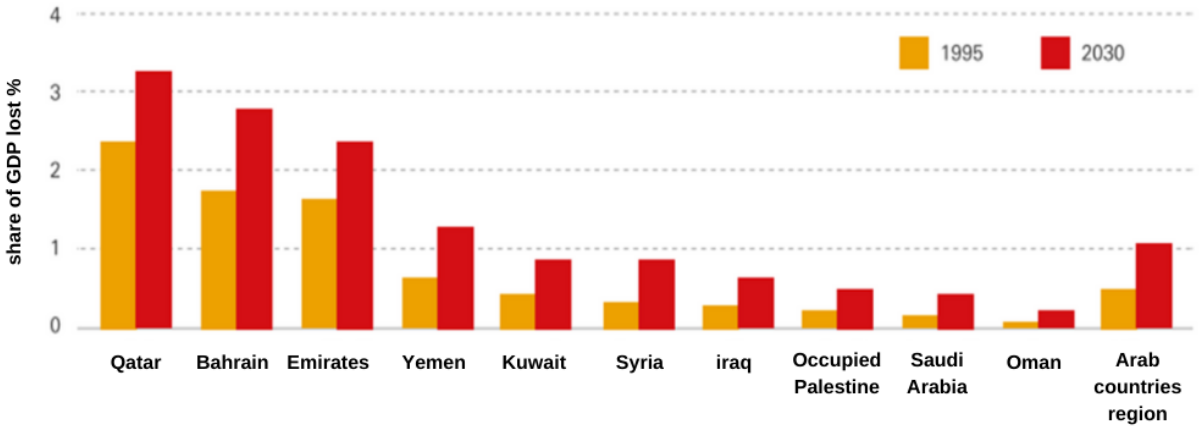


Figure 3-41: Percentage of GDP loss due to heat stress in the context of global warming and a 1.5-degree Celsius temperature rise (ILO, 2019)

The Iraqi government has expanded its plans to broaden the scope of free healthcare services for all citizens and has adopted a strategy by the Ministry of Health to adapt to the effects of climate change. The proposed adaptation measures to enhance the resilience of the health sector include:

- Enhancing adaptation strategies with gender considerations in mind.
- Rehabilitating vulnerable communities and poor groups to make them more resilient to health risks.
- Preparing a health and climate change atlas to identify the most vulnerable areas and conducting applied studies on health impacts.
- Establishing an early warning system for timely alerts and interventions in public health using modern technology.
- Raising health awareness in communities exposed to climate-related diseases.
- Improving healthcare services and increasing the resilience of the sector, while building the capacity of health personnel.
- Assessing the health sector's exposure to climate impacts with the aim of reducing mortality.
- Promoting community participation and raising awareness of the effects of climate change on human health.

87 The joint report of UNICEF, the World Health Organization, the Food and Agriculture Organization, and the United Nations Development Program - 2012

CHAPTER 4

MITIGATION ACTIONS

4 MITIGATION ACTIONS

This chapter provides a description of greenhouse gas mitigation scenarios at the national level from various sectors and explains the methodology for developing the baseline (reference) scenario, which includes information about the current status of these sectors and their emissions. The mitigation analysis also evaluates a range of potential interventions to reduce human emissions across different sectors, supporting global efforts to limit long-term global warming.

4.1 METHODOLOGY

The analysis of greenhouse gas (GHG) emissions mitigation at the national level was conducted sector by sector, examining the potential for reducing emissions in the energy sector (primary energy, renewable energy, and energy efficiency). To achieve this goal, two scenarios were developed: the baseline scenario and the mitigation scenario.

- Baseline Scenario: This scenario assumes that no future policies or programs aimed at reducing GHG emissions or enhancing carbon removal will be implemented. Establishing a logical baseline scenario is a crucial part of the mitigation assessment, as the benefits and additional costs of mitigation options are directly linked to the definition of the baseline scenario. The baseline scenario was built based on prevailing trends, plans, and national policies at the time of writing this chapter (Q1 2023), requiring forecasts of future levels for the period 2021-2050 based on current levels. These forecasts were based on assumptions regarding population growth, GDP, and other variables from official sources such as the United Nations, World Bank, and International Energy Agency.
- Mitigation Scenario: This scenario was developed according to a set of criteria reflecting the specific conditions of Iraq, such as the potential for significantly reducing GHG gas emissions, direct and indirect economic impacts, alignment with national development goals, the potential effectiveness of policies, sustainability of options, data availability, and other sector-specific criteria.

The scenarios and mitigation steps cover the period from 2021 to 2050, with the analysis in the energy sector based on the Low Emissions Analysis Platform (LEAP), a multifaceted software system for integrated energy planning and climate change mitigation assessment. LEAP is used to track energy consumption and production across all sectors of the economy. It was used for the first time in Iraq to analyze mitigation measures in the energy sector. The baseline scenario for the energy sector designates 2021 as the base year, considering the policies, programs, and projects outlined in the National Integrated Energy Strategy for the period 2013-2030 as confirmed inputs until 2050 using the LEAP emissions analysis model. For non-energy-related sectors (industry, agriculture, forestry, other land uses, and waste), the scenario was built using statistical and economic tools while considering population growth and GDP.

4.2 DATA SOURCES AND KEY ECONOMIC AND DEMOGRAPHIC CONSIDERATIONS

The basic macroeconomic data used to build the baseline scenario was obtained from the following sources:

- GDP Data: Historical values were taken from the World Bank website, while short-term forecasts (2021-2027) were obtained from the International Monetary Fund (IMF) website[88], and long-term forecasts (2028-2050) were sourced from the International Institute for Applied Systems Analysis (IIASA) database.[89]
- Value-Added Data: Figures from the World Bank website were used to calculate the value added in various economic sectors.
- Population Data: Data on population numbers, household sizes, and expected population growth rates (rural and urban) for the period (2010-2050) were obtained from the United Nations website and the Global Data Lab.
- Energy Demand Data: Historical data (1995-2020) was based on energy balances from the International Energy Agency (IEA) website, while demand for the period (2020-2050) was projected based on local and global trends, population growth, and economic growth.
- Electricity Generation Data: Sourced from the Ministry of Electricity, the Global Energy Station Database of the World Resources Institute, and the World Bank database.
- Wasted and Lost Electricity During Transmission and Distribution: Obtained from the International Energy Agency (IEA) website.
- Oil Refining Data: Taken from the National Integrated Energy Strategy for the period 2013-2030 and the International Energy Agency (IEA) website.
- Oil and Natural Gas Production Data: Sourced from the National Integrated Energy Strategy for the period 2013-2030 and the International Energy Agency (IEA) website.

4.3 DESCRIPTION OF THE REFERENCE SCENARIO AND ESTIMATION OF ITS EMISSIONS FOR ALL SECTORS

Below is a description of the sector, strategies, and activities taken into consideration in the reference scenario until the year 2050.

4.3.1 DEMAND AND SUPPLY

Total final energy consumption in Iraq reached 22552 kilo tons of oil equivalent according to the International Energy Agency statistics for 2018, distributed sectorally as follows: Transport sector 50%, residential sector 24%, industrial sector 19%, and other sectors 7%. The overall energy mix consists predominantly of 78% oil, 21% natural gas, and less than 1% renewable energy.

88 IMF WEO. (2021, April). IMF World Economic Outlook. Retrieved from https://www.imf.org/en/Publications/WEO/weo-database/2021/April.
89 IIASA. (n.d.). Shared Socioeconomic Pathways. (SSP#2, OECD model versions) (2025-2100) SSP Public Database (Version 2.0). Retrieved from https://tntcat.iiasa.ac.at/SspDb.

4.3.2 CRUDE OIL

Iraq's oil reserves are estimated at approximately 144.3 billion barrels[90], making it the fifth-largest holder of conventional oil reserves in the world, following Saudi Arabia and Iran. Production is concentrated in 33 oil fields, managed by five oil companies: North Oil, South Oil, Missan Oil, Dhi Qar Oil, and Basra Oil. Additionally, there are 58 non-producing oil fields. Crude oil production peaked at 3.5 million barrels per day in 1979, declined to 2.3 million barrels per day in 2010, and reached 4.2 million barrels per day in 2022, with plans to increase production to 4.5 million barrels per day in 2023. Currently, 80% of production is concentrated in four main fields: Rumaila, Kirkuk, West Qurna, and Zubair. The Rumaila and Kirkuk fields are the most mature, achieving reserve-to-production ratios of 45 years for Rumaila and 80 years for Kirkuk, while other fields have reserve-to-production ratios exceeding 100 years, with significant potential for production capacity growth.

The amount of oil refined in refineries was 256.8 million barrels, with a total designed capacity of 278.1 million barrels.[91] However, current production of petroleum products and dry gas does not meet local demand, especially for the Ministries of Industry and Minerals and Electricity, leading to the need for importing petroleum products, particularly light products such as gasoline and diesel oil. Iraq has three main refineries located in Baiji, Dora, and Basra, with a designed refining capacity of up to 900,000 barrels per day. However, due to aging production units and sabotage, the available refining capacity is approximately 600,000 barrels per day. There is a gap between demand and production, as Iraq produces more fuel oil than local demand, while gasoline, diesel, and liquefied petroleum gas production falls short of local needs, increasing the necessity for imports. On the other hand, fuel oil production exceeds demand, and due to the inability to sell the entire quantity produced locally, it is sometimes exported or blended with crude oil.

4.3.3 NATURAL GAS

Iraq has three producing natural gas fields and 58 non-producing fields (either under development or discovered) [92], with natural gas reserves estimated at approximately 130 trillion cubic feet. In 2022, dry gas production reached around 1,317 million cubic feet per day, and liquefied gas production was 5,571 tons per day.[93] The oil fields also produce associated gas, with associated gas production in 2022 amounting to approximately 3,015 million standard cubic feet per day, expected to reach 4,106 million standard cubic feet per day by the end of 2023.

The quantities of utilized associated gas in 2021 and 2022 were approximately 1,565 and 1,603 million standard cubic feet per day, respectively, while the amounts of flared gas for the same years were about 1,411 and 1,421 million standard cubic feet per day. It is anticipated that gas production will reach 6.5 million standard cubic feet per day, in line with the global average reserve-to-production ratio of 47 years. Currently, more than 40% of the produced gas is flared, which represents a waste of natural resources and a significant source of air pollution, due to inadequate infrastructure for collecting and processing associated gas. According to the International Energy Agency's report, gas production in Iraq is expected to increase by 84% by 2026 and by 160% by 2030 compared to 2022 data.[94]

90 https://www.rystadenergy.com/
91 Data from the Ministry of Oil / Department of Studies, Planning, and Monitoring / Document with number 9728 dated 3/4/2022.
92 According to the document from the Ministry of Oil number 11358 dated 5/4/2023.
93 https://www.rystadenergy.com/
94 International Energy Agency (IEA) Report for the year 2022.

4.3.4 ELECTRICITY GENERATION

According to 2018 data, the energy mix used for electricity generation consists of 50% natural gas, 48% oil, and 2% from renewable sources. Iraq faces a severe electricity production shortfall estimated at about 15-20% of total demand based on 2021 data. This shortfall imposes significant costs on the economy, resulting in wasted production time, damage to capital assets due to power outages, and an inability to conduct business operations reliably. The interruption of energy supplies has led to the proliferation of private diesel generators, increasing production costs, noise, air pollution, and emissions of large amounts of CO_2.

Preliminary estimates from the National Integrated Energy Strategy indicate that the cost of electricity shortages to the Iraqi economy exceeds $40 billion annually. To mitigate these impacts, the Ministry of Electricity developed a plan in 2010 to increase generation to meet demand by the end of 2015; however, this target has not been achieved.

4.3.5 RENEWABLE ENERGY SECTOR

Despite being one of the largest producers of oil and gas in the world, Iraq is seeking to diversify its energy sources by harnessing renewable energy. Iraq's efforts in this area include developing solar, wind, and hydro energy through various projects in collaboration with specialized companies. In 2020, the Iraqi Ministry of Electricity announced the launch of several renewable energy projects, including a solar power generation project in Anbar Province and another for wind energy generation in Dhi Qar Province. Iraq is expected to see further expansion in renewable energy in the coming years as part of its efforts to diversify energy sources and achieve environmental and economic sustainability.

4.3.6 TRANSPORTATION SECTOR

The transportation sector in Iraq is considered a vital part of the infrastructure, but it faces numerous challenges, such as increasing demand for transportation services due to population and economic growth, as well as a lack of services. To overcome these challenges, it is essential to improve infrastructure, increase investment in public transport, and enhance management to efficiently organize transportation movement. To achieve this, Iraq needs a comprehensive strategy. The Ministry of Transport has already begun implementing reforms through annual plans aimed at:

- Improving infrastructure and applying electronic governance.
- Developing available transportation means such as buses, trains, and airplanes, and enhancing mass transit by increasing the number of public transport buses.
- Encouraging the private sector to invest in the transportation sector.
- Investing in clean and environmentally friendly energy sources, keeping up with modern technology to support mitigation of climate change impacts, such as the suspended train project and the shift toward sustainable transportation and hybrid vehicles.

4.3.7 INTEGRATED NATIONAL ENERGY STRATEGY FOR THE PERIOD 2013-2030

The Integrated National Energy Strategy for the period 2013-2030 was launched in Iraq in 2013, aiming to achieve energy security by improving the energy sector in Iraq. This objective is clearly reflected in the strategy's vision, which is to "develop the energy sector in an interconnected, coherent, sustainable, and environmentally friendly manner to meet local energy needs, foster multidimensional national economic growth to improve the living standards of Iraqi citizens, create new job opportunities, and position Iraq as a major player in regional and global energy markets." Based on the stated vision, five pillars of the strategy can be derived:

- Energy Security: Meeting domestic energy demand reliably in terms of products, quantities, quality, and price.
- Maximizing Government Revenue: Achieving the highest level of government revenue through investments in the energy sector.
- Economic Diversification: Developing industries and services to diversify the Iraqi economy and increase the share of non-oil GDP, including non-oil energy sectors, government services, and revenues from other sectors.
- Job Creation: Achieving the highest level of employment opportunities and household income.
- Environmental Sustainability: Reducing the negative impact of the energy sector on the environment.

The strategy includes a set of objectives and measures, including:

- Improving energy efficiency and reducing waste.
- Increasing oil and natural gas production and enhancing Iraq's export capacity.
- Diversifying energy sources by increasing renewable energy production.
- Developing the electricity sector and improving the transmission and distribution system.
- Enhancing the capabilities of workers in the energy sector and developing its institutions.
- Strengthening international partnerships in the energy field.

The Integrated National Energy Strategy relies on several actions and policies, including encouraging investment in the energy sector and renewable energy, energy efficiency, developing legislation and regulations governing the sector, and recommending enhancing partnerships between the public and private sectors.

4.3.8 POLICIES, LAWS AND ENERGY INFRASTRUCTURE PROJECTS

The legislative framework for the Iraqi oil sector consists of a set of laws and regulations that govern various oil activities such as exploration, production, export, and distribution. Among these laws are the Hydrocarbon Resource Conservation Law No. 84 of 1985, the Oil Products Import and Sale Law No. 9 of 2006, the Law on Combating Oil Smuggling and its Derivatives No. 41 of 2008 and its instructions, and the Private Investment Law in Oil Refining No. 64 of 2009 and its instructions.

The Iraqi government is working on developing policies to enhance investments in the oil sector and improve environmental and social performance, such as:

- Export Policy: Aims to achieve the highest revenues through the export of oil products.
- Environmental Regulations: Focus on preserving the environment and reducing the environmental impacts of exploration operations.

- Local Capacity Development Policy: Seeks to enhance the skills of local workers and encourage cooperation between local and international companies.
- Infrastructure Development Policy: Aims to improve the infrastructure of the oil sector.

In the framework of the Integrated National Energy Strategy, the strategy recommended implementing a number of initiatives for the oil sector, including:

- Expanding the crude oil pumping system in northern Iraq: Raising the unloading capacity to 2.25 million barrels per day and considering alternatives for transporting crude through Turkey and Syria to the Mediterranean Sea, or through Jordan to the Red Sea. The plans include rehabilitating and expanding the pipelines extending to Turkey and Syria, and creating new lines to increase export capacity.
- Expanding the crude oil pumping system in southern Iraq: Raising the unloading capacity to 6.8 million barrels per day by 2014, through the establishment of four additional floating export ports and increasing the export capacity of the Khor Al-Amaya port. A portion of this capacity will be allocated for a new type of heavy crude oil.
- Rehabilitating the strategic oil transportation line between southern and northern Iraq: Aiming to transport Basra light crude to northern oil unloading centers. Part of the strategic line has been rehabilitated and a parallel line added to increase the capacity to 2.9 million barrels per day.

The Integrated National Energy Strategy recommends the Ministry of Oil to implement three main initiatives in the natural gas sector:

1. Accelerating the establishment of associated gas collection facilities: This includes separating gas from crude oil through pressure to ensure the utilization of the produced gas instead of burning it.
2. Developing gas infrastructure: This includes linking gas processing plants to demand centers for the production of dry gas, liquefied petroleum gas, and light naphtha. It also involves enhancing the existing infrastructure between processing plants, refineries, and end-users, and boosting the capacity of filling, storage, and export centers in the south.
3. Completing the master gas plan: With the increase in the number of power generation stations and new industrial facilities, a detailed technical study is required to design an integrated infrastructure that includes a network of pipelines, storage facilities, and pressure and central control centers to ensure effective management of associated gas.

Iraq also faces significant challenges in the electricity sector, suffering from a severe shortage in generation capacity, resulting in substantial economic losses estimated at over $40 billion annually. To overcome these challenges, the strategy recommends the following:

1. Building 40 new power stations: These stations will add 22 gigawatts to the current generation capacity, with flexibility in fuel use (natural gas or fuel oil) until the gas infrastructure is fully developed. The new stations will rely on the more efficient and environmentally friendly combined cycle gas turbines (CCGT).
2. Replacing oil with natural gas: Iraq aims to increase the percentage of natural gas used in electricity generation from the current 25% to 80% by 2030, allowing for oil export and use in refineries and industry instead of burning it.
3. Expanding and enhancing the transmission and distribution network: Iraq will work to reduce technical losses and improve network management through a smart grid program.
4. Gradually increasing electricity consumption fees after 2016: Fees will be adjusted to align with production costs, with measures introduced for demand management, such as eco-friendly building codes and load monitoring programs.

5. Enhancing the use of renewable energy sources: The use of solar and wind energy will be expanded to meet demand in remote areas and connect them to the grid, with the feasibility of generating electricity from hydropower being studied. Renewable generation capacity is expected to reach 2 gigawatts by 2030, representing about 5% of the total capacity of the electricity system.

4.4 EMISSIONS ACCORDING TO THE BASELINE SCENARIO OF GHG FROM THE ENERGY SECTOR

This section of the report provides an overview of GHG emissions from the energy sector according to the reference scenario developed using the LEAP program.

Data extracted from the national GHG inventory indicates that the energy sector was the main source of GHG emissions in Iraq, accounting for approximately 85% of total emissions in 2019, with a contribution of 150.68 million tons of CO_2 equivalent. The energy sector and its sub-sectors are expected to remain a major source of emissions in the future.

Estimates from the reference scenario suggest that the share of the energy sector in emissions will decrease to 81% of total emissions by 2050, due to Iraq's increasing reliance on renewable energy sources and improvements in energy efficiency in the future. According to the reference scenario, the primary sources of GHG emissions from the energy sector include electricity generation, transportation, industrial activities, residential activities, oil production and refining (Figure 4-1).

Data indicates that emissions are expected to nearly double between 2020 and 2050, projected to reach 271.31 million tons of CO_2 equivalent compared to 138.58 million tons in 2020 (Table 4-1).

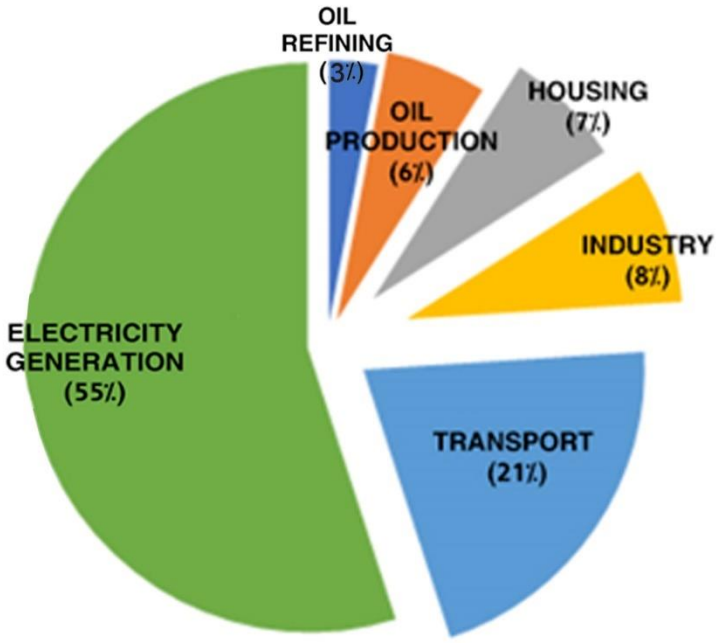


Figure 4-1: Contribution of sub-sectors of energy to GHG emissions (%) for the year 2021.

Table 4-1: Total GHG emissions from the energy sector in the base scenario for selected years.

Scenario	2020	2021	2025	2030	2035	2040	2045	2050
Emissions from Sector	138.58	138.97	159.56	189.32	214.51	235.51	254.08	271.31

* Excluding fugitive emission calculations

The following describes the assumptions of the reference scenario for estimating GHG emissions from various sub-sectors in energy supply and demand:

- Energy consumption was classified by sector and type of fuel used, including residential, services, industry, transportation, and non-energy uses. Historical data was obtained from the International Energy Agency for the period 1995-2020, and future forecasts were based on historical data as well as economic and demographic growth trends.

- The assumptions related to power generation are based on the expansion of capacity and generation according to the type of power plant, along with transmission and distribution losses on the supply side. Other sectors include oil refining and oil and natural gas production.

CO_2 will remain dominant in GHG emissions from the energy sector, a trend expected to continue for many years to come (Tables 4-2 and 4-3, and Figure 4-2).

Table 4-2: GHG emissions from energy demand and supply by subsectors in the baseline scenario for selected years (million tons of CO_2 equivalent)

Activity	2000	2010	2020	2030	2040	2050
Demand	44.33	46.89	49.37	61.62	73.67	77.06
Residential	6.89	10.91	9.50	9.59	9.01	7.94
Industrial	10.49	7.57	10.49	14.31	18.43	20.28
Transportation	26.91	28.35	29.31	37.62	46.12	48.71
Other/Services	0.05	0.06	0.07	0.09	0.12	0.13
Conversion	19.09	37.66	89.28	127.79	161.95	194.38
Electricity Generation	16.12	34.00	77.18	104.35	138.51	170.93
Oil Refining	2.65	3.38	4.00	11.36	11.36	11.36
Oil Production	0.31	0.28	8.11	12.08	12.08	12.08
Total (Demand + Conversion)	63.42	84.54	138.66	189.41	235.63	271.44

Table 4-3: GHG Emissions by Gas in the Baseline Energy Scenario for Selected Years (Million Metric Tons of CO2 Equivalent)

GHG	2000	2010	2020	2030	2040	2050
Carbon Dioxide	76.87	101.49	173.46	241.47	287.43	323.12
Methane	41.97	53.57	108.41	161.56	161.63	161.67
Nitrous Oxide	0.54	0.61	0.78	1.05	1.23	1.31

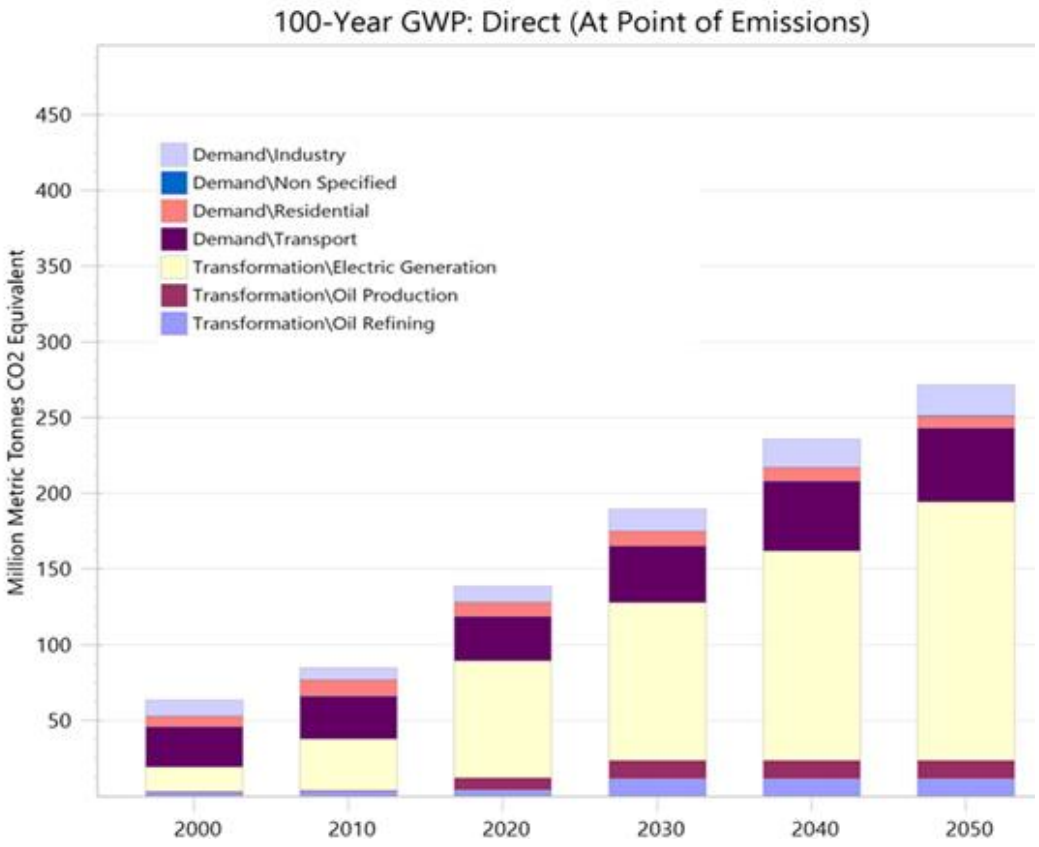


Figure 4-2: GHG Emissions (Million Tons CO2 Equivalent) by Energy Sectors in the Reference Scenario for Selected Years

4.5 REFERENCE SCENARIO FOR OTHER SECTORS

4.5.1 INDUSTRIAL OPERATIONS SECTORS

According to statistics from the Iraqi Ministry of Planning, the total volume of industrial production in Iraq in 2020 amounted to approximately 20.7 trillion Iraqi dinars (about 14 billion US dollars). The main industries in Iraq include oil and gas, petrochemicals, fertilizers, food, and beverages, dairy and cheese, iron and steel, cement, chemicals, furniture and wood products, clothing and textiles, electrical and electronic appliances. Industrial commodity exports from Iraq in 2020 amounted to approximately 4.7 billion US dollars. The most important industrial exports include refined oil and petrochemicals, iron and steel, cement, clothing, and textiles.

In 2020, the number of industrial companies operating in Iraq was approximately 472, including both government-owned and private companies. According to official statistics, government investments in productive industries in Iraq in 2020 amounted to around 375 billion Iraqi dinars (approximately 256 million US dollars). The Iraqi government focuses its efforts on developing strategic industries, including oil, gas, petrochemicals, and electrical industries, by providing incentives and necessary facilities to companies operating in these sectors.

The industrial sector in Iraq encompasses various industries, including six energy-intensive sectors: petrochemicals, fertilizers, steel, aluminum, cement, and bricks. The petrochemical and fertilizer industries require substantial amounts of natural gas as raw material.

Industrial processes contributing to GHG emissions include the production of cement, ammonia, iron, and steel. As of 2010, Iraq had 20 cement factories with a designed capacity of 23 million tons per year. Some of these factories are in poor condition, and the electricity shortage has reduced operational capacity, with the current cement production meeting only half of the local demand.

4.5.2 AGRICULTURAL SECTOR

According to official statistics, the agricultural area in Iraq was approximately 9.5 million hectares in 2020, with a total agricultural production of 11.5 million tons. The forests in Iraq are sparse and cover less than 1% of the country's area, primarily concentrated in northern Iraq, such as the Kurdistan mountains and areas adjacent to the Turkish border. Iraqi forests consist of oak, pine, cypress, Lebanese cedar, and acacia trees, providing vital habitats for a variety of animals and birds.

The Iraqi lands are characterized by vast areas of pastures and marshes, which represent an important resource for wildlife, agricultural, pastoral, and hunting uses. The marshes are one of the prominent wetland areas in Iraq, located in the south along the border with Iran, covering an area of over 20,000 km². They are known for their rich ecological diversity, including many endangered plant and animal species, and serve as habitats for numerous migratory and local birds.

Pastures cover extensive areas of agricultural land in Iraq and are a significant source for livestock breeding and the production of milk and meat. The grasses and plants in the pastures vary according to geographical regions, highlighting the importance of managing these pastures sustainably to enhance productivity and preserve biodiversity and environmental integrity.

4.5.3 WASTE MANAGEMENT SECTOR

Iraq produces approximately 31,000 tons of solid waste daily; however, a significant portion of this waste is improperly disposed of, resulting in environmental pollution and negative impacts on public health and quality of life. In 2019, the estimated quantities of wastewater generated were around 1,112 million cubic meters annually, while the quantities treated were approximately 670 million cubic meters annually, representing only 60.3% of the total. The country has 64 treatment plants serving 34.5% of the population, which is considered a low percentage. Additionally, about 17,400 tons of sludge were produced during the same year, some of which is used for agricultural purposes.

4.5.4 GHG EMISSIONS IN THE BASELINE SCENARIO FOR VARIOUS SECTOR

The baseline scenario was estimated based on the actual emissions of various economic sectors from the GHG inventory and the shared database of the European Commission. Post-2019 forecasts were built based on the expected increase in GDP as shown in Table 4-4.

Table 4-4: Total GHG Emissions for Various Sectors (Excluding Energy) in the Baseline Scenario for Selected Years

Baseline Scenario	2020	2021	2025	2030	2035	2040	2045	2050
IPPU	6.69	6.88	8.18	10.52	13.31	15.79	18.11	20.41
AFOLU	10.19	10.29	10.69	11.19	11.69	12.19	12.69	13.19
Waste	10.72	11.02	13.10	16.85	21.32	25.29	29.00	32.70
Total Emissions	27.60	28.19	31.97	38.56	46.32	53.27	59.80	66.30

4.5.5 TOTAL GHG EMISSIONS IN THE BASELINE REFERENCE SCENARIO.

The net anthropogenic GHG emissions in 2019 amounted to approximately 178.11 million tons of CO2 equivalent, based on the national GHG inventory calculations using default emission factors in accordance with the Intergovernmental Panel on Climate Change (IPCC) Guidelines (2006), due to the unavailability of national factors. These emissions are expected to increase, according to international calculations for the baseline scenario, from 310.16 million tons in 2021 to 552.28 million tons of CO2 equivalent by 2050. The calculations for the baseline scenario were based on the integrated national energy strategy, which indicates that 40% of the natural gas in the fields is being flared (Table 4-5).

Table 4-5: GHG Emissions in the Baseline Scenario for Iraq (Million Tons of CO_2 Equivalent)

Year	Energy	Emissions from Combustion	IPPU	AFOLU	Waste	Total Emissions in Baseline Scenario
2020	138.58	144.01	6.69	10.19	10.72	310.19
2021	138.97	143.01	6.88	10.29	11.02	310.16
2025	159.56	174.85	8.18	10.69	13.10	366.39
2030	189.32	214.66	10.52	11.19	16.85	442.53
2035	214.51	214.66	13.31	11.69	21.32	475.49
2040	235.51	214.66	15.79	12.19	25.29	503.44
2045	254.08	214.66	18.11	12.69	29.00	528.54
2050	271.44	214.66	20.41	13.19	32.70	552.28

4.6 DESCRIPTION OF THE MITIGATION SCENARIO AND ESTIMATION OF EMISSIONS FOR ALL SECTORS

Mitigation measures were prepared in accordance with Annex III of Decision 1 of the 17th Conference of the Parties, which relates to the guidelines for the preparation of reports on national communications updates for a two-year period regarding climate change. This decision obliges non-Annex I parties to provide information on measures aimed at mitigating the effects of climate change by addressing anthropogenic emissions according to sources and sinks for all GHGs not covered by the Montreal Protocol. During the preparation of this chapter, four pathways for GHG mitigation measures (35 projects) were identified and analyzed, and they were added to the list of mitigation measures. The updated mitigation scenario includes several projects focusing on the following areas: primary energy, renewable energy, and energy efficiency

4.6.1 DESCRIPTION OF MITIGATION PATHWAYS AND PROJECTS IN THE ENERGY SECTOR

Pathway One: Reducing Losses in Electricity Transmission and Distribution Networks and Improving Power Plant Efficiency This pathway aims to enhance the efficiency of electricity generation plants and reduce losses in electricity transmission and distribution networks from 20% in 2020 to 15% by 2030 and 10% by 2050. The project involves implementing gradual improvements that include optimal distribution and generation aspects, improving system power factor, and upgrading or replacing conductors and insulators with lower resistance equipment. The project also seeks to reduce the carbon footprint in the oil and gas sector by developing wells and oil refineries.

Pathway Two: Retiring Fossil Fuel Power Plants (While Retaining Gas Plants) This pathway includes 21 projects to increase the capacities of certain combined-cycle plants and convert simple gas units to combined-cycle units for electricity generation, with a total capacity of 8,789 megawatts between 2021 and 2030. Iraq aims to cease operations of diesel-powered plants by 2026 and then convert all fossil fuel-powered plants to combined gas units by 2035.
Pathway Three: Investing in Associated Gas and Utilizing It in Power Generation, Industry, or Export This pathway includes four projects aimed at reducing the amounts of flared gas by 50% by 2030,

which will decrease methane emissions and increase the available supplies of natural gas for other uses. The dual impact of this pathway is to reduce emissions from flaring and provide larger quantities of natural gas.

Pathway Four: Increasing the Share of Renewable Energy in the Energy Mix
This pathway includes nine proposed projects for generating electricity from solar energy in various regions of Iraq, with a total capacity of 7,755 megawatts between 2021 and 2030. These projects aim to raise the share of renewable energy in the energy mix to 8.5% by 2030 (3% hydropower, 2.5% wind energy, and 3% solar energy) and to 12% by 2050 (5% hydropower, 3% wind energy, and 4% solar energy). For details on these pathways, refer to Annex One Report (BUR).

4.7 ESTIMATION OF TOTAL REDUCTIONS FROM MITIGATION PATHWAYS

A total of 35 projects have been proposed within four pathways to reduce GHG emissions in the energy sector, focusing on electricity generation and the utilization of associated gas. These projects are expected to achieve a cumulative reduction in GHG emissions of 324.78 million tons of CO_2 equivalent by 2030 and 2311.12 million tons by 2050, respectively.

Table 4-6 illustrates the expected reductions from the implementation of these pathways for the years 2021, representing the beginning of climate action; 2025, representing the end of the first period of the (NDCs) submitted by Iraq; and 2030, representing the end of the second period of that document. Additionally, Table 4-7 shows the expected cumulative reductions for each pathway in 2030 and 2050, which correspond to the long-term implementation periods of the reduction strategies under the Paris Agreement.

Table 4-6: Expected reduction quantities for each pathway Years.

Year	Reduction from Electricity Generation Pathways (1, 2, 4)	Reduction from Associated Gas Investment Pathway (3)
	Million Tons of CO_2 Equivalent	
2021	5.09	-
2025	29.90	24.62
2030	65.40	80.61

Table 4-7: Mitigation pathways and cumulative reduction quantities for each of them

Mitigation Pathways	Cumulative Reduction of Pathway (Million Tons of CO2 Equivalent)
Pathway One: Project to Reduce Losses in the Electricity Transmission and Distribution Network and Improve the Efficiency of Power Generation Stations.	In 2030: 324.78 In 2050: 2311.12
Pathway Two: Project to Retire Fossil Fuel Power Plants.	
Pathway Four: Project to Increase the Share of Renewable Energy in the Energy Mix	
Pathway Three: Project to Invest in Associated Gas and Its Uses in the Energy Production, Industry, or Export Sector	In 2030: 331,34 In 2050: 1,943.47

4.8 FINAL OVERALL RESULTS OF MITIGATION ANALYSIS

4.8.1 THE OVERALL SCENARIO FOR MITIGATING GHG EMISSIONS

A set of interventions has been proposed to mitigate GHG emissions across several sectors, including primary energy, renewable energy, and energy efficiency. These interventions are expected to achieve reductions in GHG emissions of 54.52 million tons by 2025, 166.83 million tons by 2035, and 205.16 million tons by 2050.

Table 4-8 presents the net GHG emissions for both the baseline scenario and the mitigation scenario for selected years, while Figure 4-9 illustrates the comparison of the mitigation scenario against the baseline scenario up to 2050.

Table 4-8: Net GHG emissions for both the baseline scenario and the mitigation scenario for selected years (million tons of CO_2 equivalent).

Year	Baseline Scenario	Mitigation Scenario	Reduction (million tons of CO_2 equivalent)
2020	310.19	310.19	0.00
2021	310.16	305.07	5.09
2025	366.39	311.87	54.52
2030	442.53	296.52	146.01
2035	475.49	308.66	166.83
2040	503.44	323.93	179.51
2045	528.54	336.27	192.27
2050	552.28	347.11	205.17

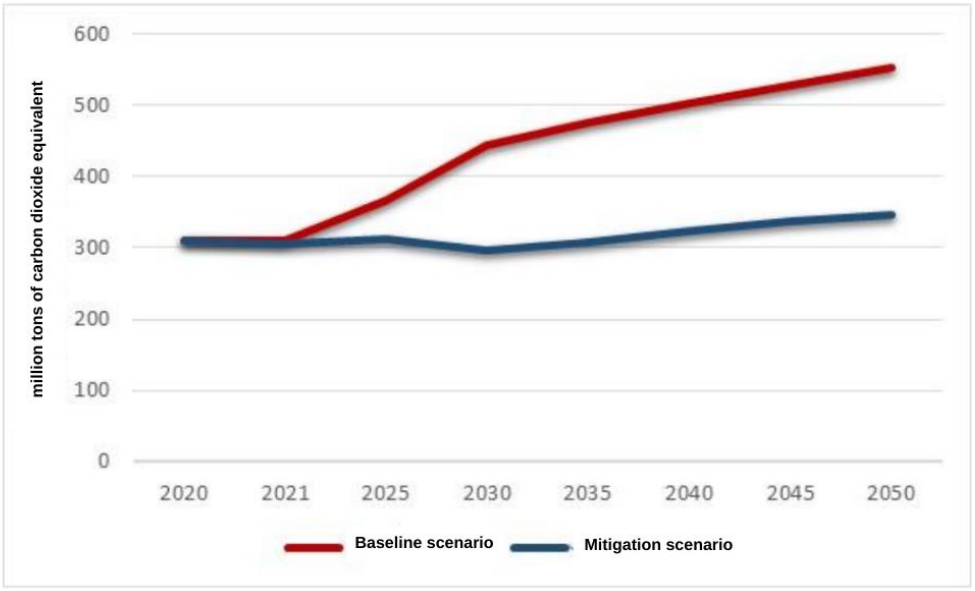


Figure 4-3: Comparison of the Mitigation Scenario with the Baseline Scenario, 2021-2050

4.8.2 PROPOSED ADDITIONAL PATHWAYS AND PROGRAMS THAT MAY ENHANCE REDUCTION RATES IN THE FUTURE

In addition to the direct pathways proposed to reduce GHG emissions, which focused on measures in the energy sector (electricity generation and refining), this section presents additional proposals for programs and measures that could form an ambitious mix of policies and projects to achieve further emission reductions.

The proposed measures in various sectors include:

Oil and Gas Sector:

- Expanding associated gas investment projects in different areas of Iraq, such as the Al-Halfaya complex in southern Iraq with a capacity of 300 million cubic meters per day. The project aims to reduce gas flaring by 50% by 2030 while utilizing associated gas for other uses.

Energy Sector (Energy Efficiency and Renewable Energy):

- Generating electricity from hydrogen.
- Generating electricity from wind energy.
- Establishing environmentally friendly waste-to-energy power plants (Bio Power).
- Replacing old street and building lighting with energy-efficient lamps.
- Expanding renewable energy projects in airports and the health sector.
- Utilizing solar-powered heaters in airports.
- Operating agricultural equipment on solar power instead of diesel.
- Producing solar-powered agricultural pumps.

Energy Efficiency in the Industrial Sector:

- Replacing fuel used in cement industry kilns with gas.
- Recycling heat generated from cement kilns.
- Improving electrical capacity with power factor correction equipment.
- Producing vanadium inhibitors to increase energy efficiency.

Transportation Sector:

- Converting public transport vehicles from gasoline to natural gas.
- Opening 60 new public transport routes and increasing the number of buses to 500.
- Adding liquid gas systems to gasoline-powered vehicles.
- Shifting towards the use of electric vehicles and establishing charging stations.
- Promoting the use of electric public transportation.

Waste Sector:

- Recycling waste to reduce landfill contributions, such as plastic and used tires.
- Recycling plant and animal waste as organic fertilizer.

Forestry, Agriculture, and Land Use Sector:

- Increasing vegetation cover (green belts) around certain sites.
- Planting mangrove trees to reduce CO_2 and protect Iraqi coastlines from erosion.
- Enhancing organic carbon storage in soil through sustainable agricultural practices.
- Rehabilitation of existing forest sites and increasing their area to reduce CO2 levels.
- Increasing green spaces in urban expansion areas and along roadways.
- Expanding the cultivation of walnut, pomegranate, and olive trees.

CHAPTER 5

OTHER INFORMATION

5 PUBLIC AWARENESS, EDUCATION, AND CAPACITY BUILDING

This chapter provides additional information relevant to achieving the goals of the United Nations Framework Convention on Climate Change (UNFCCC). According to the Convention's guidelines, non-Annex I parties are required to provide information on their contributions to climate data research and monitoring, as well as the implementation of a technology transfer framework for adaptation and mitigation. Additionally, information must be provided regarding actions and efforts related to education, training, and awareness-raising about climate change, capacity building, information exchange, communication, and networking.

5.1 NATIONAL PRIORITIES FOR FINANCING CLIMATE MITIGATION EFFORTS

According to the Nationally Determined Contributions (NDC) document and its implementation roadmap, Iraq has identified priority sectors for reducing greenhouse gas emissions, including energy, industry, agriculture, waste, transport, and construction. The Iraqi national contribution also focuses on adaptation measures for the ten sectors most vulnerable to climate change, which include water, agriculture, health, natural ecosystems and forests, coastal areas and rising sea levels, sewage and waste, climate events and recurring risks, energy and transport, higher education, scientific research and technology, and tourism and world heritage.

Most areas of Iraq still lack a specific climate policy. Here are some priority directions that have emerged as actual needs during the implementation period of Iraq's national contribution:

- Halting all flaring of associated gas.
- Establishing waste sorting and recycling stations.
- Converting power generation stations from petroleum fuel to renewable energy or gas.
- Adopting policies to encourage investment in renewable energy.
- Taking action to reduce deforestation and increase forest areas.
- Utilizing combined cycle technology to benefit from the heat generated during power production.
- Promoting the use of smart meters in all areas of Iraq.
- Encouraging advanced technologies for hydrogen production and its use as clean energy.

Enhancing enabling environments and capacity building, along with better coordination of relevant policies, is essential to scale up climate programs. To mobilize more private financing, public funding must be used effectively to build appropriate regulatory frameworks, develop technical capacities, employ staff, improve national and local institutional arrangements, and risk mitigation mechanisms. At the national level, information related to education and training, public awareness-raising, capacity building, and steps taken to integrate climate change into policies, studies, and research is of great importance in the context of national reporting.

5.2 INFORMATION RELATED TO IMPLEMENTING THE OBJECTIVES OF THE FRAMEWORK CONVENTION

5.2.1 RAISING PUBLIC AWARENESS

Environmental awareness aims to disseminate and deepen environmental knowledge among all segments of society through appropriate means and messages, encouraging them to participate in protecting the environment and conserving its resources. Since climate change is a challenge of our time, and women and children are the most vulnerable to it, comprehensive environmental awareness has become essential, with a need to establish strategies, plans, and laws targeting all community segments, especially the most vulnerable groups.

To enhance public awareness about the impact of climate change in Iraq, the Development Acceleration Lab of the United Nations Development Programme (UNDP) worked through the "Learning Journey on Climate Change" project (2020) to develop innovative methodologies for studying environmental challenges. The project focused on analyzing the reasons behind the community's weak sense of responsibility regarding climate change issues. The first phase of the research revealed a lack of studies related to climate change in Iraq, particularly those highlighting community roles and local solutions, and showed the need to unify stakeholder efforts under a common vision.

In the second phase, 12 stakeholders from various sectors were identified to participate in discussion sessions on climate change challenges in Iraq. The "Mission 1.5" game was also launched to raise awareness on this topic. An analysis of the existing ecosystem in Iraq revealed a gap between the efforts of official entities and the local community, as it was found that local populations were unaware of the government initiatives being implemented, hindering the achievement of the desired change.

The team at the Development Acceleration Lab in Iraq conducted surveys of residents and analyzed their behaviors in facing climate change issues, aiming to identify active stakeholders and motivate them to educate the community about their responsibilities towards climate change.

5.2.2 CAPACITY BUILDING

Climate action in Iraq aims to take necessary measures to mitigate the risks of environmental degradation, climate change, and disasters by building capacities and providing technical support to ministries, government departments, and local and regional authorities. This effort is intended to empower these entities to fulfill their legal and regulatory obligations, enhance environmental sustainability, and halt climate change in Iraq.

Among the initiatives, the "Stimulating Climate Action in Iraq" project (2022), supported by the UNDP, stands out. This two-year project aims to enhance Iraq's capacity to adapt to climate change, manage natural resources, and increase resilience to climate-related risks. The project also targets support for the Iraqi government and the Kurdistan Region in achieving their climate ambitions, with a focus on renewable energy, water resource management, and preparedness for drought and other disasters.

The "Addressing Climate Change in Iraq and the Middle East" program, part of the Reviving the Mesopotamia initiative (2021), focuses on reforestation, water management, sewage treatment, reducing carbon emissions, and expanding the use of clean energy. The success of the program relies

on coordination between ministries and government agencies, as well as the enactment of new legislation to promote environmental transformation.

To ensure the success of the Reviving the Mesopotamia project, Iraq seeks support from international agencies, such as the World Bank and the International Monetary Fund, to build capacity and provide necessary funding for climate change adaptation. Iraq is also working with the UNDP to implement the second workshop project to train on dealing with the Green Climate Fund, aiming to build the capacities of the relevant national authority and ensure access to fund financing. Iraq is expected to complete this project by the fourth quarter of 2023, which will enhance its participation in national and regional climate change mitigation initiatives.

5.2.3 PROMOTING GREEN INNOVATION AND TECHNOLOGY

Iraq is implementing projects in the oil and gas sector in collaboration with international partners and is utilizing associated gas. However, the country still requires additional emission reductions. Associated gas from oil in the southern region constitutes two-thirds of Iraq's natural gas, with approximately 630 billion cubic feet being flared, continuing to occur until 2021, making Iraq the second-largest country after Russia in gas flaring. Iraq is expected to achieve an additional production of 1.2 billion cubic feet of flareable gas per day by the end of 2023, highlighting the need to focus on technologies that reduce flaring during production.

Iraq is cooperating with the United Nations Program to accomplish a project aimed at enhancing carbon reduction in Baghdad, funded by the Global Environment Facility (GEF). Additionally, the Central Bank of Iraq has launched an initiative to transition to renewable energy sources in collaboration with the Higher Lending Committee, which includes support for residential projects that rely on solar energy.

The Ministry of Environment, in collaboration with the Climate Technology Centre and Network (CTCN), has prepared a document outlining technological needs for the industry, energy, agriculture, and water resources sectors, aiming to reduce greenhouse gas emissions and enhance adaptation to climate change. This document includes plans for improving energy generation, enhancing energy efficiency, stimulating research and development, promoting sustainable agriculture techniques, water management, and waste treatment.

Energy plans focus on overcoming electricity shortages, increasing energy production from waste, and encouraging the use of renewable energy in public buildings. In the industry, efforts are centered on improving manufacturing efficiency and recycling waste heat. In water resources, the focus is on improving water management and developing early warning systems. In agriculture, plans include enhancing productivity, combating desertification, and improving agricultural management practices.

5.2.4 HIGHER EDUCATION, SCIENTIFIC RESEARCH, SCIENCES, AND TECHNOLOGY, AND INCORPORATING CLIMATE CHANGE IN CURRICULA

Scientific research is one of the most critical pillars of progress in all countries, regardless of their size or wealth. No country can achieve a level of advancement without coordinated and targeted research that is practically applied.[95] Consequently, most nations allocate a significant portion of their annual budgets to research and development. Addressing the impacts of climate change requires enhancing scientific research and technological development in fields such as technology transfer, industry, oil, energy, and transportation. Therefore, it is essential to prioritize the preparation of comprehensive studies on climate change and its effects and to support graduate students in conducting research on these issues.

Despite the progress made in this area, there is still a need for increased support for scientific research, particularly through boosting the national budgets allocated for research and development. The Ministry of Higher Education, in coordination with the Ministry of Environment, is working to increase opportunities for graduate students to study in advanced countries, which enhances the reliability and quality of research. Scientific twinning programs and the development of institutions according to global standards are strategic pillars of higher education in Iraq, especially in areas that contribute to solving community problems. [96]

To improve research activities, there is a need to reactivate the Scientific Research Council and establish new research centers in universities, while also revitalizing existing centers, increasing the number of registered research papers in international journals, and enhancing the exchange of scientific expertise with institutions both within Iraq and abroad, alongside bolstering research mission programs.[97]

The UNDP, in collaboration with Iraqi ministries, has implemented a project to promote the use of solar energy, which included the installation of six research stations to study the types of solar panels suitable for Iraq's conditions. This project opened avenues for cooperation between the public and private sectors in the field of renewable energy and encouraged the review and analysis of national laws related to renewable energy. Additionally, the Ministry of Environment has implemented an awareness program as part of the national strategy for environmental protection to encourage the use of renewable energy sources, particularly solar energy.

95 Iraq's Need for Scientific Research, especially in the Topic of Global Climate Change Impacts, by Dr. Nasrat Adamu, Researcher in Water Resources and Global Climate Change, 2014.
96 Climate and Development Report for Iraq - World Bank Group, 2022
http://documents.worldbank.org/curated/en/099725011152218218/P177639022730b00009631058ac78c5972b
97 Iraq's need for scientific research, especially in the topic of the impacts of global climate change, Dr. Nasrat Adamo, researcher in water resources and global climate change, 2014.

ANNEX 1

IRAQ'S FIRST BIENNIAL UPDATE REPORT

6 ANNEX 1 – IRAQ'S FIRST BIENNIAL UPDATE REPORT

This annex includes Iraq's first Biennial Update report, which the Iraqi government decided to attach to the second national communication due to the simultaneous preparation of both documents. It has been prepared in accordance with the guidelines outlined in the Framework Convention on Climate Change, which non-Annex I Parties must follow when preparing their interim reports. This report aims to provide the latest information on the measures taken by the state to implement the convention, update national greenhouse gas (GHG) inventory lists, outline the actions taken to reduce emissions, and present its current needs along with the technical and financial support it has received

6.1 NATIONAL GHG INVENTORY- YEAR 2019

GHG inventories (emissions and removals) have been prepared based on Decision 17 of the Eighth Conference of the Parties, which requires each non-Annex I Party to provide estimates of human-induced emissions of carbon dioxide (CO_2), methane (CH4), and nitrous oxide (N2O) by source, as well as estimates of removals by sink, where appropriate and as far as possible. The decision also encourages non-Annex I Parties to provide information on human-induced emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6) if feasible. Additionally, Parties are encouraged to report on human-induced emissions from other GHG sources, such as carbon monoxide (CO), nitrogen oxides (NOx), and non-methane volatile organic compounds (NMVOCs). Other gases not covered by the Montreal Protocol, such as sulfur oxides, may be included at the discretion of the relevant authorities based on guidelines from the Intergovernmental Panel on Climate Change (IPCC).

6.1.1 METHODOLOGY- NATIONAL INVENTORY LIST CALCULATIONS

The national GHG emissions for 2019 were estimated using the Intergovernmental Panel on Climate Change (IPCC) Guidelines 2006 and the 2019 Refinement, along with the IPCC Software for non-Annex I parties to the United Nations Framework Convention on Climate Change, as well as a workbook on how to use Excel to calculate volatile emissions.
National experts relied on Tier 1 methods for all sectors and sub-sectors due to the lack of available data for higher tiers. The sub-sectors included:

National experts used Tier 1 for all sectors due to the unavailability of necessary data for higher tiers. The sectors and sub-sectors considered include:

1. Energy:
    - Combustion in stationary and mobile sources
    - Volatile emissions
2. Industrial Processes and Product Use (IPPU):
    - Mining, chemical, and metal industries
    - Non-energy products and solvent use
3. Agriculture, Forestry, and Other Land Use (AFOLU):
    - Livestock
    - Land
    - Total sources and non-CO2 emissions sources
4. Waste Management and Sewage (Waste):
    - Solid waste disposal
    - Systematic and open waste burning
    - Wastewater treatment and discharge

An inventory was conducted for each gas type using mass units, estimating the quantities of anthropogenic direct GHG emissions for carbon dioxide, methane, and nitrous oxide, by sources and sinks.

Using the IPCC Guidelines 2006 and 2019 Refinements and its software (Version 2.691), indirect GHG such as non-methane volatile organic compounds, nitrogen oxides, and carbon monoxide for the energy sector were also estimated. An Excel workbook was used to calculate volatile emissions from the oil and gas sector. In the reporting tables for the inventory results, the codes NO (not occurring), NE (not estimated), and NA (not applicable) were used when necessary, following best practices. All direct and indirect gases were accounted for in gigagrams, as well as direct gas emissions in terms of carbon dioxide equivalent (CO_2 equivalent). The global warming potential values specified in the Second Assessment Report of the Intergovernmental Panel on Climate Change (100-year time horizon) were used to convert the gas measurement units.

6.2 GHG INVENTORY BY SECTOR

In 2019, Iraq contributed emissions totaling 177,617.19 gigagrams of CO_2 equivalent. The distribution of total GHG emissions in Iraq by sector shows that the energy sector was the main source, accounting for 84.72% of national emissions, followed by waste management and wastewater sector at 10.73%.

Table 6-1: GHG Emissions by Sector, 2019

Category	Emissions (Gigagrams of CO_2 equivalent)	Percentage of Total
Total National Net Emissions	177,617.19	100
Energy	150,484.50	84.72
IPPU	2,414.64	1.36
AFOLU	5,652.37	3.18
Waste	19,065.68	10.73

6.2.1 GHG EMISSIONS IN THE ENERGY SECTOR

Energy-related activities contribute significantly to GHG emissions in Iraq. These emissions are classified into two main categories: emissions from fuel combustion and fugitive emissions (non-combustion emissions). In 2019, total emissions from the energy sector amounted to 150,484.50 Gg CO_2 equivalent, with 80.76% resulting from fuel combustion and 19.24% from fugitive emissions from oil and natural gas, as shown in Table 6-2 and Figure 6-1. Within fuel combustion activities, the largest share of emissions came from the energy industries sector, accounting for 67%, followed by the transport sector with 18%. Other sectors, such as the residential sector, manufacturing industries, and construction, contributed 8% and 7%, respectively, to total emissions (Figure 6-2)

Table 6-2: Net Emissions of the Energy Sector, 2019

Category	Net CO_2	CH_4	N_2O	Total Energy Sector Emissions	NOx	CO	NMVOC
	gigagrams	gigagrams of CO_2 equivalent			gigagrams		
Energy Sector	133,122.46	16,762.80	599.24	150,484.50	141.85	33,256.75	996.43
1. Fuel Combustion Activities	120,838.76	153.24	542.81	121,534.81	141.85	33,256.75	629.54
Energy Industries	81,187.90	49.73	124.62	81,362.25	72.99	28.49	2.24
Manufacturing Industries and Construction (ISIC)	8,381.63	7.13	21.04	8,409.79	58.02	7.40	2.89
Transport	21,208.09	64.87	381.79	21,654.75	3.22	33,214.88	624.20
Other Sectors (Residential, etc.)	10,061.14	31.51	15.08	10,107.73	7.62	5.98	0.20
Unspecified	NE	NE	NE	NE	NE	NE	NE
2. Fugitive Emissions (Oil and Natural Gas)	12,283.70	790.93	0.18	28,949.67	NA	NA	366.90

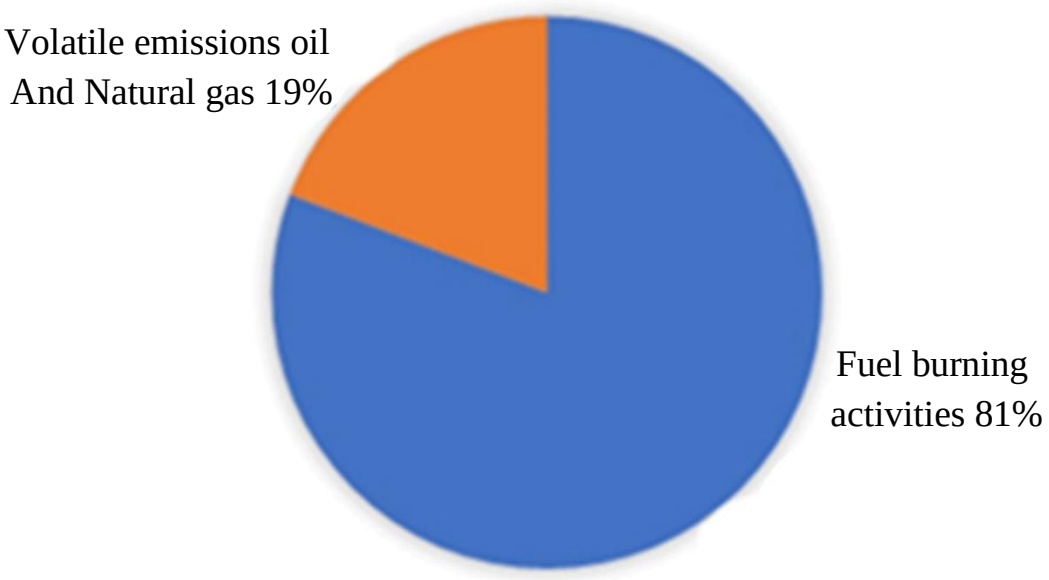


Figure 6-2: Emissions (%) from the Energy Sector, 2019

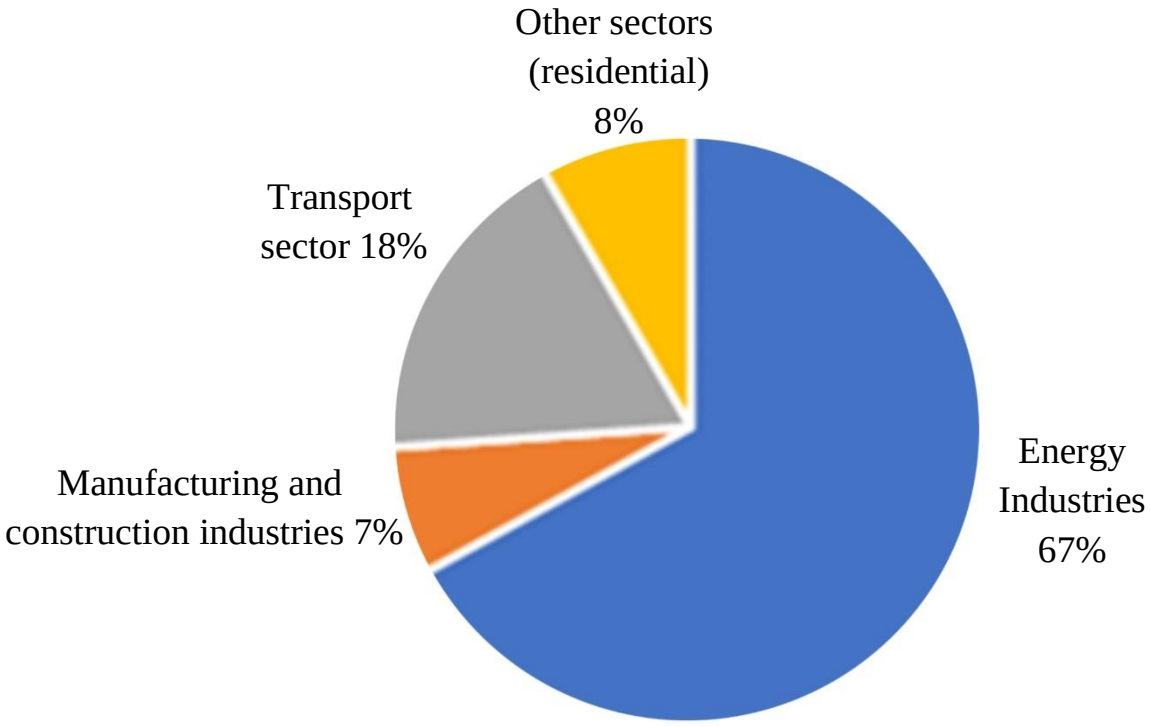


Figure 6-3: Emissions (%) by Subsector within the Fuel Combustion Activity Sector, 2019

6.2.2 GHG Emissions from International Navigation

Emissions from international air and maritime navigation for the year 2019 were estimated as shown in Table 6-3.

Table 6-3: Reported Emissions under memo 5, 2019

Emissions	CO_2 Net	CH_4	N_2O	Total Emissions
	gigagrams	gigagrams of CO_2 equivalent		
Total International Navigation	868.1312	0.752	7.39	876.53
Air Navigation	691.8512	0.412	5.97	698.23
Maritime Navigation	176.28	0.34	1.42	178.30

6.2.3 GHG Emissions from the IPPU Sector

In 2019, GHG emissions from the Industrial Processes and Product Use (IPPU) sector amounted to 2,414.64 Gg of CO_2 equivalent, representing 1.36% of Iraq's total GHG emissions. These emissions primarily originated from the mineral industry within the public sector only, due to the lack of available data on the private sector (Table 6-4).

Table 6-4: Emissions from Sub-sectors of Industrial Operations, 2019

Sector	Giga Grams of CO_2 Equivalent	Percentage
IPPU	2414.64	100
Mining Industries	2412.73	99.92
Chemical Industries	1.73	0.07
Metal Industries	0.19	0.01

6.2.4 GHG Emissions Results in the AFOLU Sector

In 2019, GHG emissions from activities in the agriculture, forestry, and other land use sector accounted for 3.18% of total emissions in Iraq, equivalent to 5,652.37 Gg of CO_2 equivalent. These activities are a source of emissions primarily consisting of methane and nitrous oxide, generated from various subcategories (Table 6-5).

Table 6-5 GHG emissions from the AFOLU

Sector	Net CO_2	CH_4	N_2O	Total Sector Emissions
	gigagrams	gigagrams of CO_2 equivalent		
AFOLU	-2296.02	3626.35	4322.04	5652.37
Livestock and Manure Management	NA	3468.17	1097.74	4565.91
Land Use	-2538.36	NA	NA	-2538.36
Total Sources and Emissions of CO2 on Land	242.34	158.18	3224.30	3624.82
Other	NO	NO	NO	NO

6.2.5 GHG EMISSIONS WITHIN THE WASTE MANAGEMENT AND SANITATION SECTOR

In 2019, GHG emissions from activities in the agriculture, forestry, and other land use sector accounted for 3.18% of total emissions in Iraq, equivalent to 5,652.37 Gg of CO_2 equivalent. These activities are a source of emissions primarily consisting of methane and nitrous oxide, generated from various subcategories (Table 6-6).

Table 6-6: Emissions from the waste management and sanitation sector, 2019

Sector	CO_2	CH_4	N_2O	Total Emissions	%
	Gigagram	Gg of CO_2 equivalent			
Waste Management and Sanitation	47.30	18484.67	533.70	19065.68	100
Solid Waste Disposal	NA	17318.75	NA	17318.75	90.84
Open Waste Burning	47.30	136.46	36.26	220.02	1.15
Sewage Treatment and Disposal	NA	1029.46	497.44	1526.90	8.01

6.3 INVENTORY OF GHG GASES BY GAS

In 2019, CO_2 was the largest contributor to GHG emissions in Iraq, amounting to 133,288.38 Gg, which is equivalent to 75.04% of total emissions. Methane followed as the second largest contributor, accounting for 21.89% of the total, as shown in Table 6-7.

Table 6-7: National Emissions by Gas, 2019

GHG	Total Net Emissions (Gg CO_2 equivalent)
CO_2	133,288.38
CH_4	38,873.82
N_2O	5,454.98
Net Emissions	177,617.19

In 2019, CO_2 emissions were primarily concentrated in the energy sector, accounting for 99.88% of total emissions, followed by the industrial processes and product use sector at 1.81%. Methane emissions were highest from the waste management and sanitation sector, representing 47.55%, followed by the energy sector at 43.12%. As for nitrous oxide, the largest emissions came from the agriculture, forestry, and other land use sector at 79.23%, followed by the energy sector at 10.99%.

Table 6-8: GHG Emissions (+) and Removal Processes (-) in Gigagrams of CO_2 Equivalent by Sector and Gas, 2019

Sector	CO_2	CH_4	N_2O	Net Emissions for Each Sector
	Gigagram	Gigagram of CO_2 equivalent		
Total National Net Emissions of GHG	133,288.38	38,873.82	5,454.98	177,617.19
Energy Sector	133,122.46	16,762.80	599.24	150,484.50
IPPU	2,414.64	NA	NA	2,414.64
AFOLU	-2,296.025	3,626.35	4,322.04	5,652.37
Waste	47.30	18,484.67	533.70	19,065.68

Note: "NA stands for "Not Available"

In the energy sector, most emissions were in the form of CO_2 at 88.46%. In the industrial processes and product use sector, all GHG emissions were in the form of CO_2 at 100%. In the agriculture, forestry, and other land use sector, nitrous oxide emissions were the most prominent at 76.46%. Meanwhile, the waste management and sanitation sector experienced the highest methane emissions at 96.95% (Table 6-8).

6.3.1 NET NATIONAL EMISSIONS

Table **6-9** shows the total emissions coming from all sectors and subsectors in 2019 as reflected in the outputs of the intergovernmental software on climate change.

Table 6-9: Total emissions from all sectors and subsectors in 2019.

GHG source and sink categories	Net CO2 (Gg)	CH4 (Gg)	N2O (Gg)	CO Gg	NOx (Gg)	NMVOCs (Gg)	Sox (Gg)
Total Net National Emissions	**133478.58**	**1851.14**	**17.598**	**33256.75**	**141.85**	**996.43**	**NE**
1 - Energy	133312.66	798.24	1.93	33256.75	141.85	996.43	NE
1A - Fuel Combustion Activities	121028.96	7.31	1.75	33256.75	141.85	629.54	NE
1A1 - Energy Industries	81378.11	2.38	0.40	28.49	72.99	2.24	NE
1A2 - Manufacturing Industries and Construction (ISIC)	8381.63	0.34	0.068	7.40	58.02	2.89	NE
1A3 - Transport	21208.09	3.09	1.23	33214.88	3.22	624.20	NE
1A4 - Other Sectors	10061.14	1.50	0.05	5.98	7.62	0.20	NE
1A5 - Other	NE	NE	NE	NE	NE	NE	NE
1B - Fugitive Emissions from Fuels	12283.70	790.93	0.18	NO/NE	NO/NE	366.90	NA
1B1 - Solid Fuels	NO	NO	NO	NO	NO	NO	NO
1B2 - Oil and Natural Gas	12283.70	790.93	0.18	NE	NE	366.90	NA
2 - Industrial Processes	2414.65	0	NA	NE	NE	NE	NE
2A - Mineral Products	2412.73	NA	NA	NA	NA	NA	NA
2B - Chemical Industry	1.73	0	NA	NE	NE	NE	NE
2C - Metal Production	0.19	NA	NA	NA	NA	NA	NA
2D - Other Production	NA	NA		NA	NA	NA	NA
2E - Production of Halocarbons and Sulphur Hexafluoride				NO	NO	NO	NO
2F - Consumption of Halocarbons and Sulphur Hexafluoride				NO	NO	NO	NO
2G - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
3 - Solvent and Other Product Use	NO	NO	NO	NO	NO	NO	NO
4 - Agriculture		165.15	13.94	NA	NA	NA	NA
4A - Enteric Fermentation		155.98		NA	NA	NA	NA
4B - Manure Management		9.17	4.13	NA	NA	NA	NA
4C - Rice Cultivation		NO		NO	NO	NO	NO
4D - Agricultural Soils			9.81	NA	NA	NA	NA
4E - Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO
4F - Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO
4G - Other (please specify)				NO	NO	NO	NO
5 - Land-Use Change & Forestry	-2538.36	7.53	0.0025	3.23	0.09	NA	NA
5A - Changes in Forest and Other Woody Biomass Stocks	-2538.36			NA	NA	NA	NA
5B - Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO
5C - Abandonment of Managed Lands	NO			NO	NO	NO	NO
5D - CO2 Emissions and Removals from Soil	NO		NO	NO	NO	NO	NO
5E - Other (please specify)	NA	7.53	0.0025	3.23	0.09	NA	NA
6 - Waste	47.30	880.22	1.72	NE	NE	NE	NA
6A - Solid Waste Disposal on Land		824.70		NE	NE	NE	NA
6B - Wastewater Handling		49.02	1.61	NE	NE	NE	NA
6C - Waste Incineration	2.20	NA	NA	NE	NE	NE	NA
6D - Other (please specify)	45.11	6.50	0.12	NE	NE	NE	NA
7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
Memo Items							
International Bunkers	85523.18	0.63	2.44	NE	NE	NE	NE
1A3a1 - International Aviation	85346.90	0.61	2.44	NE	NE	NE	NE

GHG source and sink categories	Net CO2 (Gg)	CH4 (Gg)	N2O (Gg)	CO Gg	NOx (Gg)	NMVOCs (Gg)	Sox (Gg)
1A3d1 - International Marine (Bunkers)	176.30	0.016	0.005	NE	NE	NE	NE
Multilateral operations	NE	NE	NE				
CO2 emissions from biomass	NE						

6.3.2 REFERENCE APPROACH

The use of the reference approach and the sectoral approach often leads to different results because the reference approach works from a macro to micro level, using total energy supply data without detailed information on fuel use in each sector. The reference approach provides CO_2 estimates for comparison with the sectoral approach. It generally gives an upper limit since some carbon in the fuel is not fully combusted but is released as volatile emissions. As a result, the CO_2 emission estimates may vary between the two approaches.

In Iraq, the CO_2 e reference approach was applied for 2019, and the results were compared with the sectoral approach, showing a difference of 4%, which falls within the allowable margin according to the methodological guidelines (Table 6-10).

Table 6-10: Reference Approach vs. Sectoral Approach, 2019

Year	CO_2 Emissions (Reference Approach) (gigagrams)	CO_2 Emissions (Sectoral Approach) (gigagrams)	Difference
2019	125,691.2	120,838.76	4.01%

GHG gas emissions were estimated using the reference approach for the time series (2015-2019), resulting in a fluctuating trend. Figure 6-3 shows a variation and increase in emissions before 2018, attributed to withdrawals from crude oil stockpiles in major southern storage facilities (Al-Faw and Al-Zubair) due to decreased oil production from northern fields, particularly during the ISIS terrorist attacks. These attacks led to infrastructure destruction and control over oil fields in northern Iraq.

The quantities of crude oil withdrawn from reserves during the years 2015, 2016, and 2017 were (-2,225,818, -904,470, and -2,757,028) thousand barrels, respectively. However, in 2018 and 2019, oil production increased due to improved security conditions and the restoration of oil fields and pipelines. This led to an increase in oil stockpiles, reaching (5,444,000 and -2,761,000) barrels, with crude oil production rates of (1,609,650,000 and 1,670,209,583) barrels for the years 2018 and 2019, respectively.

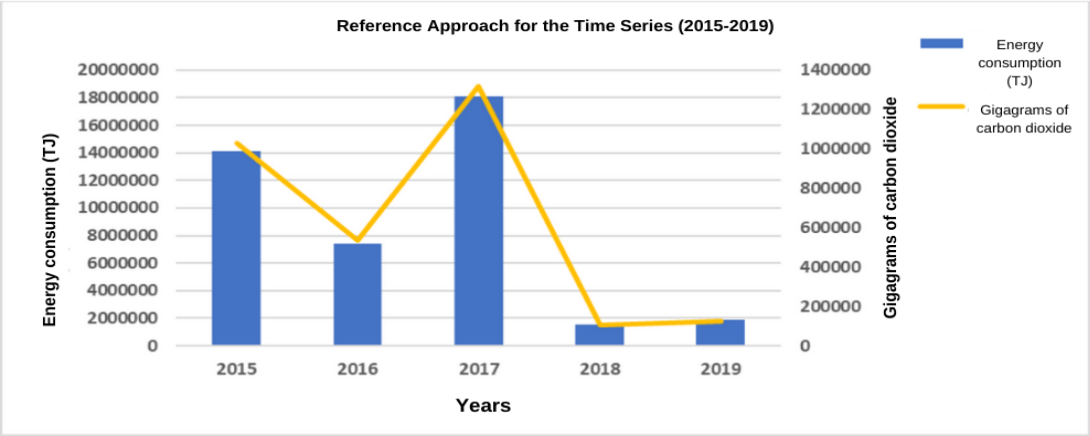


Figure 6-3: Reference Time Series Approach (2015-2019)

6.3.3 KEY CATEGORIES ANALYSIS

In 2019, various subcategories of fuel combustion activities were among the top three sources, accounting for approximately 66.6% of total emissions, led by energy industries (liquid and gaseous fuels) and road transportation. Additionally, solid waste, the industrial processes and product use (IPPU) sector, and the agriculture, forestry, and other land use (AFOLU) sector contributed to the remainder, bringing the total to 95% of Iraq's overall emissions (Table 6-11).

Table 6-11: Key Category Analysis (Tier Assessment), 2019

A	B	C	D	F	G
Category code in the guidance manual of the IPCCC	Specific category from the guidance manual of the IPCCC	GHG	Emissions: 2000 Gigagrams of CO_2 Equivalent	Emission level from a specific category 2000	Cumulative Percentage Total from the Column F
1.A.1	Energy Industries - Liquid Fuels	CO_2	41354.28	0.27	26.90
1.A.1	Energy Industries - Gaseous Fuels	CO_2	39833.62	0.26	52.81
1.A.3.b	Road Transportation	CO_2	21150.04	0.14	66.56
4.A	Solid Waste Disposal	CH_4	17318.75	0.11	77.83
1.A.4	Other Sectors - Liquid Fuels	CO_2	10061.14	0.07	84.37
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	8381.22	0.05	89.82
3.A.1	Enteric Fermentation	CH_4	3275.56	0.02	91.95
3.B.1.a	Forest land Remaining Forest land	CO_2	2538.81-	0.02	93.61
2.A.1	Cement production	CO_2	2412.73	0.02	95.17

6.3.4 UNCERTAINTY ANALYSIS

Uncertainty analysis is a fundamental part of the inventory process, aiming to identify priorities for improving inventory accuracy and guiding decisions regarding the methodology used. The analysis was conducted following the 2006 IPCC Guidelines using the "Tier 1 Approach: Error Propagation."

This approach estimates uncertainty in each inventory category and analyzes errors using data from 2019 and the base year 2000. The analysis was based on the Tier 1 approach and included

all source categories and direct GHG. Uncertainty was estimated using default values provided in the IPCC Guidelines.

The results indicate that net emissions for 2019 amounted to 263,910.68 Gg CO_2 equivalent, with an uncertainty range of ±3%. This means there is a 95% probability that actual emissions fall between 255,940.57 and 271,880.78 Gg CO_2 equivalent.
Compared to the base year 2000, the trend shows a 12.42% increase in emissions from 2000 to 2019.

6.4 QUALITY CONTROL

A team of experts from the Royal Scientific Society (RSS) in Jordan provided technical support for the preparation of the GHG inventory. This support included organizing training workshops, providing guidelines and instructional materials, reviewing studies and reports, and offering assistance through both in-person and remote meetings.

The team conducted a comprehensive review based on the indicators outlined in Annex III of Decision 2 from COP 17 (UNFCCC, 2011), the guidelines of the Intergovernmental Panel on Climate Change (IPCC), and the reporting requirements for non-Annex I parties submitting Biennial Update Reports to the UNFCCC Secretariat.

Additionally, the RSS team collaborated with the project management team at the Climate Change Directorate to conduct an in-depth review of all sectoral reports and their revisions. The work included the following:
- Providing comprehensive assessments and technical reviews, verifying accuracy to ensure consistency and completeness, and avoiding duplication in calculations.
- Ensuring the accuracy of input data, verifying the use of correct references, and checking for errors in data transcription.
- Confirming that emission factors and units were correctly recorded and that appropriate conversion factors were applied, while ensuring consistency among experts across different sub-sectors.
- Maintaining detailed internal documentation to support the estimates and enable full reproducibility of the inventory.
- Archiving and securely storing inventory data to facilitate detailed review processes.

6.5 ANALYSIS OF GHG MITIGATION MEASURES OUTLINED WITHIN IRAQ FIRST BIENNIAL UPDATE REPORT

This chapter of Iraq's First Biennial Update Report on Climate Change describes mitigation projects, scenarios, and potential interventions that can be implemented at the national level to reduce anthropogenic GHG emissions across various sectors

6.5.1 DESCRIPTION OF THE MITIGATION SCENARIO AND ESTIMATION OF ITS RESULTING EMISSIONS ACROSS ALL SECTORS

Mitigation measures have been prepared in accordance with Annex III of Decision No. 2 from COP 17, concerning guidelines for preparing reports on updates of national communications over a two-year period regarding climate change. These guidelines stipulate that non-Annex I parties should provide tables of information on actions aimed at mitigating the impacts of

climate change by addressing human-induced emissions by sources and removal points for all GHGs not covered by the Montreal Protocol.

In this chapter, four pathways for GHG mitigation actions have been identified, comprising 35 projects. These projects have been analyzed and added to the list of mitigation measures. The completed mitigation scenario includes several projects aimed at reducing GHGs in the areas of primary energy, renewable energy, and energy efficiency.

6.5.2 Description of Mitigation Pathways and Projects in the Energy Sector

6.5.2.1 Pathway 1 Reduce Losses in the Electricity Transmission and Distribution Network and Improve Efficiency of Power Generation Plants

The project aims to improve the efficiency of power generation plants and reduce losses in the electricity transmission and distribution network from 20% in 2020 to 15% by 2030, and then to 10% by 2050. The project is being implemented gradually and focuses on the optimal use of distribution and generation, improving the system's power factor, and upgrading or replacing conductors and insulators with lower resistance equipment. The project also aims to reduce the carbon footprint in the oil and gas sector by developing oil wells and refineries. Table 6-12 includes a description of a proposed project to improve the efficiency of electricity production in power plants in Iraq from 2021 to 2050.

Table 6-12: Description of project proposed to improve electricity efficiency production in power plants for the period 2021-2050

Number 1 Path 1 Name and Brief Description of Mitigation Measures	A roadmap to improve the efficiency of electricity production in power plants in Iraq and reduce losses in electricity transmission and distribution, with joint funding: International and national - Shared benefits
Sector and Subsector (and Reduced GHGs): Energy / Primary Energy and Efficiency Improvement Reduction of CO_2	Implementation Entity Ministry of Electricity / Ministry of Oil In collaboration with the German company Siemens
Status (Planned, Implemented, Ongoing, Canceled/ Invalid)	Under implementation
Key Assumptions Used in the Mitigation Analysis	Reducing the carbon footprint in the oil and gas sector through the establishment of wells, refineries, and transportation and distribution networks.
Time Period (Years)	(2021-2026)
Objective of Mitigation measures	
Optimizing distribution and generation usage and reducing the carbon footprint in the oil and gas sector.	
The planned activities within the mitigation measures:	
- Installing 40 Air Inlet Cooling systems. - Installing additional capacity of 792 megawatts. - Improving the system's capacity factor, upgrading existing conductors and insulators, or replacing them with equipment of lower resistance.	

6.5.2.2 Pathway 2: Retirement of Fossil Fuel Power Plants (while Retaining Natural Gas Power Plants)

This pathway assumes the complete cessation of fossil fuel power plants by 2035. Iraq seeks to phase out by 2026 all diesel-operated power plants and convert by 2035 all simple cycle plants operating on other types of fossil fuels to Natural Gas Combined Cycle power plants as instructed under the Integrated National Energy Strategy.[98] Below are outlines of 21 projects to increase the capacities of some existing combined cycle power plants and convert several other simple cycle gas plants to combined cycle power plants to produce more electricity to reach a total capacity of 8789 megawatts during the period 2021-2030

98 The Integrated National Energy Strategy for the period 2013-2030 - Page 81.

Table 6-13: Description of the first project within the second path is to increase the capacities of some combined cycle power plants and convert several simple gas units into combined units for electricity generation for the period between 2021 and 2030.

Number1 Path 2 Name and Brief Description of Mitigation Measures	Al-Samawah Combined Cycle Power Plant - An added capacity of 250 MW to reach a total capacity of 750 MW Dhi Qar Combined Cycle Power Plant - An added capacity of 250 MW to reach a total capacity of 750 MW
Sector and Subsector Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity under contract with GE (General Electric) USA
Status (Planned, Implemented, Under Execution, Canceled/Invalid)	Under Implementation / Phase one has been implemented, and phase two is on hold due to lack of funding
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-14 Description of the Second Project within Path 2 to Increase Capacities of Some Combined Cycle Plants and Convert Several Plants

Number 2 Path 2 Name and Brief Description of Mitigation Measures	Basmaya Investment Power Plant Project - Phase One and Two with an added capacity of 1000 MW to reach a total capacity of 3000 MW Basmaya Investment Power Plant Project - Phase Three with an added capacity of 500 MW to reach a total capacity of 1500 MW
Sector and Subsector (and Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity under a private sector contract - National funding
Status (Planned, Implemented, Under Execution, Canceled/Invalid)	Phase one has been implemented, and phase two is on hold due to lack of funding
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-15: Description of the Third Project within Path 2 to Increase Capacities of Some Combined Cycle Plants and Convert Several Plants from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 3 Path 2 Name and Brief Description of Mitigation Measures	Rumaila Investment Power Plant Project - Phase One with an added capacity of 500 MW to reach a total capacity of 1000 MW Rumaila Investment Power Plant Project - Phase Two with an added capacity of 500 MW to reach a total capacity of 1500 MW
Sector and Subsector (and Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity - National funding, private sector
Status (Planned, Implemented, Under Execution, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-16: Description of the Fourth Project within Path 2 to Increase Capacities of Some Combined Cycle Plants and Convert Several Plants from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 4 Path2 Name and Brief Description of Mitigation Measures	Project to Convert Simple Gas Units at Rumaila Plant to Combined Units - Phase One with an added capacity of 500 MW to reach a total capacity of 1500 MWProject to Convert Simple Gas Units at Rumaila Plant to Combined Units - Phase Two with an added capacity of 500 MW to reach a total capacity of 1500 MW
Sector and Subsector (and Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity : Ministry of Electricity - National funding
Status (Planned, Implemented, Under Execution, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-17: Description of the Fifth Project within Path 2 to Increase Capacities of Some Combined Cycle Plants and Convert Several Plants from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 5 Path 2 Name and Brief Description of Mitigation Measures	Project to Convert the Maysan Simple Plant to Combined Cycle with an added capacity of 250 MW to reach a total capacity of 750 MW
Sector and Subsector (and Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity - National funding
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Implemented
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-18: Description of the Sixth Project within Path 2 to Increase Capacities of Some Combined Cycle Plants and Convert Several Plants from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 6 Path 2 Name and Brief Description of Mitigation Measures	Project to Convert the Amara Simple Plant to Combined Cycle with an added capacity of 250 MW to reach a total capacity of 750 MW
Sector and Subsector (and Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity - National funding
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Implemented
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-19: Description of the Seventh Project within Path 2 to Increase Capacities of Some Combined Cycle Plants and Convert Several Plants from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 7 Path 2 Name and Brief Description of Mitigation Measures	Project to Convert the Kirkuk Gas Plant to Combined Cycle with an added capacity of 278 MW to reach a total capacity of 557 MW
Sector and Subsector (and Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity - Contract signed with Steller Energy on 2021/12/02 - Loan from BANK EXIM for 36 months post financial closure
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
The path aims, through all its projects, for the complete cessation of fossil fuel power plants by 2035. Iraq seeks to cease all diesel-powered plants by 2026, followed by the cessation of all simple cycle plants operating on other types of fossil fuels by 2035, converting all of them to gas combined cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
- Complete cessation of fossil fuel power plants by 2035 - Replacing simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) - Replacing diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 6-20: Description of Project Eight Under Path Two for Increasing Capacities of Some Combined Cycle Stations and Converting Several Stations from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 8 Path 2 Name and Brief Description of Mitigation Measures	Project to convert Al-Diwaniyah gas station to a combined cycle with an additional capacity of 250 MW, making a total capacity of 500 MW
Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Body Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
Complete cessation of fossil fuel plants by 2035	
Planned Activities under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 - Replace simple cycle gas stations with those operating on a combined cycle principle (2021-2030) - Replace diesel-operated stations with those operating on a combined cycle principle (2026)	

Table 6-21: Description of Project Three Under Path Two for Increasing Capacities of Some Combined Cycle Stations and Converting Several Stations from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 9 Path 2 Name and Brief Description of Mitigation Measures	Project to convert Al-Mansouriyah gas station to a combined cycle with an additional capacity of 364 MW, making a total capacity of 728 MW
Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Body Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2030 - 2026)
Objective of Mitigation Measures	
Complete cessation of fossil fuel plants by 2035	
Planned Activities under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 - Replace simple cycle gas stations with those operating on a combined cycle principle (2021-2030) - Replace diesel-operated stations with those operating on a combined cycle principle (2026)	

Table 6-22: Description of Project Ten Under Path Two for Increasing Capacities of Some Combined Cycle Stations and Converting Several Stations from Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 10 Path 2 Name and Brief Description of Mitigation Measures	Project to convert Al-Hillah gas station to a combined cycle with an additional capacity of 125 MW, making a total capacity of 250 MW
Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Body Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
Complete cessation of fossil fuel plants by 2035	
Planned Activities under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 - Replace simple cycle gas stations with those operating on a combined cycle principle (2021-2030) - Replace diesel-operated stations with those operating on a combined cycle principle (2026)	

Table 6-23: Description of Project 11 under Path 2 for Increasing Capacities of Combined Cycle Power Plants and Converting Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 11 Path 2 Short Description of Mitigation Measures	Project to convert Al-Zubair Gas Power Plant to a combined cycle with an added capacity of 125 MW, bringing the total capacity to 250 MW
Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and capacity increase
Time Period (Years)	(2026 – 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel plants by 2035. Iraq seeks to shut down all diesel-powered plants by 2026, followed by all simple cycle plants operating on other fossil fuels by 2035, converting them all to Combined Cycle Gas Units (NG-Combined Cycle)	
Planned Activities Under Mitigation Measure	

- Complete cessation of fossil fuel plants by 2035
- Replace simple cycle gas plants with combined cycle capacities (2021-2030)
- Replace diesel-powered plants with combined cycle plants (2026)

Table 6-24: Description of Project 12 under Path 2 for Increasing Capacities of Combined Cycle Power Plants and Converting Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 12 Path 2 Short Description of Mitigation Measures Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Project to convert Karbala Gas Power Plant to a combined cycle with an added capacity of 125 MW, bringing the total capacity to 250 MW Ministry of Electricity, Shanghai Company
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and capacity increase
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel plants by 2035. Iraq seeks to shut down all diesel-powered plants by 2026, followed by all simple cycle plants operating on other fossil fuels by 2035, converting them all to Combined Cycle Gas Units (NG-Combined Cycle)	
Planned Activities Under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 - Replace simple cycle gas plants with combined cycle capacities (2021-2030) - Replace diesel-powered plants with combined cycle plants (2026)	

Table 6-25: Description of Project 13 under Path 2 for Increasing Capacities of Combined Cycle Power Plants and Converting Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 13 Path 2 Short Description of Mitigation Measures	Project to convert Najaf Gas Power Plant to a combined cycle with an added capacity of 125 MW, bringing the total capacity to 250 MW
Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity, Shanghai Company
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and capacity increase
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel plants by 2035. Iraq seeks to shut down all diesel-powered plants by 2026, followed by all simple cycle plants operating on other fossil fuels by 2035, converting them all to Combined Cycle Gas Units (NG-Combined Cycle)	
Planned Activities Under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 - Replace simple cycle gas plants with combined cycle capacities (2021-2030) - Replace diesel-powered plants with combined cycle plants (2026)	

Table 6-26: Description of Project 14 under Path 2 for Increasing Capacities of Combined Cycle Power Plants and Converting Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 14 Path 2 Short Description of Mitigation Measures	Project to convert Al-Sadr 1 Gas Power Plant to a combined cycle with an added capacity of 160 MW, bringing the total capacity to 320 MW Project to convert Al-Sadr 2 Gas Power Plant to a combined cycle with an added capacity of 169 MW, bringing the total capacity to 338 MW
Sector and Sub-sector (Reduced GHGs) CO_2 Reduction Implementing Entity	Energy / Fuel Switching and Efficiency Improvement Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and capacity increase
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel plants by 2035. Iraq seeks to shut down all diesel-powered plants by 2026, followed by all simple cycle plants operating on other fossil fuels by 2035, converting them all to Combined Cycle Gas Units (NG-Combined Cycle)	
Planned Activities Under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 – Replace simple cycle gas plants with combined cycle capacities (2021-2030) - Replace diesel-powered plants with combined cycle plants (2026)	

Table 6-27: Description of Project 15 under Path 2 for Increasing Capacities of Combined Cycle Power Plants and Converting Simple Gas Units to Combined Units for Electricity Generation from 2021 to 2030

Number 15 Path 2 Short Description of Mitigation Measures	Project to convert Al-Haideriya 1 Gas Power Plant to a combined cycle with an added capacity of 250 MW, bringing the total capacity to 500 MW
Sector and Sub-sector (Reduced GHGs) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increased generation efficiency and capacity increase
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel plants by 2035. Iraq seeks to shut down all diesel-powered plants by 2026, followed by all simple cycle plants operating on other fossil fuels by 2035, converting them all to Combined Cycle Gas Units (NG-Combined Cycle)	
Planned Activities Under Mitigation Measure	
- Complete cessation of fossil fuel plants by 2035 - Replace simple cycle gas plants with combined cycle capacities (2021-2030) - Replace diesel-powered plants with combined cycle plants (2026)	

Table 6-28: Description of Project 16 in Path 2 for Increasing Capacities of Combined Cycle Stations from 2021-2030

Number 16 Path 2 Name and Brief Description of Mitigation Actions	Project to convert the Al-Quds 1 gas station to a combined cycle with an added capacity of 250 MW, making the total capacity 500 MW. Project to convert the Al-Quds 3 gas station to a combined cycle with an added capacity of 250 MW, making the total capacity 500 MW.
Sector and Subsector (GHGs Reduced) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status ((Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026, followed by stopping all simple-cycle stations operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities Under the Mitigation Action	
- Complete cessation of fossil fuel power stations by 2035 - Replacement of simple gas cycle stations with capacities operating on the principle of combined cycle (2021-2030) - Replacement of diesel-operated stations with stations operating on the principle of combined cycle (2026)	

Table 6-29: Description of Project 17 in Path 2 for Increasing Capacities of Combined Cycle Stations from 2021-2030

Number 17 Path 2 Name and Brief Description of Mitigation Actions	Project to convert the Al-Khairat gas station to a combined cycle with an added capacity of 625 MW, making the total capacity 1250 MW.
Sector and Subsector (GHGs Reduced) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026, followed by stopping all simple-cycle stations operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities Under the Mitigation Action	
- Complete cessation of fossil fuel power stations by 2035 - Replacement of simple gas cycle stations with capacities operating on the principle of combined cycle (2021-2030) - Replacement of diesel-operated stations with stations operating on the principle of combined cycle (2026)	

Table 6-30: Description of Project 18 in Path 2 for Increasing Capacities of Combined Cycle Stations from 2021-2030

Number 18 Path 2 Name and Brief Description of Mitigation Actions	Project to convert the Al-Qayyarah gas station to a combined cycle with an added capacity of 375 MW, making the total capacity 750 MW.
Sector and Subsector (GHGs Reduced) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026, followed by stopping all simple-cycle stations operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities Under the Mitigation Action	
- Complete cessation of fossil fuel power stations by 2035 - Replacement of simple gas cycle stations with capacities operating on the principle of combined cycle (2021-2030) - Replacement of diesel-operated stations with stations operating on the principle of combined cycle (2026)	

Table 6-31: Description of Project 19 in Path 2 for Increasing Capacities of Combined Cycle Stations from 2021-2030

Number 19 Path 2 Name and Brief Description of Mitigation Actions	Project to convert the Akkas gas station to a combined cycle with an added capacity of 125 MW, making the total capacity 250 MW.
Sector and Subsector (GHGs Reduced) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026, followed by stopping all simple-cycle stations operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities Under the Mitigation Action	
- Complete cessation of fossil fuel power stations by 2035 - Replacement of simple gas cycle stations with capacities operating on the principle of combined cycle (2021-2030) - Replacement of diesel-operated stations with stations operating on the principle of combined cycle (2026)	

Table 6-32: Description of Project 20 in Path 2 for Increasing Capacities of Combined Cycle Stations from 2021-2030

Number 20 Path 2 Name and Brief Description of Mitigation Actions	Project to convert the Dibis gas station to a combined cycle with an added capacity of 169 MW, making the total capacity 338 MW.
Sector and Subsector (GHGs Reduced) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026, followed by stopping all simple-cycle stations operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities Under the Mitigation Action	
- Complete cessation of fossil fuel power stations by 2035 - Replacement of simple gas cycle stations with capacities operating on the principle of combined cycle (2021-2030) - Replacement of diesel-operated stations with stations operating on the principle of combined cycle (2026)	

Table 6-33: Description of Project 21 in Path 2 for Increasing Capacities of Combined Cycle Stations from 2021-2030

Number 21 Path 2 Name and Brief Description of Mitigation Actions	Project to convert the South Baghdad 1 gas station to a combined cycle with an added capacity of 125 MW, making the total capacity 250 MW.
Sector and Subsector (GHGs Reduced) Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid))	Under Impelmentation
Key Assumptions Used in Mitigation Analysis	Increased generation efficiency and increased capacity
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measures	
The path aims for the complete cessation of fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026, followed by stopping all simple-cycle stations operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities Under the Mitigation Action	
- Complete cessation of fossil fuel power stations by 2035 - Replacement of simple gas cycle stations with capacities operating on the principle of combined cycle (2021-2030) - Replacement of diesel-operated stations with stations operating on the principle of combined cycle (2026)	

6.5.2.3 PATHWAY 3: UTILIZING ASSOCIATED GAS AND ITS INVESTMENT IN THE ENERGY, INDUSTRY OR EXPORT SECTOR

The project aims to reduce the amount of flared gas by 50% by 2030, which translates to a decrease in burned methane emissions per ton of produced equivalent fuel. Additionally, the project seeks to capture associated gas and make it available for other uses, achieving a dual benefit of reducing combustion emissions and increasing natural gas supply. Below is a description of four proposed projects to achieve these objectives, as outlined in Tables (6-34 to 6-37).

Table 6-34: Description of the First Project within the Third Path for Associated Gas Investment by 2030

Number 1 Path 3 Project Name and Brief Description of Mitigation Measures	Basra Gas Complex – Investment in flared associated gas from the Rumaila, Zubair, and West Qurna 1 fields, with a capacity of 200 MMSCF for the first phase and 200 MMSCF for the second phase.
Sector and Subsector (and Reduced Greenhouse Gases) Energy / Primary Energy CO_2 Reduction	Implementing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions in Mitigation Analysis	50% reduction in flared gas by 2030, capturing and using associated gas for other uses.
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measures	
Reduce combustion emissions and increase the availability of natural gas.	
Planned Mitigation Activities	
- Capture associated gas and make it available for other uses.	

Table 6-35: Description of the Second Project within the Third Path for Associated Gas Investment by 2030

Number 2 Path 3 Project Name and Brief Description of Mitigation Measures	Nasiriyah and Gharraf Gas Complex – Investment in flared associated gas from the Nasiriyah and Gharraf fields with a capacity of 200 MMSCF per day.
Sector and Subsector (and Reduced Greenhouse Gases) Energy / Primary Energy CO_2 Reduction	Implementing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Impelmentation
Key Assumptions in Mitigation Analysis	50% reduction in flared gas by 2030, capturing and using associated gas for other uses.
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measure	
Reduce combustion emissions and increase the availability of natural gas.	
Planned Mitigation Activities	
- Capture associated gas and make it available for other uses.	

Table 6-36: Description of the Third Project within the Third Path for Associated Gas Investment by 2030

Number 3 Path 3 Project Name and Brief Description of Mitigation Measures	Artawi Gas Complex – Investment in flared associated gas from the West Qurna, Majnoon, Siba, and Luhais fields, with a capacity of 300 MMSCF for the first phase and 300 MMSCF/day for the second phase.
Sector and Subsector (and Reduced Greenhouse Gases) Energy / Primary Energy CO_2 Reduction	Implementing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions in Mitigation Analysis	50% reduction in flared gas by 2030, capturing and using associated gas for other uses.
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measure	
Reduce combustion emissions and increase the availability of natural gas.	
Planned Mitigation Activities	
- Capture associated gas and make it available for other uses.	

Table 6-37: Description of the Fourth Project within the Third Path for Associated Gas Investment by 2030

Number 4 Path 3 Project Name and Brief Description of Mitigation Measures	Faihaa Gas Complex – Investment in flared associated gas from the Faihaa field, with a capacity of 120 MMSCF/day.
Sector and Subsector (and Reduced Greenhouse Gases) Energy / Primary Energy CO_2 and CH_4 Reduction	Implementing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Key Assumptions in Mitigation Analysis	50% reduction in flared gas by 2030, capturing and using associated gas for other uses.
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measure	
Reduce combustion emissions and increase the availability of natural gas.	
Planned Mitigation Activities	
- Capture associated gas and make it available for other uses.	

6.5.2.4 PATHWAY 4: INCREASING THE SHARE OF RENEWABLE ENERGY IN THE ENERGY MIX

The project aims to increase additional capacities from solar, hydropower, and wind energy to reach 8.5% of the total energy (3% from hydropower, 2.5% from wind energy, and 3% from solar energy) by 2030, and 12% by 2050 (5% from hydropower, 3% from wind energy, and 4% from solar energy). The project includes the implementation of 9 proposed projects for electricity generation from solar energy in multiple regions of Iraq, with a total capacity of 7,755 megawatts during the period from 2021 to 2030, as shown in tables (6-38 to 6-46).

Table 6-38: Description of the First Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 1 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Basra - Artawei by Southern Production Company with a total capacity of 1000 MWac
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity/Southern Production Company Investor Company TOTAL
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity distribution network - Generation of electricity from solar energy in Basra - Artawei by Southern Production Company with a total capacity of 1000 MWac	

Table 6-39: Description of the Second Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 2 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Al-Amarah, Al-Qurna, Al-Ramadi (1&2), and Mosul - Ain Tamr, with a total capacity of 2000 MWac
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company Abu Dhabi Future Energy Company (Masdar)
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network- Generation of electricity from solar energy in Al-Amarah, Al-Qurna, Al-Ramadi (1&2), and Mosul - Ain Tamr, with a total capacity of 2000 MWac	

Table 6-40: Description of the Third Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 3 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Project to supply the Ministry of Electricity headquarters in Baghdad with 1 MW of solar energy connected to the national electricity grid (on-grid)
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implenmentation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2021 - 2025)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Project to equip the Ministry of Electricity headquarters in Baghdad with 1 MW - installation of solar panels and supply of generated energy to the national electricity network	

Table 6-41: Description of the Fourth Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 4 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Karbala and Alexandria by the Middle Euphrates Production Company with a total capacity of 525 MWac
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company Scatec (Norway)
Status **(**Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network - Generation of electricity from solar energy in Karbala and Alexandria by the Middle Euphrates Production Company with a total capacity of 525 MWac	

Table 6-42: Description of the Fifth Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 5 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Al-Samawah by Southern Production Company with a total capacity of 2000 MWac, noting that the capacity added in the first phase is 750 MW
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company Power China
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network- Generation of electricity from solar energy in Al-Samawah by Southern Production Company with a total capacity of 2000 MWac, noting that the capacity added in the first phase is 750 MW	

Table 6-43: Description of the Sixth Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 6 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Najaf by the Middle Euphrates Production Company with a total capacity of 1000 MWac
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company ACWA Power
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network- Generation of electricity from solar energy in Najaf by the Middle Euphrates Production Company with a total capacity of 1000 MWac	

Table 6-44: Description of the Seventh Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 7 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Abu Khasib, Al-Bat'ha, and Al-Islah by Southern Production Company with a total capacity of 1000 MWac, noting that the capacity added in the first phase is 550 MW
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company Gulf Power
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network - Generation of electricity from solar energy in Abu Khasib, Al-Bat'ha, and Al-Islah by Southern Production Company with a total capacity of 1000 MWac, noting that the capacity added in the first phase is 550 MW	

Table 6-45: Description of the Eighth Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 8 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Al-Khidr, Al-Ramla, and Al-Jasan by Southern Production Company, Middle Euphrates Production Company, and Central Region Production Company with a total capacity of 150 MWac, with a capacity of 50 MW for each site
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company Phanse
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under Implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network - Generation of electricity from solar energy in Al-Khidr, Al-Ramla, and Al-Jasan by Southern Production Company, Middle Euphrates Production Company, and Central Region Production Company with a total capacity of 150 MWac, with a capacity of 50 MW for each site	

Table 6-46: Description of the Ninth Project under Pathway 4 for Additional Capacities of Solar, Hydropower, and Wind Energy by 2030

Number 9 Path 4 Brief Name and Description of Mitigation Measures	Solar Power Generation Project in Sawah 1 and Sawah 2 by Southern Production Company with a total capacity of 80 MWac
Sector and Sub-Sector (and Reduced Greenhouse Gases) Energy/Renewable Energy CO_2 Reduction	Implementing Entity Ministry of Electricity Investor Company European Jordanian
Status (Planned, Implemented, Under Implementation, Canceled/Invalid)	Under implementation
Main Assumptions Used in Mitigation Analysis	Increasing the share of renewable energy in the energy mix at the expense of fossil fuels and diesel
Time Period (Years)	(2026 - 2030)
Objective of Mitigation Measure	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thus achieving sustainability in electricity generation and reducing emissions	
Planned Activities within Mitigation Measure	
- Installation of solar panels and supply of generated energy to the national electricity network - Generation of electricity from solar energy in Sawah 1 and Sawah 2 by Southern Production Company with a total capacity of 80 MWac	

6.6 ESTIMATION OF THE OVERALL REDUCTION FROM MITIGATION PATHWAYS

A total of 35 projects have been proposed across four pathways to mitigate greenhouse gas emissions in the electricity generation and refining sector (associated gas investment). The net cumulative reduction in greenhouse gas emissions is approximately 324.78 and 2311.12 million tons of CO2 equivalent in 2030 and 2050, respectively, as shown in Table 4-7, titled "Mitigation Pathways and Cumulative Reduction Quantities," referenced in Chapter Four of this document.

6.7 NATIONAL MONITORING, REPORTING AND VERIFICATION SYSTEM - MRV

This chapter of the report describes the current status of GHG inventory activities and the analysis of mitigation measures. It also presents a proposal for establishing a monitoring, reporting, and verification system designed in consultation with various stakeholders at the national level.

The primary objective of the proposed system is to support Iraq in fulfilling its commitments under the Framework Convention on Climate Change by reporting on GHG emissions and removals by source, as well as assessing and monitoring progress in implementing mitigation projects and programs. Additionally, it aims to monitor and evaluate all types of support dedicated to climate change, including financial and technical assistance, technology transfer, and capacity building.

Iraq seeks the necessary support to design a comprehensive monitoring, reporting, and verification system that encompasses all activities and sectors in a flexible and scalable manner. Iraq recognizes that this system will enhance transparency in several areas, including:

- A national inventory GHG emissions reported in detail by source.
- Assessment of progress towards achieving the nationally determined contribution.
- Monitoring the impacts of climate change and adaptation.
- Describing co-benefits between mitigation and adaptation and measuring the impact of response measures on the national economy.
- Identifying the institutional structures needed to address climate change according to international and national trends.
- Assessing national needs for climate technology and identifying what has been achieved within the framework of sustainable development goals.
- Identifying the capacities that need to be developed to ensure effective national mitigation measures that contribute to creating green jobs.
- Determining the type of financing and investment necessary to implement the national contribution according to national policies.

The integrated measurement, reporting, and verification framework consists of four main elements, as shown in Table 6-47. Iraq aims to obtain the necessary support to design a comprehensive monitoring, reporting, and verification system that includes all forms of activities across all sectors in a flexible and scalable manner. Iraq acknowledges that this system will institutionalize transparency in several key areas, including:

- A national inventory of GHG reported in detail by each source.
- Assessment of progress towards achieving Iraq's nationally determined contribution.
- The impacts of climate change and adaptation.
- Describing co-benefits between mitigation and adaptation and measuring the impact of response measures on the national economy.
- Identifying the type, shape, and level of institutional structures required according to international and national approaches to address climate change.
- Assessing national needs and the type of climate technology required and received to contribute to achieving sustainable development goals.
- Identifying the capacities that should be built to ensure effective national mitigation measures that provide green jobs.
- Determining the type of financing and investment needed to ensure the implementation of the national contribution in accordance with national policy.

Table 6 47: Components of an Integrated Framework for Measurement, Reporting, and Verification

Component 1: National GHG Inventory	Component 2: Implementation of Nationally Determined Contributions / Mitigation Actions	Component 3: Climate Activities Funding Flow	Component 4 Sustainable Development Goals
• GHG Emission Sectors • Monitoring and Data Collection • Calculation of GHG Emissions • Analysis and Reporting • Results and Reporting	• Implementation of the Nationally Determined Contributions Roadmap – Priority Mitigation Actions • Tracking Mitigation Actions • Monitoring and Reporting • Results and Reporting	• Funding Climate Activities to Implement Nationally Determined Contributions • Resource Allocation and Funding Schedule • Monitoring and Reporting • Results and Reports	• Developing plans to achieve the Sustainable Development Goals relevant to mitigation actions. • Monitoring data on the impact of Sustainable Development Goals • Review and analysis • Results and reports on the impact of Sustainable Development Goals

The Framework Convention has previously outlined the principles for the National Measurement, Reporting, and Verification (MRV) system, including procedures and methodologies (the Intergovernmental Panel on Climate Change). Reporting frequency and content are specified (content of National Communications in Decision 17/CP.8[99] and content of updated reports for the biennium in Decision 1/CP.1, Annex 1).[100] The updated biennial reports should focus on mitigation actions and any updates or amendments to the previous national communication should be included. Later, the updated biennial reports will be replaced with transparency reports covering a two-year period, addressing the following:

- Inventory of GHGs at the national level.
- Information on progress tracking in the implementation/achievement of nationally determined contributions.
- Information on provided and expected support (developed countries).
- Information on required and received support (developing countries).
- Declaration of adaptation.

99 (UNFCCC, 2002)
100 (UNFCCC, 2011)

6.7.1 CURRENT PRACTICES IN MONITORING, REPORTING AND VERIFICATION

6.7.1.1 GHG INVENTORY LISTS

GHG inventories are prepared only for climate change reports submitted to the United Nations Framework Convention on Climate Change (national communications and biennial update reports). Currently, this process is not periodic and does not have a specific date for implementation, but it is usually conducted through national efforts within projects supported by the Global Environment Facility and various United Nations programs.

Data for estimating GHG inventories are collected through traditional methods, and the data collection process is characterized as lengthy and demanding, requiring official keys and messages issued by the Ministry of Environment (as the project owner and national focal point for the United Nations Framework Convention on Climate Change) to all ministries, stakeholders, and national institutions that possess the required data.

6.7.1.2 MONITORING CLIMATE CHANGE MITIGATION MEASURES REGARDING THE ANALYSIS OF GHG MITIGATION IN IRAQ

It is worth mentioning regarding the analysis of GHG mitigation in Iraq that this experience is still immature and requires significant capacity-building efforts in various sectors. The initial national communication did not address specific national contributions to the analysis of programs and projects for calculating reduction targets. Instead, it only provided a descriptive list of mitigation opportunities available in several sectors, which could serve as a foundational step for optimal task accomplishment. Additionally, Iraq had limited experience with the intricacies of clean development mechanism projects, and it lacked projects in this field that could be referred to and built upon

6.7.1.3 MONITORING THE FORMS OF RECEIVED SUPPORT

The national institutions responsible for receiving and distributing climate change funding in Iraq are the Ministry of Finance, the Ministry of Planning, and the Ministry of Environment. This support includes the following types:

- Local Public Financing: The public sector is funded through executive ministries.
- International Aid: As a developing country, Iraq receives international support from entities such as:
- Support from international institutions: such as the United Nations Development Programme, the United Nations Environment Programme, and the European Union.
- Funding from development banks: such as the European Bank for Reconstruction and Development, the European Investment Bank, the German Development Bank, the Green Climate Fund, and the Adaptation Fund.

The inconsistent definitions and standards for determining climate financing and distinguishing between climate financing and other forms of financing pose an inherent challenge in all efforts to monitor climate financing, both from the perspective of the supporter and the beneficiary of the support. The main issue is how to distinguish between climate financing and official development assistance, and how to determine the portion of climate financing that is additional to official development assistance.

Difficulty in establishing indicators to describe financial data related to financing, for example: Iraq, like other developing countries, faces several challenges in verifying climate financing information provided by developed countries, including:

- Lack of sufficient institutional arrangements: There is a lack of clearly defined roles and responsibilities among various ministries concerning climate change. The Ministry of Finance and the Ministry of Planning work in coordination with the Ministry of Environment and development partners to maintain records of official development assistance flowing to the country.
- Inconsistent definitions and standards: Distinguishing between climate financing and other forms of financing is a significant challenge. The main problem lies in how to differentiate between climate financing and official development assistance, and how to determine the portion of climate financing that exceeds official development assistance.
- Difficulty in establishing financial indicators: It is challenging to identify indicators to measure the efficiency and impact of adaptation financing, to establish indicators for climate financing in multi-objective projects, as well as for sectoral projects that include climate-related co-benefits.
- Lack of technical systems: There is a deficiency in the mechanisms and technical systems necessary to identify and record climate financing expenditures, such as reporting models and programming platforms for storing and sharing information, and mechanisms for integrating climate change into national financial systems and monitoring and reporting.
- Constraints on information availability: Confidentiality and restrictions on certain financial data pose a barrier.

By developing an effective system for monitoring, reporting, and verifying climate financing that addresses these challenges and clarifies the roles and responsibilities of stakeholders, the flow of funding can be determined more accurately, and its use can be ensured effectively to combat future climate impacts.

6.7.1.4 PROPOSAL FOR ESTABLISHING A COMPREHENSIVE NATIONAL REGISTRY SYSTEM.

The expected outputs of implementing an integrated, multi-level framework for measurement, reporting, and verification to monitor climate action include collecting GHG data at various levels: national, sectoral, institutional, and project-based, and tracking progress towards achieving nationally determined contributions.

The proposed overall local monitoring, reporting, and verification system will be managed by the Ministry of Environment, where all information must be provided to the Climate Change Directorate. The system will operate through a national platform and database accessible to all institutions, ministries, and stakeholders via the internet, with each user being assigned a username and password tailored to their responsibilities and position in the system structure. This system must be developed to achieve a transparent, consistent, comprehensive, accurate, and comparable inventory, along with reaching typical mitigation and adaptation results. These results should be included in the national registry and updated regularly.

The electronic platform, through several pages, collects information from various entities and subjects it to predetermined mathematical equations, calculations, and methodologies according to the desired objective of each sector. These objectives could include conducting

inventories of gases, removal operations, evaluating national conditions, mitigation and adaptation activities, calculating reductions, and monitoring progress towards achieving nationally determined contributions. The platform should be equipped with the capabilities to develop and store quarterly, semi-annual, annual, and final reports.

The design of the information technology support system should be done in close collaboration with all stakeholders, considering their specific needs. All stakeholders should be involved in the early stages and consulted on system design, data flow, type, and format. Engaging all entities in designing a robust, multi-level risk monitoring, reporting, and verification system that is flexible and offers the necessary benefits will increase the chances of long-term success and sustainability.

It is of paramount importance to adopt an approach based on information systems, including a clear and practical design that defines responsibilities, describes data flows, and operates under supportive governance for implementation. A monitoring, reporting, and verification system could be thought of as a comprehensive system incorporating various elements such as process design, activity data flows, governance mechanisms, and information technology support systems.

Regarding institutional arrangements, the highest-level commitment will be ensured by a formal agreement from the Cabinet to regulate data collection and information exchange. If necessary, legislation may be enacted to compel institutions to share climate change-related data. This is a fundamental step to ensure that all relevant government entities are committed and fully aware of their responsibilities.

The general objectives of local institutional arrangements related to monitoring, reporting, and verification include:

- Fulfilling the reporting requirements of the United Nations Framework Convention on Climate Change (UNFCCC).
- Continuously building national capacities and ensuring the sustainability of reporting processes.
- Informing policymakers at both national and international levels.
- Assisting in institutionalizing activities related to climate change reporting.

6.8 TYPES OF MONITORING, REPORTING AND VERIFICATION SYSTEMS

Monitoring, Reporting, and Verification (MRV) systems typically involve three forms: MRV of GHG emissions, MRV of policies and projects, and MRV of climate action.

6.8.1 MONITORING, REPORTING AND VERIFICATION RELATED TO GHG EMISSIONS

In the national inventory, emissions are inventoried with the aim of understanding the pattern of emissions and reporting them through filling out a form that includes an inventory of the quantities of those emissions. Refer to the proposed framework for GHG emissions inventory (table 6-48).

Table 6-48: Proposed Framework for GHG Emissions Inventory

Ultimate Objective of Monitoring, Reporting, and Verification - GHG Emissions Inventory	Collect data to estimate GHG emissions by sources and removal points as a prelude to conducting a national inventory of GHGs, reporting on it, and verifying it in national reports and periodic reports for biennial periods.
Institutions Participating in the Process	Ministry of Environment, national executive ministries, and data providers
Methodology Followed	Monitoring - Collecting activity data for the GHG inventory list from participating institutions and drawn from the electronic platform and database and assigning a username and password to each entity using that platform. Reporting - Calculating emissions requires parties to rely on methodologies and calculation methods outlined by the international governmental body concerned with climate change in the principles set out in the document (1996/2006 IPCC). Verification includes the following: - Local technical review. - International review conducted by an accredited entity such as the Global Support Program under the United Nations Development Program and the United Nations Environment Program.
Necessary Technical Resources and Tools	Necessary human resources include: • Technical staff with the ability and knowledge to deal with large data sets. • Programming models for calculating and measuring GHG inventories in various sectors based on the methodologies. Development of tools to harness information technology and database platforms for data storage and reporting.
Timeframe	Annual report issuance (or as needed)

6.8.2 MONITORING, REPORTING AND VERIFICATION RELATED TO MITIGATION ACTIONS (POLICIES AND PROJECTS)

Through this system, Iraq aims to assess the impacts of GHG emissions mitigation as well as monitor the progress in its implementation. Table 6-49 represents the proposed framework for the mitigation system.

Table 6-49: Proposed Framework for Mitigation Actions Monitoring, Reporting, and Verification

Ultimate Objective of Monitoring, Reporting, and Verification - Mitigation Actions	Track progress in planning, managing, and implementing mitigation measures and analyze their effectiveness.	
Institutions Participating in the Process		Ministry of Environment, national executive ministries, and data providers
Methodology Followed		Calculations based on methodologies approved by official bodies (e.g., Clean Development Mechanism methodologies)
Monitoring at the Level of the First Project Owner/Implementer	All information about mitigation projects from all levels and calculating the national total reduction number	- Registering projects/programs/interventions on the system platform – - Calculating reduction from projects and input programs
Monitoring at the Level of Relevant Institutions/Ministries		- Verifying the estimated reduction from projects and programs within a specific ministry or institution
Monitoring at the Level of Different Sectors		- Managing the reporting of reductions from sectoral projects and programs and assessing the estimated reduction from projects and programs at the sector level (across various ministries and institutions)
National-Level Monitoring		- Estimating and assessing the reduction achieved from various sectors in nationally determined contributions - Estimating and assessing the reduction achieved in programs and policies from various sectors – Utilizing the final reports of the national reports for the secretariat of the convention.
Resources, Capacities, Staff, and Tools		• Specialized staff for data collection. • Models for measurement, reporting, and verification • Information technology tools and database platforms for data storage and reporting.
Timeframe	Annual report issuance	

6.8.3 MONITORING, REPORTING AND VERIFICATION OF CLIMATE SUPPORT

This system aims to track the provision and receipt of climate support and evaluate it, such as climate finance, technology transfer, and capacity building. Regarding the data entry for this system, the following are recommended:

- Monitoring and reporting data on international support for the public sector should be entered by the Ministry of Planning and the Ministry of Finance.
- Monitoring and reporting on international support for non-governmental organizations should be conducted by the Ministry of Planning and the Ministry of Finance.

It is essential to work on increasing transparency by clarifying definitions of climate finance procedures, whether related to the type of flows required to be included (public and private) or the types of activities that meet the criteria for monitoring, whether for emissions reduction and adaptation or for enabling activities or for early warning and reporting. Therefore, the entity responsible for monitoring, reporting, and verification of support (Ministry of Finance or Ministry of Planning) needs the following:

- Developing definitions and standards to identify climate finance (distinguishing climate finance from other forms of financing). This can be coordinated with the Ministry of Environment and the Climate Change Directorate team.
- A decision is needed regarding the level of detail for the classification system, as follows:
- A broad classification system determines whether the activity should be included in adaptation projects or mitigation projects.
- The second level of classification can consider mitigation activities by sector, such as activities undertaken in the energy, forests, transport, or manufacturing sectors.
- The final level looks at another layer of detail at the sub-sector level. For example, activities in the energy sector can be divided by technology: wind, solar, geothermal energy, and so on. Iraq needs to determine a practical level of detail and consider how to identify adaptation projects concerning national development plans and development assistance projects.
- Clear and well-defined roles and responsibilities for preparing GHG inventory estimates (internally and externally), a plan to ensure quality control, an archiving system, and a description of the data collection process and crystallizing the outlines of an inventory of quantities and estimates of GHGs.

Table 6-50: Proposed Design for the Monitoring, Reporting, and Verification System for Climate Support

Monitoring, Reporting, and Verification System for Support	The objective of continuous monitoring and verification of support (i.e., climate finance, technology transfer, and capacity building) is to track the availability and receipt of climate support, monitor achieved results, and evaluate their impact.
Primary Institution	Ministry of Finance and Ministry of Planning
Methodology	Developing national guidelines to provide guidance on measuring climate change, tracking it, and reporting on it.
Estimation Methodology	The convention does not specify measurement methodologies. Parties have the right to develop their own methodologies that suit their national circumstances.
Resources, Capacities, Staff, and Tools	The necessary human resources include: - Technical staff with the ability and knowledge to deal with large data sets. - Programming models for calculating, measuring, and preparing reference scenarios and mitigation scenarios. - Development of information technology tools, platforms, and databases for storing and reporting data.
Timeframe	Annual report

6.9 SUMMARY

It is clear from the above that Iraq has recognized the importance of climate change and the necessity to address it, while striving to adopt a green and sustainable economy. However, the Directorate of Climate Change, which is the national institutional structure responsible for managing climate change issues, still requires further support and empowerment to build and manage a comprehensive and transparent system.

ANNEX II

EMISSION INVENTORY LISTS FOR THE YEAR 2000

Annex II-Table 1 Net Emission Inventory for All National Sectors for the Year 2000 According to the Primary and Secondary Classifications of the IPCC Categories

Inventory Year: 2000

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)				Emissions (Gg)				
Categories	Net CO2 (1)(2)	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors (3)	Other halogenated gases without CO2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	59383.50086	411.0526	9.5258	0	0	2.39	0	0	0.0879	3.2338	0	0
1 - Energy	59785.23173	6.122185	0.8033	0	0	0	0	0	0	0	0	0
1.A - Fuel Combustion Activities	59785.23173	6.122185	0.8033	0	0	0	0	0	0	0	0	0
1.A.1 - Energy Industries	23089.31586	0.733809	0.1319						0	0	0	0
1.A.2 - Manufacturing Industries and Construction	14172.10908	0.200536	0.1085						0	0	0	0
1.A.3 - Transport	10318.48527	3.780003	0.4937						0	0	0	0
1.A.4 - Other Sectors	12205.32152	1.407838	0.0691						0	0	0	0
1.A.5 - Non-Specified	0	0	0						0	0	0	0
1.B - Fugitive emissions from fuels	0	0	0	0	0	0	0	0	0	0	0	0
1.B.1 - Solid Fuels	0	0	0						0	0	0	0
1.B.2 - Oil and Natural Gas	0	0	0						0	0	0	0
1.B.3 - Other emissions from Energy Production	0	0	0						0	0	0	0
1.C - Carbon dioxide Transport and Storage	0	0	0	0	0	0	0	0	0	0	0	0
1.C.1 - Transport of CO2	0								0	0	0	0
1.C.2 - Injection and Storage	0								0	0	0	0
1.C.3 - Other	0								0	0	0	0

2 - Industrial Processes and Product Use	2217.289004	0.053487	0	0	0	2.39	0	0	0	0	0	0
2.A - Mineral Industry	1060.12485	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	1031.4616								0	0	0	0
2.A.2 - Lime production	28.66325								0	0	0	0
2.A.3 - Glass Production	0								0	0	0	0
2.A.4 - Other Process Uses of Carbonates	0								0	0	0	0
2.A.5 - Other (please specify)	0	0	0						0	0	0	0
2.B - Chemical Industry	1152.928814	0.053487	0	0	0	0	0	0	0	0	0	0
2.B.1 - Ammonia Production	1023.864421								0	0	0	0
2.B.2 - Nitric Acid Production			0						0	0	0	0
2.B.3 - Adipic Acid Production			0						0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			0						0	0	0	0
2.B.5 - Carbide Production	0	0							0	0	0	0
2.B.6 - Titanium Dioxide Production	0								0	0	0	0
2.B.7 - Soda Ash Production	0								0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	129.064393	0.053487							0	0	0	0
2.B.9 - Fluorochemical Production				0	0	0	0	0	0	0	0	0
2.B.10 - Other (Please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.C - Metal Industry	4.21774	0	0	0	0	0	0	0	0	0	0	0
2.C.1 - Iron and Steel Production	3.8264	0							0	0	0	0
2.C.2 - Ferroalloys Production	0	0							0	0	0	0
2.C.3 - Aluminium production	0				0			0	0	0	0	0
2.C.4 - Magnesium production	0					0		0	0	0	0	0
2.C.5 - Lead Production	0.39134								0	0	0	0
2.C.6 - Zinc Production	0								0	0	0	0
2.C.7 - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	0.0176	0	0	0	0	0	0	0	0	0	0	0
2.D.1 - Lubricant Use	0.0176								0	0	0	0
2.D.2 - Paraffin Wax Use	0								0	0	0	0
2.D.3 - Solvent Use									0	0	0	0
2.D.4 - Other (please specify)	0	0	0						0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor				0	0	0	0	0	0	0	0	0
2.E.2 - TFT Flat Panel Display					0	0	0	0	0	0	0	0
2.E.3 - Photovoltaics					0			0	0	0	0	0
2.E.4 - Heat Transfer Fluid					0			0	0	0	0	0
2.E.5 - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning				0				0	0	0	0	0
2.F.2 - Foam Blowing Agents				0				0	0	0	0	0
2.F.3 - Fire Protection				0	0			0	0	0	0	0
2.F.4 - Aerosols				0				0	0	0	0	0
2.F.5 - Solvents				0	0			0	0	0	0	0
2.F.6 - Other Applications (please specify)				0	0			0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	2.39	0	0	0	0	0	0
2.G.1 - Electrical Equipment					0	0		0	0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses					0	2.39		0	0	0	0	0
2.G.3 - N2O from Product Uses			0						0	0	0	0
2.G.4 - Other (Please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.H - Other	0	0	0	0	0	0	0	0	0	0	0	0
2.H.1 - Pulp and Paper Industry	0	0							0	0	0	0
2.H.2 - Food and Beverages Industry	0	0							0	0	0	0
2.H.3 - Other (please specify)	0	0	0						0	0	0	0

3 - Agriculture, Forestry, and Other Land Use	-2630.629023	181.2643	7.7046	0	0	0	0	0	0.0879	3.2338	0	0
3.A - Livestock	0	175.3166	2.0796	0	0	0	0	0	0	0	0	0
3.A.1 - Enteric Fermentation		168.7969							0	0	0	0
3.A.2 - Manure Management		6.519642	2.0796						0	0	0	0
3.B - Land	-2598.572181	0	0	0	0	0	0	0	0	0	0	0
3.B.1 - Forest land	-2598.572181								0	0	0	0
3.B.2 - Cropland	0								0	0	0	0
3.B.3 - Grassland	0								0	0	0	0
3.B.4 - Wetlands	0		0						0	0	0	0
3.B.5 - Settlements	0								0	0	0	0
3.B.6 - Other Land	0								0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	164.5431333	5.947697	5.625	0	0	0	0	0	0.0879	3.2338	0	0
3.C.1 - Emissions from biomass burning		5.947697	0.0025						0.0879	3.2338	0	0
3.C.2 - Liming	0								0	0	0	0
3.C.3 - Urea application	164.5431333								0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils			3.2836						0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils			1.3711						0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management			0.9679						0	0	0	0
3.C.7 - Rice cultivation		0							0	0	0	0
3.C.8 - Other (please specify)		0	0						0	0	0	0
3.D - Other	-196.5999749	0	0	0	0	0	0	0	0	0	0	0
3.D.1 - Harvested Wood Products	-196.5999749								0	0	0	0
3.D.2 - Other (please specify)	0	0	0						0	0	0	0
4 - Waste	11.60914616	223.6127	1.0179	0	0	0	0	0	0	0	0	0
4.A - Solid Waste Disposal	0	206.9011	0	0	0	0	0	0	0	0	0	0
4.B - Biological Treatment of Solid Waste	0	0	0	0	0	0	0	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	11.60914616	1.672441	0.0301	0	0	0	0	0	0	0	0	0
4.D - Wastewater Treatment and Discharge	0	15.03913	0.9878	0	0	0	0	0	0	0	0	0
4.E - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	0	0	0	0	0	0	0	0	0	0	0	0
5.B - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
Memo Items (5)												
International Bunkers	9.6556644	0.000878	0.0003	0	0	0	0	0	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers) (2)	0	0	0						0	0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (2)	9.6556644	0.000878	0.0003						0	0	0	0
1.A.5.c - Multilateral Operations (5)	0	0	0	0	0	0	0	0	0	0	0	0

Volatile Emissions According to the 2019 Refinement of the IPCC

1.B - Fugitive emissions from fuels	0	0	0	0	0	0	0	0	0	0	0	0
1.B.1 - Solid Fuels	0	0	0						0	0	0	0
1.B.2 - Oil and Natural Gas	16444.016	444.622	0.1049						0	0	211.755	0
1.B.3 - Other emissions from Energy Production	0	0	0						0	0	0	0

Annex II - Table 2: Summary of Emissions for All National Sectors in 2000 According to the Classifications Approved by the Intergovernmental Panel on Climate Change (Inventory Year: 2000)

Categories	Emissions (Gg)					
	Net CO_2 (1)(2)	CH_4	N_2O	SF_6	NO_x	CO
Total National Emissions and Removals	59383.50086	411.0526	9.5258	2.39	0.0879	3.2338
1 - Energy	59785.23173	6.122185	0.8033	0	0	0
1.A - Fuel Combustion Activities	59785.23173	6.122185	0.8033		0	0
2 - Industrial Processes and Product Use	2217.289004	0.053487	0	2.39	0	0
2.A - Mineral Industry	1060.12485	0	0		0	0
2.B - Chemical Industry	1152.928814	0.053487	0	0	0	0
2.C - Metal Industry	4.21774	0	0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	0.0176	0	0		0	0
2.G - Other Product Manufacture and Use	0	0	0	2.39	0	0
3 - Agriculture, Forestry, and Other Land Use	-2630.629023	181.2643	7.7046	0	0.0879	3.2338
3.A - Livestock		175.3166	2.0796		0	0
3.B - Land	-2598.572181		0		0	0
3.C - Aggregate sources and non-CO_2 emissions sources on land	164.5431333	5.947697	5.625		0.0879	3.2338
3.D - Other	-196.5999749	0	0		0	0
4 - Waste	11.60914616	223.6127	1.0179	0	0	0
4.A - Solid Waste Disposal		206.9011			0	0
4.B - Biological Treatment of Solid Waste		0	0		0	0
4.C - Incineration and Open Burning of Waste	11.60914616	1.672441	0.0301		0	0
4.D - Wastewater Treatment and Discharge		15.03913	0.9878		0	0
5 - Other	0	0	0	0	0	0
International Bunkers	9.6556644	0.000878	0.0003	0	0	0
1.A.3.a.i - International Aviation (International Bunkers) (1)	0	0	0		0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	9.6556644	0.000878	0.0003		0	0
1.A.5.c - Multilateral Operations (1)(2)	0	0	0	0	0	0

Inventory Year: 2000

Categories	Emissions (Gg)			
	Net CO_2 (1)(2)	CH_4	N_2O	NMVOCs
1.B - Fugitive emissions from fuels	16444.016	444.622	0.1049	211.755

Annex II - Table 3: Greenhouse Gas Emissions Inventory from the Energy Sector for the Year 2000 According to IPCC Classifications

Inventory Year: 2000

Categories	Emissions (Gg)		
	CO_2	CH_4	N_2O
1 - Energy	59785.2317	6.1222	0.8033
1.A - Fuel Combustion Activities	59785.2317	6.1222	0.8033
1.A.1 - Energy Industries	23089.3159	0.7338	0.1319
1.A.1.a - Main Activity Electricity and Heat Production	19412.8792	0.6481	0.1196
1.A.1.b - Petroleum Refining	1532.64738	0.0475	0.0085
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	2143.78924	0.0382	0.0038
1.A.1.c.ii - Other Energy Industries	2143.78924	0.0382	0.0038
1.A.2 - Manufacturing Industries and Construction	14172.1091	0.2005	0.1085
1.A.2.a - Iron and Steel	0.64768332	3E-05	5E-06
1.A.2.c - Chemicals	991.797714	0.0179	0.0018
1.A.2.d - Pulp, Paper, and Print	31.7234688	0.0012	0.0002
1.A.2.e - Food Processing, Beverages, and Tobacco	10.8931575	0.0004	9E-05
1.A.2.h - Machinery	1.37975571	6E-05	1E-05
1.A.2.i - Mining (excluding fuels) and Quarrying	2.7650415	0.0001	2E-05
1.A.2.k - Construction	12995.6951	0.1754	0.1052
1.A.2.l - Textile and Leather	64.0089494	0.0025	0.0005
1.A.2.m - Non-specified Industry	73.1982566	0.0029	0.0006
1.A.3 - Transport	10318.4853	3.78	0.4937
1.A.3.a - Civil Aviation	0.1135134	8E-07	3E-06
1.A.3.b - Road Transportation	10318.3718	3.78	0.4937
1.A.3.b.i - Cars	6866.85232	3.2699	0.3171
1.A.3.b.ii - Light-duty trucks	2247.70169	0.2919	0.1157
1.A.3.b.iii - Heavy-duty trucks and buses	838.295523	0.0441	0.0441
1.A.3.b.iv - Motorcycles	365.522219	0.1741	0.0169
1.A.4 - Other Sectors	12205.3215	1.4078	0.0691
1.A.4.a - Commercial/Institutional			
1.A.4.b - Residential	12205.3215	1.4078	0.0691
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms			

Annex II - Table 4: Inventory of Fugitive Emissions from the Oil and Gas Sector for the Year 2000

Inventory Year	2000
Tier	1

Sector	
Category	
Category Code	

IPCC Code	**Sector Name**	**Subcategory**	**C Emissions (Gg CH_4)**	**E Emissions (Gg CO_2)**	**G Emissions (Gg N_2O)**	**H Emissions (Gg CO_2 Equivalent)**	**J Emissions (Gg NMVOC)**
			C=A*B/1000	E=A*D/1000	G=A*F/1000	H=E+(C*GWP)+(G*GWP)	J=A*I/1000
1.B.2	**Oil and Natural Gas**						
1.B.2.a	**Oil**						
1.B.2.a.i	Exploration	Onshore conventional	3.027	66.601	4.84E-04	130.324	0.424
1.B.2.a.ii	Production and upgrading	Onshore: Most activities occurring with lower-emitting technologies and practices	440.474	6809.933	0.10	16091.316	189.207
1.B.2.a.iii	Transport	Pipelines	0.107	0.010	NA	2.248	1.066
1.B.2.a.iv	Refining	All	1.015	197.896	0.00	220.128	8.795
1.B.2.a.v	Distribution of Oil Products	Gasoline	NA	NA	NA	NA	10.671
		Diesel (gas oil)	NA	NA	NA	NA	0.583
		Kerosene	NA	NA	NA	NA	0.416
		Jet kerosene (Jet A1)	NA	NA	NA	NA	0.007
		Residual Fuel Oil	NA	NA	NA	NA	0.585
		LPG	NA	NA	NA	NA	4.41E-04
1.B.2.a.vi	Other	NE	0	0.000	0.00	0.000	0.000
1.B.2.a.vii	Abandoned Oil Wells	NE	0	0.000	0.00	0.000	0.000

Total emissions (Oil)			444.622	7074.439	0.105	16444.016	211.755
1.B.2.b	**Natural Gas**						
1.B.2.b.i	Exploration	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.ii	Production	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.iii	Processing	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.iv	Transmission and Storage	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.v	Distribution	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.vi	Gas post-Meter	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.vii	Other	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.viii	Abandoned Gas Wells	NO	0.000	0.000	0.000	0	0.000
Total (NG)			0	0	0	0	0
Total (Oil + NG)			444.622	7074.439	0.105	16444.016	211.755

Annex II - Table 5: Inventory of International Aviation and Shipping Emissions for the Year 2000

	Emissions (Gg)						
Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
Memo Items (3)							
International Bunkers	9.6556644	0.0009	0.0003	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers) (1)				0	0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	9.6556644	0.0009	0.0003	0	0	0	0
1.A.5.c - Multilateral Operations (1)(2)				0	0	0	0

Annex II - Table 6: Summary of Indirect Emissions (Precursors) from Sub-sectors of the Energy Sector in 2000

Sub sector	Subcategories	NO_X	CO	NMVOC
Fuel combustion	Energy industry	24.97	5.44	0.481
	Manufacturing industries and construction	92.55	12.25	4.86
	transport	39.092	275.21	42.545
	Another sector	0.132	7.832	0.2217
	Non- specified	NO	NO	NO
Fugitive emission	Oil and Natural gas	NA	NA	211.755
Total		156.744	457.476	295.86

Annex II - Table 7: Detailed Inventory of Indirect Emissions (Precursors) from Sub-sectors of the Energy Sector in 2000

Subsector	Subcategories		NO_x	CO	NMVOC
1 A Fuel combustion	1 A 1 Energy industry total				
	Electricity generation	total	24.97	5.44	0.481
		Fuel type			
		Residual fuel oil	14.165	1.506	0.2294
		Gas/diesel oil	0.1406	0.035	0.00173
		Natural gas (dry)	8.899	3.899	0.25
	Petroleum refining	total	0.0455	0.1976	0.029
		Fuel type			
		Residual fuel oil	1.7	0.187	0.0286
		Gas/diesel oil	0.0097019	0.0024	0.000119
		Natural gas	0.0188	0.0082	0.00055
	Other energy industries		NA	NA	NA
	1 A 2 Manufacturing industries and construction total		NO_X	CO	NMVOC
	industry	Fuel type	92.55	12.25	4.86
	Iron & steel	diesel	0.0044	0.00057	0.00021
	chemicals	Residual fuel oil	0.07	0.0092	0.0034
		Natural gas	1.29	0.507	0.402
	Pulp, paper &print	Gas/diesel	0.0348	0.0044	0.00169
		Residual fuel oil	0.155	0.02	0.00759
		Natural gas	0.0041	0.00163	0.0013
	Food, processing, beverage & tobacco	Diesel/gas oil	0.0754	0.0097	0.0097
	machinery	Diesel/ gas oil	0.00955	0.00122	0.00046
	mining	Diesel/ gas oil	0.0191	0.00246	0.00093
	construction	Diesel/ gas oil	89.97	11.575	4.384
	Textile & leather	Diesel /gas oil	0.132	0.017	0.0064
		residual	0.297	0.0038	0.0144
	Non- specified	Diesel/ gas oil	0.368	0.047	0.0179
		residual	0.1318	0.0169	0.00642
	1 A 3 Transport total		NO_X	CO	NMVOC
	Transport type	fuel type	39.092	275.21	42.545
	Domestic Aviation	Aviation gasoline	0.000144	0.0432	0.00068

Subsector	Subcategories		NO_x	CO	NMVOC
	PC	Motor gasoline	19.52	189.45	23.597
	Light duty truck	Gas/ diesel oil	8.423	4.18	0.87
		motor gasoline	1.76	20.33	1.94
	Heavy duty truck	Diesel/ gas oil	8.599	1.953	0.494
	Motorcycle	Motor gasoline	0.79	59.257	15.644
	International water born navigation		NA	NA	NA
	1 A 4 Other sector total		NO_X	CO	NMVOC
	residential	Fuel type	0.132	7.832	0.2217
		LPG	3.912	1.994	0.1457
		Other kerosene	5.22	5.838	0.0706
	Non- specified		NO	NO	NO
Fuel combustion indirect emission	Total				
1 B Fugitive emission	1B 2 Oil and natural gas		NO_X	CO	NMVOC
	1 B 2 a oil total				211.755
	exploration	Onshore conventional	NA	NA	0.424
	Production and upgrading	Onshore: Most activities occurring with lower- emitting technologies and practices	NA	NA	189.207
	transport	pipelines	NA	NA	1.066
	refining	all	NA	NA	8.795
	Distribution of oil products	Fuel type			
		gasoline	NA	NA	10.671
		Diesel (gas oil)	NA	NA	0.583
		kerosene	NA	NA	0.416
		Jet kerosene (Jet A1)	NA	NA	0.007
		Residual fuel oil	NA	NA	0.585
		LPG	NA	NA	0.000
		Other	NA	NA	0.000
	Abandoned oil wells	NE			
Total energy indirect emissions			156.744	457.476	295.86

Annex II - Table 8: Greenhouse Gas Inventory from Sub-sectors of the Industrial Processes and Product Use Sector in 2000 (Inventory Year: 2000)

Categories	(Gg)			CO_2 Equivalents (Gg)		
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
2 - Industrial Processes and Product Use	2217.289004	0.053487	0	0	0	2.39
2.A - Mineral Industry	1060.12485	0	0	0	0	0
2.A.1 - Cement production	1031.4616					
2.A.2 - Lime production	28.66325					
2.A.4 - Other Process Uses of Carbonates	0	0	0	0	0	0
2.B - Chemical Industry	1152.928814	0.053487	0	0	0	0
2.B.1 - Ammonia Production	1023.864421					
2.B.8 - Petrochemical and Carbon Black Production	129.064393	0.053487	0	0	0	0
2.B.8.a - Methanol	0	0				
2.B.8.b - Ethylene	128.829467	0.053487				
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	0.234926	0				
2.B.9 - Fluorochemical Production	0	0	0	0	0	0
2.C - Metal Industry	4.21774	0	0	0	0	0
2.C.1 - Iron and Steel Production	3.8264	0				
2.C.5 - Lead Production	0.39134					
2.C.6 - Zinc Production	0					
2.D - Non-Energy Products from Fuels and Solvent Use (6)	0.0176	0	0	0	0	0
2.D.1 - Lubricant Use	0.0176					
2.E - Electronics Industry	0	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning	0	0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	2.39
2.G.1 - Electrical Equipment	0	0	0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses	0	0	0	0	0	2.39
2.G.2.c - Other (please specify) (3)					0	2.39
2.G.3 - N2O from Product Uses	0	0	0	0	0	0

Annex II - Table 9: Emissions Inventory from Sub-sectors of the Agriculture, Forestry, and Other Land Use Sector in 2000 (Inventory Year: 2000)

Categories	(Gg)				
	Net CO2 emissions/removals	Emissions			
		CH_4	N_2O	NO_x	CO
3 - Agriculture, Forestry, and Other Land Use	-2630.629023	181.2642528	7.704631388	0.08787625	3.233846
3.A - Livestock	0	175.3165556	2.079635515	0	0
3.A.1 - Enteric Fermentation	0	168.796914	0	0	0
3.A.1.a - Cattle	0	98.793113	0	0	0
3.A.1.a.i - Dairy Cows		24.943		0	0
3.A.1.a.ii - Other Cattle		73.850113		0	0
3.A.1.b - Buffalo		20.857485		0	0
3.A.1.c - Sheep		33.46872		0	0
3.A.1.d - Goats		6.64401		0	0
3.A.1.e - Camels		4.195108		0	0
3.A.1.f - Horses		0.932868		0	0
3.A.1.g - Mules and Asses		3.90561		0	0
3.A.2 - Manure Management (1)	0	6.51964164	2.079635515	0	0
3.A.2.a - Cattle	0	2.389279	0.937410964	0	0
3.A.2.a.i - Dairy cows		0.818	0.225430779	0	0
3.A.2.a.ii - Other cattle		1.571279	0.711980185	0	0
3.A.2.b - Buffalo		1.896135	0.132248373	0	0
3.A.2.c - Sheep		1.0040616	0.743992164	0	0
3.A.2.d - Goats		0.22589634	0.156624468	0	0
3.A.2.e - Camels		0.17510016	0.026107206	0	0
3.A.2.f - Horses		0.08499464	0.016271965	0	0
3.A.2.g - Mules and Asses		0.3515049	0.066980375	0	0
3.A.2.i - Poultry		0.39267	0	0	0
3.B - Land	-2598.572181	0	0	0	0
3.B.1 - Forest land	-2598.572181	0	0	0	0
3.B.1.a - Forest land Remaining Forest land	-2598.572181			0	0
3.B.1.b - Land Converted to Forest land	0	0	0	0	0
3.B.2 - Cropland	0	0	0	0	0
3.B.2.b - Land Converted to Cropland	0	0	0	0	0
3.B.3 - Grassland	0	0	0	0	0
3.B.3.b - Land Converted to Grassland	0	0	0	0	0
3.B.4 - Wetlands	0	0	0	0	0
3.B.4.a - Wetlands Remaining Wetlands	0	0	0	0	0
3.B.4.b - Land Converted to Wetlands	0	0	0	0	0
3.B.5 - Settlements	0	0	0	0	0
3.B.5.b - Land Converted to Settlements	0	0	0	0	0
3.B.6 - Other Land	0	0	0	0	0
3.B.6.b - Land Converted to Other land	0	0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land (2)	164.5431333	5.94769716	5.624995873	0.08787625	3.233846

3.C.1 - Emissions from biomass burning	0	5.94769716	0.002460535	0.08787625	3.233846
3.C.1.a - Biomass burning in forest lands		5.85279081	0	0	0
3.C.1.b - Biomass burning in croplands		0.09490635	0.002460535	0.08787625	3.233846
3.C.3 - Urea application	164.5431333			0	0
3.C.4 - Direct N2O Emissions from managed soils (3)			3.283612268	0	0
3.C.5 - Indirect N2O Emissions from managed soils			1.371060685	0	0
3.C.6 - Indirect N2O Emissions from manure management			0.967862385	0	0
3.D - Other	-196.5999749	0	0	0	0
3.D.1 - Harvested Wood Products	-196.5999749			0	0

Annex II - Table 10: Emissions Inventory from the Waste Sub-sector in 2000

Inventory Year: 2000

Categories	Emissions [Gg]		
	CO_2	CH_4	N_2O
4 - Waste	11.60914616	223.612693	1.017870535
4.A - Solid Waste Disposal	0	206.9011216	0
4.A.1 - Managed Waste Disposal Sites			
4.A.2 - Unmanaged Waste Disposal Sites			
4.A.3 - Uncategorized Waste Disposal Sites			
4.B - Biological Treatment of Solid Waste		0	0
4.C - Incineration and Open Burning of Waste	11.60914616	1.672440612	0.030103931
4.C.1 - Waste Incineration	0	0	0
4.C.2 - Open Burning of Waste	11.60914616	1.672440612	0.030103931
4.D - Wastewater Treatment and Discharge	0	15.03913077	0.987766604
4.D.1 - Domestic Wastewater Treatment and Discharge		15.03913077	0.987766604
4.D.2 - Industrial Wastewater Treatment and Discharge		0	

Annex II - Table 11: Comparison of Emissions Inventory Between the Reference Approach and the Sectoral Approach in 2000

	Reference Approach				Sectoral Approach		Difference	
Fuel	**Apparent Consumption (TJ)**	**Excluded consumption (TJ)**	**Apparent Consumption (excluding non-energy use and feedstocks) (TJ)**	**CO2 Emissions (Gg)**	**Energy Consumption (TJ)**	**CO2 Emissions (Gg)**	**Energy Consumption (%)**	**CO2 Emissions (%)**
Crude Oil	1138430.898		1138430.898	83484.93252	80786.655	5921.661812	1309.181873	1309.822701
Orimulsion	0		0	0			0	0
Natural Gas Liquids	-300.10474	0	-300.10474	-19.25672082			100	100
Motor Gasoline	-300.78371		-300.78371	-20.8443111	110277.319	7642.218207	-100.2727521	-100.2727521
Aviation Gasoline	0		0	0			0	0
Jet Gasoline	0		0	0			0	0
Jet Kerosene	0		0	0	1.5876	0.1135134	-100	-100
Other Kerosene	0	0	0	0	102423.528	7364.251663	-100	-100
Shale Oil	0		0	0			0	0
Gas/Diesel Oil	-94289.82595	0	-94289.82595	-6983.733109	214917.9091	15925.41707	-143.8724843	-143.8527486
Residual Fuel Oil	-133421.2384		-133421.2384	-10322.35647	113477.1276	8783.129676	-217.5754455	-217.5248101
Liquefied Petroleum Gases	-53.3071	0	-53.3071	-3.361901107	76720.6	4841.06986	-100.0694821	-100.0694454
Ethane	0	0	0	0			0	0
Naphtha	-80359.18135	0	-80359.18135	-5893.006632			100	100
Bitumen	0	20461.8	-20461.8	-1650.5852			100	100
Lubricants	0	13307.406	-13307.406	-975.87644			100	100
Petroleum Coke	0	0	0	0			0	0
Refinery Feedstocks	0		0	0			0	0
Refinery Gas	0	0	0	0			0	0
Paraffin Waxes	0	100.1382	-100.1382	-7.343468			100	100
White Spirit and SBP	0	0	0	0			0	0
Other Petroleum Products	0		0	0			0	0
Anthracite	0		0	0			0	0
Coking Coal	0		0	0			0	0
Other Bituminous Coal	0		0	0			0	0
Sub-Bituminous Coal	0		0	0			0	0
Lignite	0		0	0			0	0
Oil Shale / Tar Sands	0		0	0			0	0
Brown Coal Briquettes	0		0	0			0	0
Patent Fuel	0		0	0			0	0
Coke Oven Coke / Lignite Coke	0	0	0	0			0	0
Gas Coke	0		0	0			0	0
Coal Tar	0	0	0	0			0	0
Natural Gas (Dry)	222528	5273.28	217254.72	12187.98979	165906.7724	9307.369931	30.94988039	30.94988039
Municipal Wastes (nonbiomass fraction)	0		0	0			0	0
Industrial Wastes	0		0	0			0	0
Waste Oils	0		0	0			0	0
Peat	0		0	0			0	0

Annex II - Table 12: Quantities of Unburned Carbon in 2000

Fuel	Estimated Quantities	Unit	Conversion Factor (TJ/Unit)	Estimated Quantities (TJ)	Carbon content (t C/TJ)	Excluded Carbon (Gg C)
Natural Gas Liquids		Gg	44.2	0	17.5	0
Other Kerosene		Gg	43.8	0	19.6	0
Gas/Diesel Oil		Gg	43	0	20.2	0
Liquefied Petroleum Gases		Gg	47.3	0	17.2	0
Ethane		Gg	46.4	0	16.8	0
Naphtha		Gg	44.5	0	20	0
Bitumen	509	Gg	40.2	20461.8	22	450.1596
Lubricants	331.03	Gg	40.2	13307.41	20	266.1481
Petroleum Coke		Gg	32.5	0	26.6	0
Refinery Gas		Gg	49.5	0	15.7	0
Paraffin Waxes	2.491	Gg	40.2	100.1382	20	2.002764
White Spirit and SBP		Gg	40.2	0	20	0
Coke Oven Coke / Lignite Coke		Gg	28.2	0	29.2	0
Coal Tar		Gg	28	0	22	0
Natural Gas (Dry)	109.86	Gg	48	5273.28	15.3	80.68118

Annex II - Table 13: Emissions Inventory Using the Reference Approach for the Fuel Combustion Category in the Energy Sector in 2000

Fuel	Unit	Production	Imports	Exports	International Bunkers	Stock change	Apparent Consumption	Conversion Factor (TJ/Unit)	Apparent Consumption (TJ)	Carbon content (t C/TJ)	Total Carbon (Gg C)	Excluded Carbon (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual CO2 Emissions (Gg CO2)
Crude Oil	Gg	128660.655	0	101747.395			26913.26	42.3	1138431	20	22768.62		22768.62	1	83484.93
Orimulsion	Gg						0	27.5	0	21	0		0	1	0
Natural Gas Liquids	Gg			6.7897			-6.7897	44.2	-300.105	17.5	-5.25183	0	-5.25183	1	-19.2567
Motor Gasoline	Gg		0	6.7897	0		-6.7897	44.3	-300.784	18.9	-5.68481		-5.68481	1	-20.8443
Aviation Gasoline	Gg		0	0			0	44.3	0	19.1	0		0	1	0
Jet Gasoline	Gg						0	44.3	0	19.1	0		0	1	0
Jet Kerosene	Gg						0	44.1	0	19.5	0		0	1	0
Other Kerosene	Gg		0	0			0	43.8	0	19.6	0	0	0	1	0
Shale Oil	Gg						0	38.1	0	20	0		0	1	0
Gas/Diesel Oil	Gg		0	2192.78665			-2192.79	43	-94289.8	20.2	-1904.65	0	-1904.65	1	-6983.73
Residual Fuel Oil	Gg		0	3302.5059			-3302.51	40.4	-133421	21.1	-2815.19		-2815.19	1	-10322.4
Liquefied Petroleum Gases	Gg		0	1.127			-1.127	47.3	-53.3071	17.2	-0.91688	0	-0.91688	1	-3.3619
Ethane	Gg						0	46.4	0	16.8	0	0	0	1	0
Naphtha	Gg		0	1805.8243			-1805.82	44.5	-80359.2	20	-1607.18	0	-1607.18	1	-5893.01
Bitumen	Gg						0	40.2	0	22	0	450.1596	-450.16	1	-1650.59
Lubricants	Gg						0	40.2	0	20	0	266.1481	-266.148	1	-975.876
Petroleum Coke	Gg						0	32.5	0	26.6	0	0	0	1	0
Refinery Feedstocks	Gg						0	43	0	20	0		0	1	0
Refinery Gas	Gg						0	49.5	0	15.7	0	0	0	1	0
Paraffin Waxes	Gg						0	40.2	0	20	0	2.002764	-2.00276	1	-7.34347
White Spirit and SBP	Gg						0	40.2	0	20	0	0	0	1	0
Other Petroleum Products	Gg						0	40.2	0	20	0		0	1	0
Anthracite	Gg						0	26.7	0	26.8	0		0		0
Coking Coal	Gg						0	28.2	0	25.8	0		0		0
Other Bituminous Coal	Gg						0	25.8	0	25.8	0		0		0
Sub-Bituminous Coal	Gg						0	18.9	0	26.2	0		0		0
Lignite	Gg						0	11.9	0	27.6	0		0		0
Oil Shale / Tar Sands	Gg						0	8.9	0	29.1	0		0		0
Brown Coal Briquettes	Gg						0	20.7	0	26.6	0		0		0
Patent Fuel	Gg						0	20.7	0	26.6	0		0		0
Coke Oven Coke / Lignite Coke	Gg						0	28.2	0	29.2	0	0	0		0
Gas Coke	Gg						0	28.2	0	29.2	0		0		0
Coal Tar	Gg						0	28	0	22	0	0	0		0
Natural Gas (Dry)	Gg	4636	0	0			4636	48	222528	15.3	3404.678	80.68118	3323.997	1	12187.99
Municipal Wastes (nonbiomass fraction)	Gg						0	10	0	25	0		0		0
Industrial Wastes	Gg						0	11.6	0	39	0		0		0
Waste Oils	Gg						0	40.2	0	20	0		0		0
Peat	Gg						0	9.76	0	28.9	0		0		0

Annex II - Table 14: Emissions Inventory by Fuel Types for the Energy Sector in 2000 (Inventory Year: 2000)

2006 IPCC Categories	Activity (TJ)			Emissions Liquid Fuel (Gg)			Emissions Gas (Gg)			Emissions Total (Gg)		
	Solid Fuel	Liquid Fuel	Gas	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1.A - Fuel Combustion Activities		698604.7263	165906.7724	50477.8618	5.9563	0.7867	9307.3699	0.1659	0.0166	59785.2317	6.1222	0.8033
1.A.1 - Energy Industries		195148.3	148363.7222	14766.111	0.5854	0.1171	8323.2048	0.1484	0.0148	23089.3159	0.7338	0.1319
1.A.1.a - Main Activity Electricity and Heat Production		182709.475	99991.68	13803.346	0.5481	0.1096	5609.5332	0.1	0.01	19412.8792	0.6481	0.1196
1.A.1.b - Petroleum Refining		12438.825	10158.33024	962.765055	0.0373	0.0075	569.88233	0.0102	0.001	1532.64738	0.0475	0.0085
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries			38213.712				2143.7892	0.0382	0.0038	2143.78924	0.0382	0.0038
1.A.1.c.i - Manufacture of Solid Fuels										0	0	0
1.A.1.c.ii - Other Energy Industries			38213.712				2143.7892	0.0382	0.0038	2143.78924	0.0382	0.0038
1.A.2 - Manufacturing Industries and Construction		177917.9592	17543.05015	13187.944	0.183	0.1068	984.16511	0.0175	0.0018	14172.1091	0.2005	0.1085
1.A.2.a - Iron and Steel		8.7406656		0.64768332	3E-05	5E-06				0.64768332	3E-05	5E-06
1.A.2.b - Non-Ferrous Metals										0	0	0
1.A.2.c - Chemicals		139.59585	17486.50615	10.8047188	0.0004	8E-05	980.99299	0.0175	0.0017	991.797714	0.0179	0.0018
1.A.2.d - Pulp, Paper, and Print		371.776025	56.544	28.5513504	0.0011	0.0002	3.1721184	6E-05	6E-06	31.7234688	0.0012	0.0002
1.A.2.e - Food Processing, Beverages, and Tobacco		147.006174		10.8931575	0.0004	9E-05				10.8931575	0.0004	9E-05
1.A.2.f - Non-Metallic Minerals										0	0	0
1.A.2.g - Transport Equipment										0	0	0
1.A.2.h - Machinery		18.620185		1.37975571	6E-05	1E-05				1.37975571	6E-05	1E-05
1.A.2.i - Mining (excluding fuels) and Quarrying		37.315		2.7650415	0.0001	2E-05				2.7650415	0.0001	2E-05
1.A.2.j - Wood and wood products										0	0	0
1.A.2.k - Construction		175380.5		12995.6951	0.1754	0.1052				12995.6951	0.1754	0.1052
1.A.2.l - Textile and Leather		838.02365		64.0089494	0.0025	0.0005				64.0089494	0.0025	0.0005
1.A.2.m - Non-specified Industry		976.381691		73.1982566	0.0029	0.0006				73.1982566	0.0029	0.0006

Annex II - Table 14: Continued - Emissions Inventory by Fuel Types for the Energy Sector in 2000 (Inventory Year: 2000)

2006 IPCC Categories	Activity (TJ)			Emissions Liquid Fuel (Gg)			Emissions Total (Gg)		
	Solid Fuel	Liquid Fuel	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1.A.3 - Transport		146394.3391		10318.4853	3.78	0.4937	10318.4853	3.78	0.4937
1.A.3.a - Civil Aviation		1.5876		0.1135134	8E-07	3E-06	0.1135134	8E-07	3E-06
1.A.3.a.i - International Aviation (International Bunkers) (2)									
1.A.3.a.ii - Domestic Aviation		1.5876		0.1135134	8E-07	3E-06	0.1135134	8E-07	3E-06
1.A.3.b - Road Transportation		146392.7515		10318.3718	3.78	0.4937	10318.3718	3.78	0.4937
1.A.3.b.i - Cars		99088.7781		6866.85232	3.2699	0.3171	6866.85232	3.2699	0.3171
1.A.3.b.ii - Light-duty trucks		30716.4525		2247.70169	0.2919	0.1157	2247.70169	0.2919	0.1157
1.A.3.b.iii - Heavy-duty trucks and buses		11313.03		838.295523	0.0441	0.0441	838.295523	0.0441	0.0441
1.A.3.b.iv - Motorcycles		5274.4909		365.522219	0.1741	0.0169	365.522219	0.1741	0.0169
1.A.3.b.v - Evaporative emissions from vehicles									
1.A.3.b.vi - Urea-based catalysts (3)							0		
1.A.3.c - Railways							0	0	0
1.A.3.d - Water-borne Navigation							0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (2)									
1.A.3.d.ii - Domestic Water-borne Navigation							0	0	0
1.A.3.e - Other Transportation							0	0	0
1.A.3.e.i - Pipeline Transport							0	0	0
1.A.3.e.ii - Off-road							0	0	0
1.A.4 - Other Sectors		179144.128		12205.3215	1.4078	0.0691	12205.3215	1.4078	0.0691
1.A.4.a - Commercial/Institutional							0	0	0
1.A.4.b - Residential		179144.128		12205.3215	1.4078	0.0691	12205.3215	1.4078	0.0691
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms							0	0	0
2 1.A.4.c.i - Stationary							0	0	0
1.A.4.c.ii - Off-road Vehicles and Other Machinery							0	0	0
1.A.4.c.iii - Fishing (mobile combustion)							0	0	0
1.A.5 - non-specified							0	0	0
1.A.5.a - Stationary							0	0	0
1.A.5.b - Mobile							0	0	0
1.A.5.b.i - Mobile (aviation component)							0	0	0
1.A.5.b.ii - Mobile (water-borne component)							0	0	0
1.A.5.b.iii - Mobile (Other)							0	0	0
1.A.5.c - Multilateral Operations (5)									

Continuation - Table 14: Emission Inventory by Fuel Types for the Energy Sector in 2000

2006 IPCC Categories	Activity (TJ)			Emissions Liquid Fuel (Gg)			Emissions Total (Gg)		
	Solid Fuel	Liquid Fuel	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
International Bunkers		125.424		9.6556644	0.0009	0.0003	9.6556644	0.0009	0.0003
1.A.3.a.i - International Aviation (International Bunkers) (2)							0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (2)		125.424		9.6556644	0.0009	0.0003	9.6556644	0.0009	0.0003
1.A.5.c - Multilateral Operations (5)							0	0	0

Annex II - Table 15: Emission Inventory by Fuel Types Used in the Industrial Processes and Product Use Sector in 2000

Categories	Activity Data			Emissions	
	Production/Consumption Quantity			CO_2 (Gg)	CH_4 (Gg)
	Description (1)	Quantity	Unit (2)	Emissions (3)	Emissions (3)
2.A - Mineral Industry				1060.12485	0
2.A.1 - Cement production	Clinker produced	1983580	t	1031.4616	
2.A.2 - Lime production	limestone	37225	t	28.66325	
2.A.3 - Glass Production				0	
2.A.4 - Other Process Uses of Carbonates (7)				0	0
2.B - Chemical Industry				1152.928814	0.053487
2.B.1 - Ammonia Production	Ammonia produced	312920	t	1023.864421	
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	Caprolactam; Glyoxal; Glyoxylic Acid	0	t		
2.B.5 - Carbide Production	Calcium Carbide Used in Acetylene Production	0	t	0	0
2.B.6 - Titanium Dioxide Production	Titanium Slag; Synthetic Rutile; Rutile TiO2	0	t	0	
2.B.7 - Soda Ash Production				0	
2.B.8 - Petrochemical and Carbon Black Production Inventory Year: 2000				129.064393	0.053487
Categories					
2.C - Metal Industry					
2.C.1 - Iron and Steel Production					
2.C.5 - Lead Production					
2.B.8.a - Methanol				0	0
2.B.8.b - Ethylene	Other	75112	t	128.829467	0.053487
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	Oxychlorination Process	1163	t	0.234926	0

Annex II - Table 16: Emission Inventory by Types and Numbers of Livestock and Land Types in the Agriculture, Forestry, and Other Land Use Sector in 2000

Inventory Year: 2000

Categories	Activity Data	Emissions	
	Number of Animals	CH_4 (Gg)	N_2O (Gg)
3.A.1 - Enteric Fermentation	10915637	168.796914	0
3.A.1.a - Cattle	1980279	98.793113	0
3.A.1.a.i - Dairy Cows	409000	24.943	
3.A.1.a.ii - Other Cattle	1571279	73.850113	
3.A.1.b - Buffalo	379227	20.857485	
3.A.1.c - Sheep	6693744	33.46872	
3.A.1.d - Goats	1328802	6.64401	
3.A.1.e - Camels	91198	4.195108	
3.A.1.f - Horses	51826	0.932868	
3.A.1.g - Mules and Asses	390561	3.90561	
3.A.1.h - Swine	0	0	
3.A.1.j - Other (please specify)		0	
3.A.2 - Manure Management (1)	30549137	6.51964164	2.079635515
3.A.2.a - Cattle	1980279	2.389279	0.937410964
3.A.2.a.i - Dairy cows	409000	0.818	0.225430779
3.A.2.a.ii - Other cattle	1571279	1.571279	0.711980185
3.A.2.b - Buffalo	379227	1.896135	0.132248373
3.A.2.c - Sheep	6693744	1.0040616	0.743992164
3.A.2.d - Goats	1328802	0.22589634	0.156624468
3.A.2.e - Camels	91198	0.17510016	0.026107206
3.A.2.f - Horses	51826	0.08499464	0.016271965
3.A.2.g - Mules and Asses	390561	0.3515049	0.066980375
3.A.2.h - Swine	0	0	0
3.A.2.i - Poultry	19633500	0.39267	0
3.A.2.j - Other (please specify)		0	0

Categories	Activity Data			Emissions				Information item: Carbon emitted as CH4 and CO (5)				
	Description (2)	Unit (ha or kg dm)	Value	CO_2 (3) (Gg)	CH_4 (4) (Gg) Biomass	CH_4 (4) (Gg) DOM	N_2O (Gg)	CO (4) (Gg) Biomass	CO (4) (Gg) DOM	NOx (Gg)	Biomass (C Gg)	DOM (C Gg)
3.C - Aggregate sources and non-CO2 emissions sources on land				0	5.94769716	0	0.002460535	3.233846	0	0.08787625	5.84670687	0
3.C.1 - Emissions from biomass burning				0	5.94769716	0	0.002460535	3.233846	0	0.08787625	5.84670687	0
3.C.1.a - Biomass burning in forest lands				0	5.85279081	0	0	0	0	0	4.389593108	0
Area burned				0	5.85279	0	0	0	0	0	4.3895925	0
Controlled Burning				0	0	0	0	0	0	0	0	0
Wildfires	Area burned	ha	40900	0	5.85279	0	0	0	0	0	4.3895925	0
Amount burned				0	0.00000081	0	0	0	0	0	6.075E-07	0
Controlled Burning				0	0	0	0	0	0	0	0	0
Wildfires	Amount burned	kg	300	0	0.00000081	0	0	0	0	0	6.075E-07	0
3.C.1.b - Biomass burning in croplands				0	0.09490635	0	0.002460535	3.233846	0	0.08787625	1.457113763	0
Area burned				0	0	0	0	0	0	0	0	0
Biomass Burning in Cropland Remaining Cropland				0	0.09490635	0	0.002460535	3.233846	0	0.08787625	1.457113763	0
Controlled Burning	Area burned	ha	6391	0	0.09490635	0	0.002460535	3.233846	0	0.08787625	1.457113763	0

Annex II - Table 17: Emission Inventory by Waste Quantities and Disposal Methods in the Waste Sector in 2000

Inventory Year: 2000

Categories	Type of Activity Data	Unit	Emissions [Gg]		
			CO2 (Gg)	CH4 (Gg)	N2O (Gg)
4.A - Solid Waste Disposal (1)			0	206.9011216	0
4.A.3 - Uncategorised Waste Disposal Sites	3602.179781	Gg		206.9011216	
4.B - Biological Treatment of Solid Waste				0	0
4.C - Incineration and Open Burning of Waste (2)			11.60914616	1.672440612	0.030103931
4.C.1 - Waste Incineration	0	Gg	0	0	0
4.C.2 - Open Burning of Waste	257.2985558	Gg	11.60914616	1.672440612	0.030103931
4.D - Wastewater Treatment and Discharge			0	15.03913077	0.987766604
4.D.1 - Domestic Wastewaster Treatment and Discharge			0	15.03913077	0.987766604
CH4 Emissions (3)	83550726.5	kg		15.03913077	
N2O Emissions (4)	125715749.6	kg			0.987766604
4.D.2 - Industrial Wastewater Treatment and Discharge			0	0	0

Inventory Year: 2000

Categories	C [Gg]
Information Items (2)	
Long-term storage of carbon in waste disposal sites	
Annual change in total long-term storage of carbon stored	5.845626222
Annual change in long-term storage of carbon in HWP waste (3)	3.650997412

Annex II - Table 18: Uncertainty Assessment for the Emission Inventory of All National Sectors in 2000

Base year for assessment of uncertainty in trend: 2000, Year T: 2000

2006 IPCC Categories	Gas	Base Year emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T
1 - Energy						
1.A.1 - Energy Industries - Liquid Fuels	CO2	14766.11104	8.660254038	10.62813794	13.70975259	0
1.A.1 - Energy Industries - Liquid Fuels	CH4	12.2943429	8.660254038	396.2722302	396.3668508	0
1.A.1 - Energy Industries - Liquid Fuels	N2O	36.2975838	8.660254038	396.2722302	396.3668508	0
1.A.1 - Energy Industries - Gaseous Fuels	CO2	8323.204818	8.660254038	6.792356108	11.00618469	0
1.A.1 - Energy Industries - Gaseous Fuels	CH4	3.115638167	8.660254038	346.4101615	346.5183978	0
1.A.1 - Energy Industries - Gaseous Fuels	N2O	4.599275389	8.660254038	346.4101615	346.5183978	0
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CO2	13187.94396	15	18.40847491	23.74598805	0
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CH4	3.842850432	15	686.3636364	686.5275241	0
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	N2O	33.09274042	15	686.3636364	686.5275241	0
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	CO2	984.1651133	7.071067812	5.545935539	8.986512171	0
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	CH4	0.368404053	7.071067812	282.8427125	282.931087	0
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	N2O	0.543834555	7.071067812	282.8427125	282.931087	0
1.A.3.a - Civil Aviation - Liquid Fuels	CO2	0.1135134	5	4.170829171	6.511206952	0
1.A.3.a - Civil Aviation - Liquid Fuels	CH4	1.66698E-05	5	100	100.124922	0
1.A.3.a - Civil Aviation - Liquid Fuels	N2O	0.000984312	5	150	150.0833102	0
1.A.3.b - Road Transportation - Liquid Fuels	CO2	10318.37175	10	8.29629129	12.99340022	0
1.A.3.b - Road Transportation - Liquid Fuels	CH4	79.38003599	10	346.9857219	347.1297901	0
1.A.3.b - Road Transportation - Liquid Fuels	N2O	153.0586583	10	302.9398928	303.1048971	0
1.A.3.b - Road Transportation	CO2	0	0	0	0	0
1.A.3.d - Water-borne Navigation - Liquid Fuels	CO2	9.6556644	5	4.301403713	6.595610199	0
1.A.3.d - Water-borne Navigation - Liquid Fuels	CH4	0.018437328	5	50	50.24937811	0
1.A.3.d - Water-borne Navigation - Liquid Fuels	N2O	0.07776288	5	140	140.0892573	0
1.A.4 - Other Sectors - Liquid Fuels	CO2	12205.32152	5	6.136158302	7.91532935	0
1.A.4 - Other Sectors - Liquid Fuels	CH4	29.56460388	5	200	200.0624902	0
1.A.4 - Other Sectors - Liquid Fuels	N2O	21.42911481	5	236.3636364	236.4165151	0
1.B.1 - Solid Fuels	CO2	0	5	0	5	0
1.B.1 - Solid Fuels	CH4	0	7.071067812	0	7.071067812	0
1.C - Carbon dioxide Transport and Storage	CO2	0	0	0	0	0
2 - Industrial Processes and Product Use						
2.A.1 - Cement production	CO2	1031.4616	35	0	35	11.1567468
2.A.2 - Lime production	CO2	28.66325	15	0	15	0.001582445
2.A.3 - Glass Production	CO2	0	5	0	5	0
2.A.4 - Other Process Uses of Carbonates	CO2	0	0	0	0	0
2.B.1 - Ammonia Production	CO2	1023.864421	5	0	5	0.224347003
2.B.2 - Nitric Acid Production	N2O	0	2	0	2	0
2.B.3 - Adipic Acid Production	N2O	0	5	0	5	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O	0	10	0	10	0
2.B.5 - Carbide Production	CO2	0	5	10	11.18033989	0
2.B.5 - Carbide Production	CH4	0	5	10	11.18033989	0
2.B.6 - Titanium Dioxide Production	CO2	0	5	0	5	0
2.B.7 - Soda Ash Production	CO2	0	5	0	5	0
2.B.8 - Petrochemical and Carbon Black Production	CO2	129.064393	24.49489743	0	24.49489743	0.014207813
2.B.8 - Petrochemical and Carbon Black Production	CH4	1.123227	24.49489743	0	24.49489743	1.08002E-06
2.B.9 - Fluorochemical Production	CHF3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CH2F2	0	1	0	1	0
2.B.9 - Fluorochemical Production	CH3F	0	1	0	1	0
2.B.9 - Fluorochemical Production	CF3CHFCHFCF2CF3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CHF2CF3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CHF2CHF2	0	1	0	1	0
2.B.9 - Fluorochemical Production	CH2FCF3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CH3CHF2	0	1	0	1	0
2.B.9 - Fluorochemical Production	CHF2CH2F	0	1	0	1	0
2.B.9 - Fluorochemical Production	CF3CH3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CF3CHFCF3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CF3CH2CF3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CH2FCF2CHF2	0	1	0	1	0
2.B.9 - Fluorochemical Production	CF4	0	1	0	1	0
2.B.9 - Fluorochemical Production	C2F6	0	1	0	1	0
2.B.9 - Fluorochemical Production	C3F8	0	1	0	1	0
2.B.9 - Fluorochemical Production	C4F10	0	1	0	1	0
2.B.9 - Fluorochemical Production	c-C4F8	0	1	0	1	0
2.B.9 - Fluorochemical Production	C5F12	0	1	0	1	0
2.B.9 - Fluorochemical Production	C6F14	0	1	0	1	0
2.B.9 - Fluorochemical Production	SF6	0	1	0	1	0
2.B.9 - Fluorochemical Production	CHCl3	0	1	0	1	0
2.B.9 - Fluorochemical Production	CH2Cl2	0	1	0	1	0
2.B.9 - Fluorochemical Production	CF3 I	0	1	0	1	0
2.C.1 - Iron and Steel Production	CO2	3.8264	10	0	10	1.25336E-05
2.C.1 - Iron and Steel Production	CH4	0	10	0	10	0
2.C.2 - Ferroalloys Production	CO2	0	5	0	5	0
2.C.2 - Ferroalloys Production	CH4	0	5	0	5	0
2.C.3 - Aluminium production	CO2	0	2	0	2	0
2.C.3 - Aluminium production	CF4	0	2	0	2	0
2.C.3 - Aluminium production	C2F6	0	2	0	2	0
2.C.4 - Magnesium production	CO2	0	5	0	5	0
2.C.4 - Magnesium production	SF6	0	5	0	5	0
2.C.5 - Lead Production	CO2	0.39134	10	0	10	1.311E-07
2.C.6 - Zinc Production	CO2	0	10	0	10	0
2.D - Non-Energy Products from Fuels and Solvent Use	CO2	0.0176	14.14213562	0	14.14213562	2.65168E-10
2.E - Electronics Industry	C2F6	0	14.14213562	0	14.14213562	0
2.E - Electronics Industry	CF4	0	17.32050808	0	17.32050808	0
2.E - Electronics Industry	CHF3	0	10	0	10	0
2.E - Electronics Industry	C3F8	0	10	0	10	0
2.E - Electronics Industry	SF6	0	14.14213562	0	14.14213562	0
2.E - Electronics Industry	C6F14	0	10	0	10	0
2.F.4 - Aerosols	CH2FCF3	0	10	10	14.14213562	0
2.F.4 - Aerosols	CH3CHF2	0	10	10	14.14213562	0
2.F.4 - Aerosols	CF3CHFCF3	0	10	10	14.14213562	0
2.F.4 - Aerosols	CF3CHFCHFCF2CF3	0	10	10	14.14213562	0
2.F.5 - Solvents	CF3CHFCHFCF2CF3	0	10	50	50.99019514	0
2.F.5 - Solvents	C6F14	0	10	50	50.99019514	0

2.F.6 - Other Applications (please specify)	CHF3	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CH2F2	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CH3F	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CF3CHFCHFCF2CF3	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CHF2CF3	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CHF2CHF2	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CH2FCF3	0	10	50	50.99019514	0
2.F.6 - Other Applications (please specify)	CH3CHF2	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CHF2CH2F	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CF3CH3	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CF3CHFCF3	0	10	50	50.99019514	0
2.F.6 - Other Applications (please specify)	CF3CH2CF3	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CH2FCF2CHF2	0	10	0	10	0
2.F.6 - Other Applications (please specify)	CF4	0	10	0	10	0
2.F.6 - Other Applications (please specify)	C2F6	0	10	50	50.99019514	0
2.F.6 - Other Applications (please specify)	C3F8	0	10	0	10	0
2.F.6 - Other Applications (please specify)	C4F10	0	10	0	10	0
2.F.6 - Other Applications (please specify)	c-C4F8	0	10	0	10	0
2.F.6 - Other Applications (please specify)	C5F12	0	10	0	10	0
2.F.6 - Other Applications (please specify)	C6F14	0	10	0	10	0
2.G - Other Product Manufacture and Use	SF6	2.39	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	CF4	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	C2F6	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	C3F8	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	C4F10	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	c-C4F8	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	C5F12	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	C6F14	0	60	58.30951895	83.66600265	0
2.G - Other Product Manufacture and Use	N2O	0	0	0	0	0
3 - Agriculture, Forestry, and Other Land Use						
3.A.1 - Enteric Fermentation	CH4	3544.735194	0	0	0	0
3.A.2 - Manure Management	CH4	136.9124744	0	0	0	0
3.A.2 - Manure Management	N2O	644.6870095	0	0	0	0
3.B.1.a - Forest land Remaining Forest land	CO2	-2598.572181	0	0	0	0
3.B.1.b - Land Converted to Forest land	CO2	0	0	0	0	0
3.B.2.a - Cropland Remaining Cropland	CO2	0	0	0	0	0
3.B.2.b - Land Converted to Cropland	CO2	0	0	0	0	0
3.B.3.a - Grassland Remaining Grassland	CO2	0	0	0	0	0
3.B.3.b - Land Converted to Grassland	CO2	0	0	0	0	0
3.B.4.a.i - Peatlands remaining peatlands	CO2	0	0	0	0	0
3.B.4.a.i - Peatlands remaining peatlands	N2O	0	0	0	0	0
3.B.4.b - Land Converted to Wetlands	N2O	0	0	0	0	0
3.B.4.b - Land Converted to Wetlands	CO2	0	0	0	0	0
3.B.5.a - Settlements Remaining Settlements	CO2	0	0	0	0	0
3.B.5.b - Land Converted to Settlements	CO2	0	0	0	0	0
3.B.6.b - Land Converted to Other land	CO2	0	0	0	0	0
3.C.1 - Emissions from biomass burning	CH4	124.9016404	0	0	0	0
3.C.1 - Emissions from biomass burning	N2O	0.76276585	0	0	0	0
3.C.2 - Liming	CO2	0	0	0	0	0
3.C.3 - Urea application	CO2	164.5431333	0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils	N2O	1017.919803	0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils	N2O	425.0288125	0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management	N2O	300.0373392	0	0	0	0
3.C.7 - Rice cultivation	CH4	0	0	0	0	0
3.D.1 - Harvested Wood Products	CO2	-196.5999749	0	0	0	0
4 - Waste						
4.A - Solid Waste Disposal	CH4	4344.923554	0	0	0	0
4.B - Biological Treatment of Solid Waste	CH4	0	0	0	0	0
4.B - Biological Treatment of Solid Waste	N2O	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	CO2	11.60914616	0	0	0	0
4.C - Incineration and Open Burning of Waste	CH4	35.12125286	0	0	0	0
4.C - Incineration and Open Burning of Waste	N2O	9.332218617	0	0	0	0
4.D - Wastewater Treatment and Discharge	CH4	315.8217462	0	0	0	0
4.D - Wastewater Treatment and Discharge	N2O	306.2076472	0	0	0	0
5 - Other						
Total						
		Sum(C): 70980.745				Sum(H): 11.397

Gas	Base Year emissions or removals (Gg CO2 equivalent)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T
	Sum(C): 70980.745			Sum(H): 11.397
				Uncertainty in total inventory: 3.376

Annex II - Table 19: Main Category Analysis of Emissions within the Inventory in 2000

B	C	D	E	F	G
IPCC Category	Greenhouse gas	2000 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F
Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	14766.11104	14766.11104	0.192866418	0.192866418
Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	13187.94396	13187.94396	0.172253311	0.36511973
Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	12205.32152	12205.32152	0.159418864	0.524538594
Road Transportation	CARBON DIOXIDE (CO2)	10318.37175	10318.37175	0.134772615	0.659311209
Energy Industries - Gaseous Fuels	CARBON DIOXIDE (CO2)	8323.204818	8323.204818	0.108712897	0.768024106
Solid Waste Disposal	METHANE (CH4)	4344.923554	4344.923554	0.056750883	0.824774989
Enteric Fermentation	METHANE (CH4)	3544.735194	3544.735194	0.046299285	0.871074274
Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-2598.572181	2598.572181	0.03394105	0.905015324
Cement production	CARBON DIOXIDE (CO2)	1031.4616	1031.4616	0.013472356	0.91848768
Ammonia Production	CARBON DIOXIDE (CO2)	1023.864421	1023.864421	0.013373126	0.931860806
Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1017.919803	1017.919803	0.013295481	0.945156287
Manufacturing Industries and Construction - Gaseous Fuels	CARBON DIOXIDE (CO2)	984.1651133	984.1651133	0.012854597	0.958010883
Manure Management	NITROUS OXIDE (N2O)	644.6870095	644.6870095	0.00842053	0.966431413
Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	425.0288125	425.0288125	0.005551481	0.971982894
Wastewater Treatment and Discharge	METHANE (CH4)	315.8217462	315.8217462	0.004125081	0.976107975
Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	306.2076472	306.2076472	0.003999508	0.980107483
Indirect N2O Emissions from manure management	NITROUS OXIDE (N2O)	300.0373392	300.0373392	0.003918915	0.984026397
Harvested Wood Products	CARBON DIOXIDE (CO2)	-196.5999749	196.5999749	0.002567875	0.986594272
Urea application	CARBON DIOXIDE (CO2)	164.5431333	164.5431333	0.002149167	0.98874344
Road Transportation	NITROUS OXIDE (N2O)	153.0586583	153.0586583	0.001999164	0.990742604
Manure Management	METHANE (CH4)	136.9124744	136.9124744	0.001788272	0.992530875
Petrochemical and Carbon Black Production	CARBON DIOXIDE (CO2)	129.064393	129.064393	0.001685765	0.99421664
Emissions from biomass burning	METHANE (CH4)	124.9016404	124.9016404	0.001631393	0.995848033
Road Transportation	METHANE (CH4)	79.38003599	79.38003599	0.001036816	0.996884849
Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	36.2975838	36.2975838	0.000474098	0.997358947
Incineration and Open Burning of Waste	METHANE (CH4)	35.12125286	35.12125286	0.000458734	0.997817681
Manufacturing Industries and Construction - Liquid Fuels	NITROUS OXIDE (N2O)	33.09274042	33.09274042	0.000432238	0.998249919
Other Sectors - Liquid Fuels	METHANE (CH4)	29.56460388	29.56460388	0.000386156	0.998636075
Lime production	CARBON DIOXIDE (CO2)	28.66325	28.66325	0.000374383	0.999010458
Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	21.42911481	21.42911481	0.000279895	0.999290353
Energy Industries - Liquid Fuels	METHANE (CH4)	12.2943429	12.2943429	0.000160582	0.999450934
Incineration and Open Burning of Waste	CARBON DIOXIDE (CO2)	11.60914616	11.60914616	0.000151632	0.999602566
Incineration and Open Burning of Waste	NITROUS OXIDE (N2O)	9.332218617	9.332218617	0.000121892	0.999724458
Energy Industries - Gaseous Fuels	NITROUS OXIDE (N2O)	4.599275389	4.599275389	6.00731E-05	0.999784531
Manufacturing Industries and Construction - Liquid Fuels	METHANE (CH4)	3.842850432	3.842850432	5.01931E-05	0.999834724
Iron and Steel Production	CARBON DIOXIDE (CO2)	3.8264	3.8264	4.99782E-05	0.999884703
Energy Industries - Gaseous Fuels	METHANE (CH4)	3.115638167	3.115638167	4.06947E-05	0.999925397
Other Product Manufacture and Use	SF6, PFCs	2.39	2.39	3.12168E-05	0.999956614
Petrochemical and Carbon Black Production	METHANE (CH4)	1.123227	1.123227	1.46709E-05	0.999971285
Emissions from biomass burning	NITROUS OXIDE (N2O)	0.76276585	0.76276585	9.96281E-06	0.999981248
Manufacturing Industries and Construction - Gaseous Fuels	NITROUS OXIDE (N2O)	0.543834555	0.543834555	7.10325E-06	0.999988351
Lead Production	CARBON DIOXIDE (CO2)	0.39134	0.39134	5.11146E-06	0.999993463
Manufacturing Industries and Construction - Gaseous Fuels	METHANE (CH4)	0.368404053	0.368404053	4.81188E-06	0.999998274
Civil Aviation	CARBON DIOXIDE (CO2)	0.1135134	0.1135134	1.48265E-06	0.999999757
Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	0.0176	0.0176	2.29881E-07	0.999999987
Civil Aviation	NITROUS OXIDE (N2O)	0.000984312	0.000984312	1.28565E-08	1
Civil Aviation	METHANE (CH4)	1.66698E-05	1.66698E-05	2.17731E-10	1
Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Energy Industries - Solid Fuels	METHANE (CH4)	0	0	0	1
Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Energy Industries - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Energy Industries - Other Fossil Fuels	METHANE (CH4)	0	0	0	1
Energy Industries - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Energy Industries - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
Energy Industries - Peat	METHANE (CH4)	0	0	0	1
Energy Industries - Peat	NITROUS OXIDE (N2O)	0	0	0	1
Energy Industries - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
Energy Industries - Biomass	METHANE (CH4)	0	0	0	1
Energy Industries - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	0	0	0	1
Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Manufacturing Industries and Construction - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Manufacturing Industries and Construction - Other Fossil Fuels	METHANE (CH4)	0	0	0	1
Manufacturing Industries and Construction - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Manufacturing Industries and Construction - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
Manufacturing Industries and Construction - Peat	METHANE (CH4)	0	0	0	1
Manufacturing Industries and Construction - Peat	NITROUS OXIDE (N2O)	0	0	0	1
Manufacturing Industries and Construction - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
Manufacturing Industries and Construction - Biomass	METHANE (CH4)	0	0	0	1
Manufacturing Industries and Construction - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
Railways	CARBON DIOXIDE (CO2)	0	0	0	1
Railways	METHANE (CH4)	0	0	0	1
Railways	NITROUS OXIDE (N2O)	0	0	0	1
Water-borne Navigation - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Water-borne Navigation - Liquid Fuels	METHANE (CH4)	0	0	0	1
Water-borne Navigation - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Water-borne Navigation - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Water-borne Navigation - Solid Fuels	METHANE (CH4)	0	0	0	1
Water-borne Navigation - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Water-borne Navigation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Water-borne Navigation - Gaseous Fuels	METHANE (CH4)	0	0	0	1
Water-borne Navigation - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Water-borne Navigation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Water-borne Navigation - Other Fossil Fuels	METHANE (CH4)	0	0	0	1
Water-borne Navigation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	1
Water-borne Navigation - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
Water-borne Navigation - Peat	METHANE (CH4)	0	0	0	1
Water-borne Navigation - Peat	NITROUS OXIDE (N2O)	0	0	0	1
Water-borne Navigation - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
Water-borne Navigation - Biomass	METHANE (CH4)	0	0	0	1
Water-borne Navigation - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
Other Transportation	CARBON DIOXIDE (CO2)	0	0	0	1
Other Transportation	METHANE (CH4)	0	0	0	1
Other Transportation	NITROUS OXIDE (N2O)	0	0	0	1
Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
Other Sectors - Solid Fuels	METHANE (CH4)	0	0	0	1
Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1

1.A.4	Other Sectors - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.4	Other Sectors - Gaseous Fuels	METHANE (CH4)	0	0	0	1
1.A.4	Other Sectors - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.4	Other Sectors - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.4	Other Sectors - Other Fossil Fuels	METHANE (CH4)	0	0	0	1
1.A.4	Other Sectors - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.4	Other Sectors - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.4	Other Sectors - Peat	METHANE (CH4)	0	0	0	1
1.A.4	Other Sectors - Peat	NITROUS OXIDE (N2O)	0	0	0	1
1.A.4	Other Sectors - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.4	Other Sectors - Biomass	METHANE (CH4)	0	0	0	1
1.A.4	Other Sectors - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Liquid Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Gaseous Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Other Fossil Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Peat	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Peat	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Biomass	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
1.B.1	Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.B.1	Solid Fuels	METHANE (CH4)	0	0	0	1
1.B.1	Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	0	0	0	1
1.B.2.a	Oil	METHANE (CH4)	0	0	0	1
1.B.2.a	Oil	NITROUS OXIDE (N2O)	0	0	0	1
1.B.2.b	Natural Gas	CARBON DIOXIDE (CO2)	0	0	0	1
1.B.2.b	Natural Gas	METHANE (CH4)	0	0	0	1
1.B.2.b	Natural Gas	NITROUS OXIDE (N2O)	0	0	0	1
1.C	Carbon dioxide Transport and Storage	CARBON DIOXIDE (CO2)	0	0	0	1
2.A.3	Glass Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.A.4	Other Process Uses of Carbonates	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.2	Nitric Acid Production	NITROUS OXIDE (N2O)	0	0	0	1
2.B.3	Adipic Acid Production	NITROUS OXIDE (N2O)	0	0	0	1
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NITROUS OXIDE (N2O)	0	0	0	1
2.B.5	Carbide Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.5	Carbide Production	METHANE (CH4)	0	0	0	1
2.B.6	Titanium Dioxide Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.7	Soda Ash Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.9	Fluorochemical Production	SF6, PFCs, HFCs and other halogenat	0	0	0	1
2.C.1	Iron and Steel Production	METHANE (CH4)	0	0	0	1
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.2	Ferroalloys Production	METHANE (CH4)	0	0	0	1
2.C.3	Aluminium production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.3	Aluminium production	PFCs (PFCs)	0	0	0	1
2.C.4	Magnesium production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.4	Magnesium production	Sulphur Hexafluoride (SF6)	0	0	0	1
2.C.6	Zinc Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.E	Electronics Industry	SF6, PFCs, HFCs and other halogenat	0	0	0	1
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	0	0	0	1
2.F.2	Foam Blowing Agents	HFCs (HFCs)	0	0	0	1
2.F.3	Fire Protection	HFCs, PFCs	0	0	0	1
2.F.4	Aerosols	HFCs, PFCs	0	0	0	1
2.F.5	Solvents	HFCs, PFCs	0	0	0	1
2.F.6	Other Applications (please specify)	HFCs, PFCs	0	0	0	1
2.G	Other Product Manufacture and Use	NITROUS OXIDE (N2O)	0	0	0	1
3.B.1.b	Land Converted to Forest land	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.2.a	Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.4.a.i	Peatlands remaining peatlands	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.4.a.i	Peatlands remaining peatlands	NITROUS OXIDE (N2O)	0	0	0	1
3.B.4.b	Land Converted to Wetlands	NITROUS OXIDE (N2O)	0	0	0	1
3.B.4.b	Land Converted to Wetlands	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.5.a	Settlements Remaining Settlements	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.5.b	Land Converted to Settlements	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.6.b	Land Converted to Other land	CARBON DIOXIDE (CO2)	0	0	0	1
3.C.2	Liming	CARBON DIOXIDE (CO2)	0	0	0	1
3.C.7	Rice cultivation	METHANE (CH4)	0	0	0	1
4.B	Biological Treatment of Solid Waste	METHANE (CH4)	0	0	0	1
4.B	Biological Treatment of Solid Waste	NITROUS OXIDE (N2O)	0	0	0	1
Total						
			70970.99363	76561.33794	1	

A	D	E	F
IPCC Category code	2000 Ex, t (Gg CO2 Eq)	|Ex, t| (Gg CO2 Eq)	Lx, t
Total	70970.99363	76561.33794	1

ANNEX III

EMISSION INVENTORY LISTS FOR 2019 (REFERENCE BASE YEAR FOR THE BIENNIAL UPDATE REPORT) AS STIPULATED BY THE GUIDELINES ADOPTED BY THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) IN 2006.

Lists for 2019

Annex III - Table 1: Net Emission Inventory Lists for All National Sectors for 2019 According to Primary and Secondary Classifications

Inventory Year: 2019

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)				Emissions (Gg)				
Categories	Net CO2 (1)(2)	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors (3)	Other halogenated gases without CO2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	121004.6813	1060.2027	17.4142	0	0	0	0	0	0.0879	3.2338	0	0
1 - Energy	120838.7583	7.296785	1.75054	0	0	0	0	0	0	0	0	0
1.A - Fuel Combustion Activities	120838.7583	7.296785	1.75054	0	0	0	0	0	0	0	0	0
1.A.1 - Energy Industries	81187.904	2.3678964	0.40247						0	0	0	0
1.A.2 - Manufacturing Industries and Construction	8381.625506	0.3393278	0.06786						0	0	0	0
1.A.3 - Transport	21208.09306	3.0888949	1.23157						0	0	0	0
1.A.4 - Other Sectors	10061.13569	1.5006659	0.04864						0	0	0	0
1.A.5 - Non-Specified	0	0	0						0	0	0	0
1.B - Fugitive emissions from fuels	0	0	0	0	0	0	0	0	0	0	0	0
1.B.1 - Solid Fuels	0	0	0						0	0	0	0
1.B.2 - Oil and Natural Gas	0	0	0						0	0	0	0
1.B.3 - Other emissions from Energy Production	0	0	0						0	0	0	0
1.C - Carbon dioxide Transport and Storage	0	0	0	0	0	0	0	0	0	0	0	0
1.C.1 - Transport of CO2	0								0	0	0	0
1.C.2 - Injection and Storage	0								0	0	0	0
1.C.3 - Other	0								0	0	0	0
2 - Industrial Processes and Product Use	2414.644624	0	0	0	0	0	0	0	0	0	0	0
2.A - Mineral Industry	2412.72668	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	2412.72668								0	0	0	0
2.A.2 - Lime production	0								0	0	0	0
2.A.3 - Glass Production	0								0	0	0	0
2.A.4 - Other Process Uses of Carbonates	0								0	0	0	0
2.A.5 - Other (please specify)	0	0	0						0	0	0	0
2.B - Chemical Industry	1.73	0	0	0	0	0	0	0	0	0	0	0
2.B.1 - Ammonia Production	0								0	0	0	0
2.B.2 - Nitric Acid Production			0						0	0	0	0
2.B.3 - Adipic Acid Production			0						0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			0						0	0	0	0
2.B.5 - Carbide Production	0	0							0	0	0	0
2.B.6 - Titanium Dioxide Production	0								0	0	0	0
2.B.7 - Soda Ash Production	0								0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	1.73	0							0	0	0	0
2.B.9 - Fluorochemical Production				0	0	0	0	0	0	0	0	0
2.B.10 - Other (Please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.C - Metal Industry	0.18794375	0	0	0	0	0	0	0	0	0	0	0
2.C.1 - Iron and Steel Production	0	0							0	0	0	0
2.C.2 - Ferroalloys Production	0	0							0	0	0	0
2.C.3 - Aluminium production	0				0			0	0	0	0	0
2.C.4 - Magnesium production	0					0		0	0	0	0	0
2.C.5 - Lead Production	0.18794375								0	0	0	0
2.C.6 - Zinc Production	0								0	0	0	0
2.C.7 - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	0	0	0	0	0	0	0	0	0	0	0	0
2.D.1 - Lubricant Use	0								0	0	0	0
2.D.2 - Paraffin Wax Use	0								0	0	0	0
2.D.3 - Solvent Use									0	0	0	0
2.D.4 - Other (please specify)	0	0	0						0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor				0	0	0	0	0	0	0	0	0
2.E.2 - TFT Flat Panel Display					0	0	0	0	0	0	0	0
2.E.3 - Photovoltaics					0			0	0	0	0	0
2.E.4 - Heat Transfer Fluid					0			0	0	0	0	0
2.E.5 - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning				0				0	0	0	0	0
2.F.2 - Foam Blowing Agents				0				0	0	0	0	0
2.F.3 - Fire Protection				0	0			0	0	0	0	0
2.F.4 - Aerosols				0				0	0	0	0	0
2.F.5 - Solvents				0	0			0	0	0	0	0
2.F.6 - Other Applications (please specify)				0	0			0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	0	0	0	0	0	0	0
2.G.1 - Electrical Equipment					0	0		0	0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses					0	0		0	0	0	0	0
2.G.3 - N2O from Product Uses			0						0	0	0	0
2.G.4 - Other (Please specify)	0	0	0	0	0	0	0	0	0	0	0	0
2.H - Other	0	0	0	0	0	0	0	0	0	0	0	0
2.H.1 - Pulp and Paper Industry	0	0							0	0	0	0
2.H.2 - Food and Beverages Industry	0	0							0	0	0	0
2.H.3 - Other (please specify)	0	0	0						0	0	0	0

Annex III - Table 2: Summary of Emissions for All National Sectors in 2019 According to the Classifications Approved by IPCC.

Inventory Year: 2019												
	Emissions (Gg)			Emissions CO2 Equivalents (Gg)				Emissions (Gg)				
Categories	Net CO2 (1)(2)	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with CO2 equivalent conversion factors (3)	Other halogenated gases without CO2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	121004.6813	1060.2027	17.4142	0	0	0	0	0	0.0879	3.2338	0	0
1 - Energy	120838.7583	7.296785	1.75054	0	0	0	0	0	0	0	0	0
1.A - Fuel Combustion Activities	120838.7583	7.296785	1.75054						0	0	0	0
1.B - Fugitive emissions from fuels	0	0	0						0	0	0	0
1.C - Carbon dioxide Transport and Storage	0								0	0	0	0
2 - Industrial Processes and Product Use	2414.644624	0	0	0	0	0	0	0	0	0	0	0
2.A - Mineral Industry	2412.72668	0	0						0	0	0	0
2.B - Chemical Industry	1.73	0	0	0	0	0	0	0	0	0	0	0
2.C - Metal Industry	0.18794375	0	0	0	0	0	0	0	0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	0	0	0						0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances				0	0			0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	0	0	0	0	0	0	0
2.H - Other	0	0	0						0	0	0	0
3 - Agriculture, Forestry, and Other Land Use	-2296.024661	172.68333	13.9421	0	0	0	0	0	0.0879	3.2338	0	0
3.A - Livestock		165.1508	3.5411						0	0	0	0
3.B - Land	-2538.361261		0						0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	242.3366	7.5325297	10.401						0.0879	3.2338	0	0
3.D - Other	0	0	0						0	0	0	0
4 - Waste	47.30309667	880.22255	1.72162	0	0	0	0	0	0	0	0	0
4.A - Solid Waste Disposal		824.70248							0	0	0	0
4.B - Biological Treatment of Solid Waste		0	0						0	0	0	0
4.C - Incineration and Open Burning of Waste	47.30309667	6.4981642	0.11697						0	0	0	0
4.D - Wastewater Treatment and Discharge		49.02191	1.60465						0	0	0	0
4.E - Other (please specify)	0	0	0						0	0	0	0
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3			0						0	0	0	0
5.B - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
Memo Items (5)												
International Bunkers	85523.17613	0.6255991	2.44305	0	0	0	0	0	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers) (1)	85346.89714	0.6096207	2.43848						0	0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	176.2789943	0.0159784	0.00457						0	0	0	0
1.A.5.c - Multilateral Operations (1)(2)	0	0	0	0	0	0	0	0	0	0	0	0

3 - Agriculture, Forestry, and Other Land Use	-2296.024661	172.68333	13.9421	0	0	0	0	0	0.0879	3.2338	0	0
3.A - Livestock	0	165.1508	3.5411	0	0	0	0	0	0	0	0	0
3.A.1 - Enteric Fermentation		155.9791							0	0	0	0
3.A.2 - Manure Management		9.1716991	3.5411						0	0	0	0
3.B - Land	-2538.361261	0	0	0	0	0	0	0	0	0	0	0
3.B.1 - Forest land	-2538.807861								0	0	0	0
3.B.2 - Cropland	0.4466								0	0	0	0
3.B.3 - Grassland	0								0	0	0	0
3.B.4 - Wetlands	0		0						0	0	0	0
3.B.5 - Settlements	0								0	0	0	0
3.B.6 - Other Land	0								0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	242.3366	7.5325297	10.401	0	0	0	0	0	0.0879	3.2338	0	0
3.C.1 - Emissions from biomass burning		7.5325297	0.00246						0.0879	3.2338	0	0
3.C.2 - Liming	0								0	0	0	0
3.C.3 - Urea application	242.3366								0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils			7.00255						0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils			2.80346						0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management			0.5925						0	0	0	0
3.C.7 - Rice cultivation		0							0	0	0	0
3.C.8 - Other (please specify)		0	0						0	0	0	0
3.D - Other	0	0	0	0	0	0	0	0	0	0	0	0
3.D.1 - Harvested Wood Products	0								0	0	0	0
3.D.2 - Other (please specify)	0	0	0						0	0	0	0
4 - Waste	47.30309667	880.22255	1.72162	0	0	0	0	0	0	0	0	0
4.A - Solid Waste Disposal	0	824.70248	0	0	0	0	0	0	0	0	0	0
4.B - Biological Treatment of Solid Waste	0	0	0	0	0	0	0	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	47.30309667	6.4981642	0.11697	0	0	0	0	0	0	0	0	0
4.D - Wastewater Treatment and Discharge	0	49.02191	1.60465	0	0	0	0	0	0	0	0	0
4.E - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	0	0	0	0	0	0	0	0	0	0	0	0
5.B - Other (please specify)	0	0	0	0	0	0	0	0	0	0	0	0
Memo Items (5)												
International Bunkers	85523.17613	0.6255991	2.44305	0	0	0	0	0	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers) (1)	85346.89714	0.6096207	2.43848						0	0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	176.2789943	0.0159784	0.00457						0	0	0	0
1.A.5.c - Multilateral Operations (1)(2)	0	0	0	0	0	0	0	0	0	0	0	0

Inventory Year: 2019

Categories	Emissions (Gg)				
	Net CO2 (1)(2)	CH4	N2O	NOx	CO
Total National Emissions and Removals	121004.6813	1060.2027	17.4142	0.0879	3.2338
1 - Energy	120838.7583	7.296785	1.75054	0	0
1.A - Fuel Combustion Activities	120838.7583	7.296785	1.75054	0	0
2 - Industrial Processes and Product Use	2414.644624	0	0	0	0
2.A - Mineral Industry	2412.72668	0	0	0	0
2.B - Chemical Industry	1.73	0	0	0	0
2.C - Metal Industry	0.18794375	0	0	0	0
3 - Agriculture, Forestry, and Other Land Use	-2296.024661	172.68333	13.9421	0.0879	3.2338
3.A - Livestock		165.1508	3.5411	0	0
3.B - Land	-2538.361261		0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	242.3366	7.5325297	10.401	0.0879	3.2338
3.D - Other	0	0	0	0	0
4 - Waste	47.30309667	880.22255	1.72162	0	0
4.A - Solid Waste Disposal		824.70248		0	0
4.B - Biological Treatment of Solid Waste		0	0	0	0
4.C - Incineration and Open Burning of Waste	47.30309667	6.4981642	0.11697	0	0
4.D - Wastewater Treatment and Discharge		49.02191	1.60465	0	0
5 - Other	0	0	0	0	0
International Bunkers	85523.17613	0.6255991	2.44305	0	0
1.A.3.a.i - International Aviation (International Bunkers) (1)	85346.89714	0.6096207	2.43848	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	176.2789943	0.0159784	0.00457	0	0
1.A.5.c - Multilateral Operations (1)(2)	0	0	0	0	0

Annex III - Table 3: Greenhouse Gas Emissions Inventory from the Energy Sector for 2019 According to IPCC Classifications.

Categories	Emissions (Gg)		
	CO_2	CH_4	N_2O
1 - Energy	120838.7583	7.2968	1.7505
1.A - Fuel Combustion Activities	120838.7583	7.2968	1.7505
1.A.1 - Energy Industries	81187.904	2.3679	0.4025
1.A.1.a - Main Activity Electricity and Heat Production	76183.50136	2.2512	0.3857
1.A.1.b - Petroleum Refining	1936.657169	0.062	0.0113
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	3067.745472	0.0547	0.0055
1.A.1.c.ii - Other Energy Industries	3067.745472	0.0547	0.0055
1.A.2 - Manufacturing Industries and Construction	8381.625506	0.3393	0.0679
1.A.2.a - Iron and Steel	0.000199636	8E-09	2E-09
1.A.2.c - Chemicals	0.409225724	7E-06	7E-07
1.A.2.e - Food Processing, Beverages, and Tobacco	8.689060756	0.0004	7E-05
1.A.2.h - Machinery	0.768642661	3E-05	6E-06
1.A.2.i - Mining (excluding fuels) and Quarrying	0.597634687	2E-05	5E-06
1.A.2.k - Construction	8371.107834	0.3389	0.0678
1.A.2.l - Textile and Leather	0.049301923	2E-06	4E-07
1.A.2.m - Non-specified Industry	0.003606935	1E-07	3E-08
1.A.3 - Transport	21208.09306	3.0889	1.2316
1.A.3.a - Civil Aviation	50.469363	0.0004	0.0014
1.A.3.a.i - International Aviation (International Bunkers) (1)			
1.A.3.a.ii - Domestic Aviation	50.469363	0.0004	0.0014
1.A.3.b - Road Transportation	21150.03522	3.0823	1.2284
1.A.3.b.i - Cars	4898.985662	0.2686	0.4029
1.A.3.b.ii - Light-duty trucks	12587.94501	2.507	0.6344
1.A.3.b.iii - Heavy-duty trucks and buses	3394.234826	0.1786	0.1786
1.A.3.b.iv - Motorcycles	268.8697242	0.128	0.0124
1.A.3.d.i - International water-borne navigation (International bunkers) (1)			
1.A.3.d.ii - Domestic Water-borne Navigation			

1.A.3.e - Other Transportation	7.588476051	0.0063	0.0017
1.A.3.e.i - Pipeline Transport			
1.A.3.e.ii - Off-road	7.588476051	0.0063	0.0017
1.A.4 - Other Sectors	10061.13569	1.5007	0.0486
1.A.4.a - Commercial/Institutional			
1.A.4.b - Residential	10061.13569	1.5007	0.0486
1.A.5.c - Multilateral Operations (1)(2)			

Annex III - Table 4: Inventory of Fugitive Emissions from the Oil and Gas Sector for 2019.

Inventory Year	2019
Tier	1

Sector							
Category							
Category Code							
			NMVOC				
IPCC Code	**Sector Name**	**Subcategory**	**C Emissions (Gg CH_4)**	**E Emissions (Gg CO_2)**	**G Emissions (Gg N_2O)**	**H Emissions (Gg CO_2 Equivalent)**	**J Emissions (Gg NMVOC)**
			C=A*B/1000	E=A*D/1000	G=A*F/1000	H=E+(C*GWP)+(G*GWP)	J=A*I/1000
1.B.2	**Oil and Natural Gas**						
1.B.2.a	**Oil**						
1.B.2.a.i	Exploration	Onshore conventional	5.311	116.840	8.50E-04	228.632	0.744
1.B.2.a.ii	Production and upgrading	Onshore: Most activities occurring with lower-emitting technologies and practices	772.736	11946.869	0.18	28229.478	331.931
1.B.2.a.iii	Transport	Pipelines	0.147	0.013	NA	3.111	1.475
1.B.2.a.iv	Refining	All	1.121	218.626	0.00	243.186	9.717
1.B.2.a.v	Distribution of Oil Products	Gasoline	NA	NA	NA	NA	18.896
		Diesel (gas oil)	NA	NA	NA	NA	1.441
		Kerosene	NA	NA	NA	NA	0.273
		Jet kerosene (Jet A1)	NA	NA	NA	NA	0.043
		Residual Fuel Oil	NA	NA	NA	NA	2.195
		LPG	NA	NA	NA	NA	4.77E-04
1.B.2.a.vi	Other	NE	0	0.000	0.00	0.000	0.000
1.B.2.a.vii	Abandoned Oil Wells	NE	0	0.000	0.00	0.000	0.000

Total (Oil) emissions			779.315	12282.348	0.182	28704.407	366.715
1.B.2.b	**Natural Gas**						
1.B.2.b.i	Exploration	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.ii	Production	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.iii	Processing	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.iv	Transmission and Storage	NO	11.616	1.351	NA	245.2891176	0.180
1.B.2.b.v	Distribution	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.vi	Gas post-Meter	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.vii	Other	NO	0.000	0.000	0.000	0	0.000
1.B.2.b.viii	Abandoned Gas Wells	NO	0.000	0.000	0.000	0	0.000
	Total (NG) emissions		11.6161146	1.350711	0.00	245.2891176	0.1800948
Total (Oil + NG) emissions			790.932	12283.699	0.1820424	28949.696	366.895

Annex III - Table 5: Inventory of International Emissions from Aviation and Shipping for 2019.

Categories	Emissions (Gg)		
	CO2	CH4	N2O
Memo Items (3)			
International Bunkers	85523.17613	0.6256	2.443
1.A.3.a.i - International Aviation (International Bunkers) (1)	85346.89714	0.6096	2.4385
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	176.2789943	0.016	0.0046
1.A.5.c - Multilateral Operations (1)(2)			
Information Items			
CO2 from Biomass Combustion for Energy Production	0		

Annex III - Table 6: Summary of Indirect Emissions (Precursors) for the Energy Sector in 2019.

Sub sector	Subcategories	NO_X	CO	NMVOC
Fuel combustion	Energy industry	72.987	28.4911	2.243
	Manufacturing industries and construction	58.02	7.4	2.89
	transport	3.223	33214.8776	624.2
	Another sector	7.62	5.982	0.203
	Non- specified	NO	NO	NO
Fugitive emission	Oil and Natural gas	NA	NA	366.715
Total		141.85	33256.7507	996.251

Annex III - Table 7: Detailed Inventory of Indirect Emissions (Precursors) for the Energy Sector in 2019.

Sub sector	Subcategories		NO_x	CO	NMVOC
1 A Fuel combustion	1 A 1 Energy industry total		72.987	28.4911	2.243
	Electricity generation	total			
		Fuel type			
		Residual fuel oil	2.281	0.242	0.36
		Gas/diesel oil	6.8	1.7	0.084
		Natural gas (dry)	57.438	25.167	1.67
	Petroleum refining	total	3.196	0.6591	0.062
		Fuel type			
		Residual fuel oil	2.14	0.228	0.034
		LPG	0.096	0.042	0.00282
		Naphtha	0.144	0.063	0.0042
		Natural gas	0.892	0.39	0.026
	Other energy industries		NA	NA	NA
	1 A 2 Manufacturing industries and construction total9		NO_X	CO	NMVOC
	industry	Fuel type	58.02	7.4	2.89
	Iron & steel	diesel	0.0000013	0.00000018	0.067
	chemicals	Residual fuel oil	0.000010	0.00000132	0.0000005
		Natural gas	0.00053	0.00021	0.000167
	Pulp, paper &print	Gas/diesel	NO	NO	NO
		Residual fuel oil	NO	NO	NO
		Natural gas	NO	NO	NO
	Food, processing, beverage & tobacco	Diesel/gas oil	0.06	0.0077	0.00293
	machinery	Diesel/ gas oil	0.0053	0.00068	0.00025
	mining	Diesel/ gas oil	0.0041	0.000532	0.000201
	construction	Diesel/ gas oil	57.95	7.456	2.824
	Textile & leather	Diesel /gas oil	0.000339	0.000043	0.0000165
		residual	0.0000017	0.00000023	0.00000009
	Non- specified	Diesel/ gas oil	0.000024	0.00000321	0.00000122
	1 A 3 Transport total		NO_X	CO	NMVOC
	Transport type	fuel type	3.223	33214.8776	624.2
	International aviation	Aviation gasoline	110.588	33176.63	525.29
	Domestic Aviation	Aviation gasoline	0.0653	19.6	96.49
	PC	Motor gasoline	0.617	5.9876	0.74
	Light duty truck	Gas/ diesel oil	0.165	0.82	0.17
		motor gasoline	0.83	9.57	0.916
	Heavy duty truck	Diesel/ gas oil	1.52	0.34	0.0879
	Motorcycle	Motor gasoline	0.0257	1.93	0.509
	International water born navigation		NA	NA	NA
	1 A 4 Other sector total		NO_X	CO	NMVOC
	residential	Fuel type	7.62	5.982	0.203
		LPG	4.22	2.152	0.157
		Other kerosene	3.4	3.83	0.046
	Non- specified		NO	NO	NO
Fuel combustion indirect emission	Total				
1 B Fugitive emission	1B 2 Oil and natural gas		NO_X	CO	NMVOC
	1 B 2 a oil total				366.715

	exploration	Onshore conventional	NA	NA	0.744
	Production and upgrading	Onshore: Most activities occurring with lower-emitting technologies and practices	NA	NA	331.931
	transport	pipelines	NA	NA	1.475
	refining	all	NA	NA	9.717
	Distribution of oil products	Fuel type			
		gasoline	NA	NA	18.896
		Diesel (gas oil)	NA	NA	1.441
		kerosene	NA	NA	0.273
		Jet kerosene (Jet A1)	NA	NA	0.043
		Residual fuel oil	NA	NA	2.195
		LPG	NA	NA	0.000
		Other	NA	NA	0.000
	Abandoned oil wells	NE			
Total energy indirect emissions			83.28	33232.477	994.636

Annex III - Table 8: Emission Inventory for the Industrial Processes and Product Use Sector in 2019.

Inventory Year: 2019

Categories	(Gg)			CO_2 Equivalents (Gg)		
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
2 - Industrial Processes and Product Use	2414.644624	0	0	0	0	0
2.A - Mineral Industry	2412.72668	0	0	0	0	0
2.A.1 - Cement production	2412.72668					
2.A.4 - Other Process Uses of Carbonates	0	0	0	0	0	0
2.B - Chemical Industry	1.73	0	0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	1.73	0	0	0	0	0
2.B.8.a - Methanol	0	0				
2.B.8.b - Ethylene	1.73	0				
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	0	0				
2.B.8.d - Ethylene Oxide	0	0				
2.B.8.e - Acrylonitrile	0	0				
2.B.8.f - Carbon Black	0	0				
2.B.9 - Fluorochemical Production	0	0	0	0	0	0
2.C - Metal Industry	0.18794375	0	0	0	0	0
2.C.1 - Iron and Steel Production	0	0				
2.C.2 - Ferroalloys Production	0	0				
2.C.3 - Aluminum production	0				0	
2.C.4 - Magnesium production (5)	0					0
2.C.5 - Lead Production	0.18794375					
2.C.6 - Zinc Production	0					
2.C.7 - Other (please specify) (3)						
2.D - Non-Energy Products from Fuels and Solvent Use (6)	0	0	0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning	0	0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	0
2.G.1 - Electrical Equipment	0	0	0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses	0	0	0	0	0	0
2.G.3 - N2O from Product Uses	0	0	0	0	0	0
2.H - Other	0	0	0	0	0	0

Annex III - Table 9: Emission Inventory for the Agriculture, Forestry, and Other Land Use Sector in 2019.

Inventory Year: 2019

Categories	(Gg)				
	Net CO2 emissions / removals	Emissions			
		CH_4	N_2O	NOx	CO
3 - Agriculture, Forestry, and Other Land Use	-2296.024661	172.6833328	13.94206757	0.08787625	3.233846
3.A - Livestock	0	165.1508031	3.5410986	0	0
3.A.1 - Enteric Fermentation	0	155.979104	0	0	0
3.A.1.a - Cattle	0	98.793113	0	0	0
3.A.1.a.i - Dairy Cows		24.943		0	0
3.A.1.a.ii - Other Cattle		73.850113		0	0
3.A.1.b - Buffalo		20.857485		0	0
3.A.1.c - Sheep		20.65091		0	0
3.A.1.d - Goats		6.64401		0	0
3.A.1.e - Camels		4.195108		0	0
3.A.1.f - Horses		0.932868		0	0
3.A.1.g - Mules and Asses		3.90561		0	0
3.A.1.h - Swine		0		0	0
3.A.1.j - Other (please specify)		0		0	0
3.A.2 - Manure Management (1)	0	9.17169909	3.5410986	0	0
3.A.2.a - Cattle	0	2.389279	0.937262696	0	0
3.A.2.a.i - Dairy cows		0.818	0.22528251	0	0
3.A.2.a.ii - Other cattle		1.571279	0.711980185	0	0
3.A.2.b - Buffalo		1.896135	0.132248373	0	0
3.A.2.c - Sheep		2.47810905	1.836235678	0	0
3.A.2.d - Goats		0.22589634	0.156624468	0	0
3.A.2.e - Camels		0.17510016	0.026107206	0	0
3.A.2.f - Horses		0.08499464	0.016271965	0	0
3.A.2.g - Mules and Asses		0.3515049	0.066980375	0	0
3.A.2.h - Swine		0	0	0	0
3.A.2.i - Poultry		1.57068	0.36936784	0	0
3.A.2.j - Other (please specify)		0	0	0	0

3.B - Land	-2538.361261	0	0	0	0
3.B.1 - Forest land	-2538.807861	0	0	0	0
3.B.1.a - Forest land Remaining Forest land	-2538.807861			0	0
3.B.1.b - Land Converted to Forest land	0	0	0	0	0
3.B.2 - Cropland	0.4466	0	0	0	0
3.B.2.a - Cropland Remaining Cropland	0.4466			0	0
3.B.2.b - Land Converted to Cropland	0	0	0	0	0
3.B.3 - Grassland	0	0	0	0	0
3.B.3.b - Land Converted to Grassland	0	0	0	0	0
3.B.4 - Wetlands	0	0	0	0	0
3.B.4.a - Wetlands Remaining Wetlands	0	0	0	0	0
3.B.4.b - Land Converted to Wetlands	0	0	0	0	0
3.B.5 - Settlements	0	0	0	0	0
3.B.5.b - Land Converted to Settlements	0	0	0	0	0
3.B.6 - Other Land	0	0	0	0	0
3.B.6.b - Land Converted to Other land	0	0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land (2)	242.3366	7.53252966	10.40096897	0.08787625	3.233846
3.C.1 - Emissions from biomass burning	0	7.53252966	0.002460535	0.08787625	3.233846
3.C.1.a - Biomass burning in forest lands		7.43762331	0	0	0
3.C.1.b - Biomass burning in croplands		0.09490635	0.002460535	0.08787625	3.233846
3.C.2 - Liming	0			0	0
3.C.3 - Urea application	242.3366			0	0
3.C.4 - Direct N2O Emissions from managed soils (3)			7.002547476	0	0
3.C.5 - Indirect N2O Emissions from managed soils			2.803458583	0	0
3.C.6 - Indirect N2O Emissions from manure management			0.592502373	0	0
3.D - Other	0	0	0	0	0

Annex III - Table 10: Emission Inventory for the Waste Sector in 2019.

Inventory Year: 2019

Categories	Emissions [Gg]		
	CO_2	CH_4	N_2O
4 - Waste	47.30309667	880.2225512	1.721615657
4.A - Solid Waste Disposal	0	824.7024765	0
4.A.1 - Managed Waste Disposal Sites			
4.A.2 - Unmanaged Waste Disposal Sites			
4.A.3 - Uncategorised Waste Disposal Sites			
4.B - Biological Treatment of Solid Waste		0	0
4.C - Incineration and Open Burning of Waste	47.30309667	6.498164166	0.116966955
4.C.1 - Waste Incineration	2.19648	0	0
4.C.2 - Open Burning of Waste	45.10661667	6.498164166	0.116966955
4.D - Wastewater Treatment and Discharge	0	49.02191046	1.604648702
4.D.1 - Domestic Wastewaster Treatment and Discharge		49.02191046	1.604648702
4.D.2 - Industrial Wastewater Treatment and Discharge		0	
4.E - Other (please specify)			

Annex III - Table 11: Comparison of Emission Inventories Between the Reference Approach and the Sectoral Approach for 2019.

Fuel	Apparent Consumption (TJ)	Excluded consumption (TJ)	Apparent Consumption (excluding non-energy use and feedstocks) (TJ)	CO2 Emissions (Gg)	Energy Consumption (TJ)	CO2 Emissions (Gg)	Energy Consumption (%)	CO2 Emissions (%)
Crude Oil	1283682.076		1283682.076	94136.68559	269015.31	19718.82222	377.1780744	377.3950722
Orimulsion	0		0	0			0	0
Natural Gas Liquids	40319.682	0	40319.682	2587.179595			100	100
Motor Gasoline	111357.2201		111357.2201	7717.055353	137455.8402	9525.689726	-18.9869125	-18.9869125
Aviation Gasoline	0		0	0			0	0
Jet Gasoline	0		0	0			0	0
Jet Kerosene	-796.446		-796.446	-56.945889	720.9909	50.469363	-210.4654719	-212.8325891
Other Kerosene	4972.224	0	4972.224	357.3371648	67265.1984	4836.367765	-92.60802894	-92.61145591
Shale Oil	0		0	0			0	0
Gas/Diesel Oil	66129.204	0	66129.204	4897.96971	375905.2826	27854.58144	-82.40801418	-82.41592781
Residual Fuel Oil	-140137.338		-140137.338	-10841.95872	175796.5535	13606.65324	-179.7156345	-179.6813039
Liquefied Petroleum Gases	-8305.4543	0	-8305.4543	-523.7973179	83889.2934	5293.414414	-109.9004938	-109.8952638
Ethane	0	0	0	0			0	0
Naphtha	-62559.08	836.155	-63395.235	-4648.9839	1619.8	118.73134	-4013.769293	-4015.549088
Bitumen	0	7638	-7638	-616.132			100	100
Lubricants	0	806.814	-806.814	-59.16636			100	100
Petroleum Coke	0	0	0	0			0	0
Refinery Feedstocks	0		0	0			0	0
Refinery Gas	0	0	0	0			0	0
Paraffin Waxes	0	8.2008	-8.2008	-0.601392			100	100
White Spirit and SBP	0	0	0	0			0	0
Other Petroleum Products	0		0	0			0	0
Anthracite	0		0	0			0	0
Coking Coal	0		0	0			0	0
Other Bituminous Coal	0		0	0			0	0
Sub-Bituminous Coal	0		0	0			0	0
Lignite	0		0	0			0	0
Oil Shale / Tar Sands	0		0	0			0	0
Brown Coal Briquettes	0		0	0			0	0
Patent Fuel	0		0	0			0	0
Coke Oven Coke / Lignite Coke	0	0	0	0			0	0
Gas Coke	0		0	0			0	0
Coal Tar	0	0	0	0			0	0
Natural Gas (Dry)	590027.52	6381.12	583646.4	32742.56304	710053.9882	39834.02874	-17.80253197	-17.80253197
Municipal Wastes (nonbiomass fraction)	0		0	0			0	0
Industrial Wastes	0		0	0			0	0
Waste Oils	0		0	0			0	0
Peat	0		0	0			0	0

Annex III - Table 12: Unburned Carbon Quantities by Fuel Type in 2019.

Fuel	Estimated Quantities	Unit	Conversion Factor (TJ/Unit)	Estimated Quantities (TJ)	Carbon content (t C/TJ)	Excluded Carbon (Gg C)
Natural Gas Liquids		Gg	44.2	0	17.5	0
Other Kerosene		Gg	43.8	0	19.6	0
Gas/Diesel Oil		Gg	43	0	20.2	0
Liquefied Petroleum Gases		Gg	47.3	0	17.2	0
Ethane		Gg	46.4	0	16.8	0
Naphtha	18.79	Gg	44.5	836.155	20	16.7231
Bitumen	190	Gg	40.2	7638	22	168.036
Lubricants	20.07	Gg	40.2	806.814	20	16.13628
Petroleum Coke		Gg	32.5	0	26.6	0
Refinery Gas		Gg	49.5	0	15.7	0
Paraffin Waxes	0.204	Gg	40.2	8.2008	20	0.164016
White Spirit and SBP		Gg	40.2	0	20	0
Coke Oven Coke / Lignite Coke		Gg	28.2	0	29.2	0
Coal Tar		Gg	28	0	22	0
Natural Gas (Dry)	132.94	Gg	48	6381.12	15.3	97.63114

Annex III - Table 13: Emissions Inventory Using the Reference Approach for the Fuel Combustion Category in the Energy Sector in 2019.

Fuel	Unit	Production	Imports	Exports	International Bunkers	Stock change	Apparent Consumption	Conversion Factor (TJ/Unit)	Apparent Consumption (TJ)	Carbon content (t C/TJ)	Total Carbon (Gg C)	Excluded Carbon (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual CO2 Emissions (Gg CO2)
Crude Oil	Gg	225713.209	0	195739.238		-373.123	30347.09	42.3	1283682	20	25673.64		25673.64	1	94136.69
Orimulsion	Gg						0	27.5	0	21	0		0	1	0
Natural Gas Liquids	Gg	912.21					912.21	44.2	40319.68	17.5	705.5944	0	705.5944	1	2587.18
Motor Gasoline	Gg		2586.057	0		72.35	2513.707	44.3	111357.2	18.9	2104.651		2104.651	1	7717.055
Aviation Gasoline	Gg						0	44.3	0	19.1	0		0	1	0
Jet Gasoline	Gg						0	44.3	0	19.1	0		0	1	0
Jet Kerosene	Gg		0			18.06	-18.06	44.1	-796.446	19.5	-15.5307		-15.5307	1	-56.9459
Other Kerosene	Gg		109.04				109.04	45.6	4972.224	19.6	97.45559	0	97.45559	1	357.3372
Shale Oil	Gg						0	38.1	0	20	0		0	1	0
Gas/Diesel Oil	Gg		1580.41			74.05	1506.36	43.9	66129.2	20.2	1335.81	0	1335.81	1	4897.97
Residual Fuel Oil	Gg			3098.905		122.643	-3221.55	43.5	-140137	21.1	-2956.9		-2956.9	1	-10842
Liquefied Petroleum Gases	Gg			165.71		9.881	-175.591	47.3	-8305.45	17.2	-142.854	0	-142.854	1	-523.797
Ethane	Gg						0	46.4	0	16.8	0	0	0	1	0
Naphtha	Gg			1328.6		31.38	-1359.98	46	-62559.1	20	-1251.18	16.7231	-1267.9	1	-4648.98
Bitumen	Gg						0	40.2	0	22	0	168.036	-168.036	1	-616.132
Lubricants	Gg						0	40.2	0	20	0	16.13628	-16.1363	1	-59.1664
Petroleum Coke	Gg						0	32.5	0	26.6	0	0	0	1	0
Refinery Feedstocks	Gg						0	43	0	20	0		0	1	0
Refinery Gas	Gg						0	49.5	0	15.7	0	0	0	1	0
Paraffin Waxes	Gg						0	40.2	0	20	0	0.164016	-0.16402	1	-0.60139
White Spirit and SBP	Gg						0	40.2	0	20	0	0	0	1	0
Other Petroleum Products	Gg						0	40.2	0	20	0		0	1	0
Anthracite	Gg						0	26.7	0	26.8	0		0		0
Coking Coal	Gg						0	28.2	0	25.8	0		0		0
Other Bituminous Coal	Gg						0	25.8	0	25.8	0		0		0
Sub-Bituminous Coal	Gg						0	18.9	0	26.2	0		0		0
Lignite	Gg						0	11.9	0	27.6	0		0		0
Oil Shale / Tar Sands	Gg						0	8.9	0	29.1	0		0		0
Brown Coal Briquettes	Gg						0	20.7	0	26.6	0		0		0
Patent Fuel	Gg						0	20.7	0	26.6	0		0		0
Coke Oven Coke / Lignite Coke	Gg						0	28.2	0	29.2	0	0	0		0
Gas Coke	Gg						0	28.2	0	29.2	0		0		0
Coal Tar	Gg						0	28	0	22	0	0	0		0
Natural Gas (Dry)	Gg	10097.36	2194.88	0			12292.24	48	590027.5	15.3	9027.421	97.63114	8929.79	1	32742.56
Municipal Wastes (nonbiomass fraction)	Gg						0	10	0	25	0		0		0
Industrial Wastes	Gg						0	11.6	0	39	0		0		0
Waste Oils	Gg						0	40.2	0	20	0		0		0
Peat	Gg						0	9.76	0	28.9	0		0		0

Annex III - Table 14: Emissions Inventory by Fuel Type for the Energy Sector in 2019.

Inventory Year: 019

2006 IPCC Categories	Emissions Liquid Fuel (Gg)		Emissions Gas (Gg)				Emissions Total (Gg)				
	Liquid Fuel	Gas	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1.A - Fuel Combustion Activities	1111668.269	710053.9882	81004.7295	6.5867	1.6795	39834.0287	0.7101	0.071	120838.7583	7.2968	1.7505
1.A.1 - Energy Industries	553341.827	710046.72	41354.283	1.6578	0.3315	39833.621	0.71	0.071	81187.904	2.3679	0.4025
1.A.1.a - Main Activity Electricity and Heat Production	535293.447	645331.2	39980.421	1.6059	0.3212	36203.0803	0.6453	0.0645	76183.50136	2.2512	0.3857
1.A.1.b - Petroleum Refining	18048.38	10032	1373.86197	0.052	0.0103	562.7952	0.01	0.001	1936.657169	0.062	0.0113
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries		54683.52				3067.74547	0.0547	0.0055	3067.745472	0.0547	0.0055
1.A.1.c.i - Manufacture of Solid Fuels									0	0	0
1.A.1.c.ii - Other Energy Industries		54683.52				3067.74547	0.0547	0.0055	3067.745472	0.0547	0.0055
1.A.2 - Manufacturing Industries and Construction	113106.8522	7.268246688	8381.21776	0.3393	0.0679	0.40774864	7E-06	7E-07	8381.625506	0.3393	0.0679
1.A.2.a - Iron and Steel	0.002694143		0.00019964	8E-09	2E-09				0.000199636	8E-09	2E-09
1.A.2.b - Non-Ferrous Metals									0	0	0
1.A.2.c - Chemicals	0.019933673	7.268246688	0.00147709	6E-08	1E-08	0.40774864	7E-06	7E-07	0.409225724	7E-06	7E-07

1.A.2.d - Pulp, Paper, and Print									0	0	0
1.A.2.e - Food Processing, Beverages, and Tobacco	117.2612788		8.68906076	0.0004	7E-05				8.689060756	0.0004	7E-05
1.A.2.f - Non-Metallic Minerals									0	0	0
1.A.2.g - Transport Equipment									0	0	0
1.A.2.h - Machinery	10.37304535		0.76864266	3E-05	6E-06				0.768642661	3E-05	6E-06
1.A.2.i - Mining (excluding fuels) and Quarrying	8.065245443		0.59763469	2E-05	5E-06				0.597634687	2E-05	5E-06
1.A.2.j - Wood and wood products									0	0	0
1.A.2.k - Construction	112970.4161		8371.10783	0.3389	0.0678				8371.107834	0.3389	0.0678
1.A.2.l - Textile and Leather	0.665188154		0.04930192	2E-06	4E-07				0.049301923	2E-06	4E-07
1.A.2.m - Non-specified Industry	0.048676583		0.00360693	1E-07	3E-08				0.003606935	1E-07	3E-08

Inventory Year: 2019

2006 IPCC Categories		Emissions Liquid Fuel (Gg)			Emissions Total (Gg)		
	Liquid Fuel	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1.A.3 - Transport	295152.998	21208.0931	3.0889	1.2316	21208.0931	3.0889	1.2316
1.A.3.a - Civil Aviation	720.9909	50.469363	0.0004	0.0014	50.469363	0.0004	0.0014
1.A.3.a.i - International Aviation (International Bunkers) (2)							
1.A.3.a.ii - Domestic Aviation	720.9909	50.469363	0.0004	0.0014	50.469363	0.0004	0.0014
1.A.3.b - Road Transportation	294326.6008	21150.0352	3.0823	1.2284	21150.0352	3.0823	1.2284
1.A.3.b.i - Cars	70692.4338	4898.98566	0.2686	0.4029	4898.98566	0.2686	0.4029
1.A.3.b.i.1 - Passenger cars with 3-way catalysts					0	0	0
1.A.3.b.i.2 - Passenger cars without 3-way catalysts	70692.4338	4898.98566	0.2686	0.4029	4898.98566	0.2686	0.4029
1.A.3.b.ii - Light-duty trucks	173948.235	12587.945	2.507	0.6344	12587.945	2.507	0.6344
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts					0	0	0
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts	173948.235	12587.945	2.507	0.6344	12587.945	2.507	0.6344
1.A.3.b.iii - Heavy-duty trucks and buses	45806.138	3394.23483	0.1786	0.1786	3394.23483	0.1786	0.1786
1.A.3.b.iv - Motorcycles	3879.794	268.869724	0.128	0.0124	268.869724	0.128	0.0124
1.A.3.b.v - Evaporative emissions from vehicles							
1.A.3.b.vi - Urea-based catalysts (3)					0		
1.A.3.c - Railways					0	0	0
1.A.3.d - Water-borne Navigation					0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (2)							
1.A.3.d.ii - Domestic Water-borne Navigation					0	0	0
1.A.3.e - Other Transportation	105.40631	7.58847605	0.0063	0.0017	7.58847605	0.0063	0.0017
1.A.3.e.i - Pipeline Transport					0	0	0

1.A.3.e.ii - Off-road	105.40631	7.58847605	0.0063	0.0017	7.58847605	0.0063	0.0017
1.A.4 - Other Sectors	150066.5918	10061.1357	1.5007	0.0486	10061.1357	1.5007	0.0486
1.A.4.a - Commercial/Institutional					0	0	0
1.A.4.b - Residential	150066.5918	10061.1357	1.5007	0.0486	10061.1357	1.5007	0.0486
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms					0	0	0
1.A.4.c.i - Stationary					0	0	0
1.A.4.c.ii - Off-road Vehicles and Other Machinery					0	0	0
1.A.4.c.iii - Fishing (mobile combustion)					0	0	0
1.A.5 - non-specified					0	0	0
1.A.5.a - Stationary					0	0	0
1.A.5.b - Mobile					0	0	0
1.A.5.b.i - Mobile (aviation component)					0	0	0
1.A.5.b.ii - Mobile (water-borne component)					0	0	0
1.A.5.b.iii - Mobile (Other)					0	0	0
1.A.5.c - Multilateral Operations (5)							

Memo Items

2006 IPCC Categories		Emissions Liquid Fuel (Gg)			Emissions Total (Gg)		
	Liquid Fuel	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
International Bunkers	9647.943	691.8512123	0.019661037	0.019295886	691.8512123	0.019661037	0.019295886
1.A.3.a.i - International Aviation (International Bunkers) (2)	7365.317	515.572218	0.003682659	0.014730635	515.572218	0.003682659	0.014730635
1.A.3.d.i - International water-borne navigation (International bunkers) (2)	2282.6255	176.2789943	0.015978379	0.004565251	176.2789943	0.015978379	0.004565251
1.A.5.c - Multilateral Operations (5)					0	0	0

Annex III - Table 15: Emissions Inventory by Fuel Type Used in the Industrial Processes and Product Use Sector in 2019.

Inventory Year: 2019

Categories	Activity Data			Emissions
	Production/Consumption Quantity			CO_2 (Gg)
	Description (1)	Quantity	Unit (2)	Emissions (3)
2.A – Mineral Industry				2412.72668
2.A.1 – Cement production	Clinker produced	4639859	t	2412.72668
2.A.2 – Lime production				0
2.A.3 – Glass Production				0
2.A.4 – Other Process Uses of Carbonates (7)				0
2.A.4.a – Ceramics				0
2.A.4.b – Other Uses of Soda Ash				0
2.A.4.c – Non Metallurgical Magnesia Production				0
2.A.4.d – Other (please specify)				0
2.A.5 – Other (please specify) (8)				
2.B – Chemical Industry				1.73
2.B.1 – Ammonia Production				0
2.B.2 – Nitric Acid Production				
2.B.3 – Adipic Acid Production				
2.B.4 – Caprolactam, Glyoxal and Glyoxylic Acid Production	Caprolactam; Glyoxal; Glyoxylic Acid	0	t	

2.B.5 – Carbide Production	Calcium Carbide Used in Acetylene Production	0	t	0
2.B.6 – Titanium Dioxide Production	Titanium Slag; Synthetic Rutile; Rutile TiO2	0	t	0
2.B.7 – Soda Ash Production				0
2.B.8 – Petrochemical and Carbon Black Production				1.73
2.B.8.a – Methanol				0
2.B.8.b – Ethylene	Other	1000	t	1.73
2.B.8.c – Ethylene Dichloride and Vinyl Chloride Monomer				0
2.B.8.d – Ethylene Oxide				0
2.B.8.e – Acrylonitrile				0
2.B.8.f – Carbon Black				0
2.B.10 – Other (Please specify) (8)				

Annex III - Table 16: Emissions Inventory by Types and Numbers of Livestock and Land Types in the Agriculture, Forestry, and Other Land Use Sector in 2019.

Inventory Year: 2019

Categories	Activity Data	Emissions	
	Number of Animals	CH_4 (Gg)	N_2O (Gg)
3.A.1 - Enteric Fermentation	20742620	155.979104	0
3.A.1.a - Cattle	1980279	98.793113	0
3.A.1.a.i - Dairy Cows	409000	24.943	
3.A.1.a.ii - Other Cattle	1571279	73.850113	
3.A.1.b - Buffalo	379227	20.857485	
3.A.1.c - Sheep	16520727	20.65091	
3.A.1.d - Goats	1328802	6.64401	
3.A.1.e - Camels	91198	4.195108	
3.A.1.f - Horses	51826	0.932868	
3.A.1.g - Mules and Asses	390561	3.90561	
3.A.1.h - Swine	0	0	
3.A.1.j - Other (please specify)		0	
3.A.2 - Manure Management (1)	99276620	9.17169909	3.5410986
3.A.2.a - Cattle	1980279	2.389279	0.937262696
3.A.2.a.i - Dairy cows	409000	0.818	0.22528251
3.A.2.a.ii - Other cattle	1571279	1.571279	0.711980185
3.A.2.b - Buffalo	379227	1.896135	0.132248373
3.A.2.c - Sheep	16520727	2.47810905	1.836235678
3.A.2.d - Goats	1328802	0.22589634	0.156624468
3.A.2.e - Camels	91198	0.17510016	0.026107206
3.A.2.f - Horses	51826	0.08499464	0.016271965
3.A.2.g - Mules and Asses	390561	0.3515049	0.066980375
3.A.2.h - Swine	0	0	0
3.A.2.i - Poultry	78534000	1.57068	0.36936784
3.A.2.j - Other (please specify)		0	0

Inventory Year: 2019

Categories	Activity Data		Net carbon stock change and CO_2 emissions				
			Biomass				
	Total Area (ha)	Thereof: Area of organic soils (ha)	Increase (Gg C)	Decrease (Gg C)	Carbon emitted as CH4 and CO from fires (1) (Gg C)	Net carbon stock change (Gg C)	Net CO_2 emissions (Gg CO_2)
3.B - Land	43379318.1	0	695.716392	3.436048	0	692.280344	-2538.361261
3.B.1 - Forest land	825000	0	695.712192	3.310048	0	692.402144	-2538.807861
3.B.1.a - Forest land Remaining Forest land	825000	0	695.712192	3.310048		692.402144	-2538.807861
3.B.1.b - Land Converted to Forest land	0	0	0	0	0	0	0
3.B.1.b.i - Cropland converted to Forest Land	0	0	0	0		0	0
3.B.1.b.ii - Grassland converted to Forest Land	0	0	0	0		0	0
3.B.1.b.iii - Wetlands converted to Forest Land	0	0	0	0		0	0
3.B.1.b.iv - Settlements converted to Forest Land	0	0	0	0		0	0
3.B.1.b.v - Other Land converted to Forest Land	0	0	0	0		0	0
3.B.2 - Cropland	3316813	0	0.0042	0.126	0	-0.1218	0.4466
3.B.2.a - Cropland Remaining Cropland	3316813	0	0.0042	0.126		-0.1218	0.4466
3.B.2.b - Land Converted to Cropland	0	0	0	0	0	0	0
3.B.2.b.i - Forest Land converted to Cropland	0	0	0	0		0	0
3.B.2.b.ii - Grassland converted to Cropland	0	0	0	0		0	0
3.B.2.b.iii - Wetlands converted to Cropland	0	0	0	0		0	0
3.B.2.b.iv - Settlements converted to Cropland	0	0	0	0		0	0
3.B.2.b.v - Other Land converted to Cropland	0	0	0	0		0	0
3.B.3 - Grassland	939030.1	0	0	0	0	0	0
3.B.3.a - Grassland Remaining Grassland	939030.1	0				0	0
3.B.3.b - Land Converted to Grassland	0	0	0	0	0	0	0
3.B.3.b.i - Forest Land converted to Grassland	0	0	0	0		0	0
3.B.3.b.ii - Cropland converted to Grassland	0	0	0	0		0	0
3.B.3.b.iii - Wetlands converted to Grassland	0	0	0	0		0	0
3.B.3.b.iv - Settlements converted to Grassland	0	0	0	0		0	0
3.B.3.b.v - Other Land converted to Grassland	0	0	0	0		0	0

3.B.4 - Wetlands (3)	0	0	0	0	0	0	0
3.B.5 - Settlements	33337800	0	0	0	0	0	0
3.B.5.a - Settlements Remaining Settlements	33337800	0				0	0
3.B.5.b - Land Converted to Settlements	0	0	0	0	0	0	0
3.B.5.b.i - Forest Land converted to Settlements	0	0	0	0		0	0
3.B.5.b.ii - Cropland converted to Settlements	0	0	0	0		0	0
3.B.5.b.iii - Grassland converted to Settlements	0	0	0	0		0	0
3.B.5.b.iv - Wetlands converted to Settlements	0	0	0	0		0	0
3.B.5.b.v - Other Land converted to Settlements	0	0	0	0		0	0
3.B.6 - Other Land	4960675	0	0	0	0	0	0
3.B.6.a - Other land Remaining Other land	4960675	0					
3.B.6.b - Land Converted to Other land	0	0	0	0	0	0	0
3.B.6.b.i - Forest Land converted to Other Land	0	0	0	0		0	0
3.B.6.b.ii - Cropland converted to Other Land	0	0	0	0		0	0
3.B.6.b.iii - Grassland converted to Other Land	0	0	0	0		0	0
3.B.6.b.iv - Wetlands converted to Other Land	0	0	0	0		0	0
3.B.6.b.v - Settlements converted to Other Land	0	0	0	0		0	0

Categories	Activity Data			Emissions							Information item: Carbon emitted as CH4 and CO (5)
	Description (2)	Unit (ha or kg dm)	Value	CO2 (3) (Gg)	CH4 (4) (Gg) Biomass	CH4 (4) (Gg) DOM	N2O (Gg)	CO (4) (Gg) Biomass	CO (4) (Gg) DOM	NOx (Gg)	Biomass (C Gg)
3.C - Aggregate sources and non-CO2 emissions sources on land				0	7.53252966	0	0.00246053 5	3.233846	0	0.08787625	7.03533124 5
3.C.1 - Emissions from biomass burning				0	7.53252966	0	0.00246053 5	3.233846	0	0.08787625	7.03533124 5
3.C.1.a - Biomass burning in forest lands				0	7.43762331	0	0	0	0	0	5.57821748 3
Area burned				0	7.43762 25	0	0	0	0	0	5.57821687 5
Controlled Burning				0	0	0	0	0	0	0	0
Wildfires	Area burned	ha	82500	0	7.43762 25	0	0	0	0	0	5.57821687 5
Amount burned				0	0.00000081	0	0	0	0	0	6.075E-07
Controlled Burning				0	0	0	0	0	0	0	0
Wildfires	Amount burned	kg	300	0	0.00000081	0	0	0	0	0	6.075E-07
3.C.1.b - Biomass burning in croplands				0	0.09490635	0	0.00246053 5	3.233846	0	0.08787625	1.45711376 3
Area burned				0	0	0	0	0	0	0	0
Biomass Burning in Cropland Remaining Cropland				0	0.09490635	0	0.00246053 5	3.233846	0	0.08787625	1.45711376 3
Controlled Burning	Area burned	ha	6391	0	0.09490635	0	0.00246053 5	3.233846	0	0.08787625	1.45711376 3
Wildfires				0	0	0	0	0	0	0	0

Inventory Year: 2019

Categories	Activity Data	Emissions
	Annual Average Population (Mg / yr.)	CO2 (Gg)
3.C.3 - Urea application	330459	242.3366
Forest Land	0	0
Cropland	330459	242.3366
Grassland	0	0
Wetlands	0	0
Settlements	0	0
Other Land	0	0

Inventory Year: 2019

Categories	Activity Data		Emissions
	Total amount of nitrogen applied (Gg N / yr.)	Area (ha)	N2O (Gg)
3.C.4 - Direct N2O Emissions from managed soils	445597787.1	0	7.002547476
Inorganic N fertilizer application	28897020		0.454096029
Organic N applied as fertilizer (manure and sewage sludge)	416681896.6		6.547858374
Urine and dung N deposited on pasture, range, and paddock by grazing animals	18870.5		0.000593073
N in crop residues	0		0
N mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils		0	0
Drainage/management of organic soils (i.e., Histosols)			0

Categories	Activity Data	Emissions
	Total amount of nitrogen applied / excreted (Gg N / yr.)	N2O (Gg)
3.C.5 - Indirect N2O Emissions from managed soils		2.803458583
From atmospheric deposition of N volatilized from managed soils from agricultural inputs of N (synthetic N fertilizers; organic N applied as fertilizer; urine and dung N deposited on pasture, range, and paddock by grazing animals (2)		1.295234249
Forest Land		0
Cropland	426.5684985	1.295234249
Grassland		0
Wetlands		0
Settlements		0
Other Land		0
From N leaching/runoff from managed soils (i.e. from synthetic N fertilizers; organic N applied as fertilizer; urine and dung N deposited on pasture, range, and paddock by grazing animals (2); N in crop residues (3); and N mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils)		1.508224334
Forest Land		0
Cropland	426.5684985	1.508224334
Grassland		0
Wetlands		0
Settlements		0
Other Land		0
3.C.6 - Indirect N2O Emissions from manure management		0.592502373

Annex III - Table 17: Emissions Inventory by Waste Quantities and Disposal Types in the Waste Sector in 2019.

Inventory Year: 2019

Categories	Type of Activity Data	Unit	Emissions [Gg]		
			CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)
4.A - Solid Waste Disposal (1)			0	824.7024765	0
4.A.1 - Managed Waste Disposal Sites	0	Gg		0	
4.A.2 - Unmanaged Waste Disposal Sites	0	Gg		0	
4.A.3 - Uncategorised Waste Disposal Sites	18078.5692	Gg		824.7024765	
4.B - Biological Treatment of Solid Waste				0	0
4.C - Incineration and Open Burning of Waste (2)			47.30309667	6.498164166	0.116966955
4.C.1 - Waste Incineration	3.84	Gg	2.19648	0	0
4.C.2 - Open Burning of Waste	999.717564	Gg	45.10661667	6.498164166	0.116966955
4.D - Wastewater Treatment and Discharge			0	49.02191046	1.604648702
4.D.1 - Domestic Wastewaster Treatment and Discharge			0	49.02191046	1.604648702
CH4 Emissions (3)	272343947	kg		49.02191046	
N2O Emissions (4)	204228016.6	kg			1.604648702
4.D.2 - Industrial Wastewater Treatment and Discharge			0	0	0
CH4 Emissions (3)				0	
N2O Emissions (4)					
4.E - Other (please specify)			0	0	0

Inventory Year: 2019

Categories	C [Gg]
Information Items (2)	
Long-term storage of carbon in waste disposal sites	
Annual change in total long-term storage of carbon stored	91.31105514
Annual change in long-term storage of carbon in HWP waste (3)	57.03006202

Annex III - Table 18: Uncertainty Assessment of the Emissions Inventory in 2019.

Base year for assessment of uncertainty in trend: 2018, Year T: 2019

2006 IPCC Categories	Gas	Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T	Inventory trend in national emissions for year t increase with respect to base year (% of base year)	Uncertainty introduced into the trend in total national emissions (%)
1 - Energy									
1.A.1 - Energy Industries - Liquid Fuels	CO2	0.160728513	41354.28301	7.071067812	8.677838292	11.19396612	1.816158113	25729276.12	539.0235414
1.A.1 - Energy Industries - Liquid Fuels	CH4	0.000121847	34.8148433	7.071067812	323.5549211	323.6321785	0.001079944	28572478.84	0.229238727
1.A.1 - Energy Industries - Liquid Fuels	N2O	0.000345708	102.7529553	7.071067812	323.5549211	323.6321785	0.009413187	29722498.36	1.998171536
1.A.1 - Energy Industries - Gaseous Fuels	CO2	23.00646674	39833.62099	8.660254038	6.792356108	11.00618469	0.965746746	173140.9757	328.2944051
1.A.1 - Energy Industries - Gaseous Fuels	CH4	0.008612046	14.91098112	8.660254038	346.4101615	346.5183978	0.000134139	173140.9757	0.027794891
1.A.1 - Energy Industries - Gaseous Fuels	N2O	0.012713021	22.01144832	8.660254038	346.4101615	346.5183978	0.000292307	173140.9757	0.060568912
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CO2	0	8381.217758	14.14213562	17.35567658	22.38793223	0.07952666	0	23.6310788
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CH4	0	7.125731687	14.14213562	647.1098422	647.264357	4.80499E-05	0	0.01021045
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	N2O	0	21.0378745	14.14213562	647.1098422	647.264357	0.00041883	0	0.088999935
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	CO2	0	0.407748639	5	3.921568627	6.354423695	1.21603E-10	0	4.18191E-08
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	CH4	0	0.000152633	5	200	200.0624902	1.68903E-14	0	3.58974E-12
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	N2O	0	0.000225316	5	200	200.0624902	3.68063E-14	0	7.82263E-12
1.A.3.a - Civil Aviation - Liquid Fuels	CO2	0	85397.3665	7.071067812	5.89844318	9.208237179	5.59380137	0	1888.696088
1.A.3.a - Civil Aviation - Liquid Fuels	CH4	0	12.80960498	7.071067812	141.4213562	141.5980226	2.97612E-05	0	0.006336913
1.A.3.a - Civil Aviation - Liquid Fuels	N2O	0	756.3766747	7.071067812	212.1320344	212.2498528	0.233150387	0	49.57503051
1.A.3.b - Road Transportation - Liquid Fuels	CO2	0	21150.03522	10	8.29629129	12.99340022	0.168952232	0	46.16971799
1.A.3.b - Road Transportation - Liquid Fuels	CH4	0	64.72773203	10	346.9857219	347.1297901	7.50183E-05	0	0.010412193
1.A.3.b - Road Transportation - Liquid Fuels	N2O	0	380.8096214	10	302.9398928	303.1048971	0.015018214	0	2.703891712
1.A.3.b - Road Transportation	CO2	0	0	0	0	0	0	100	0
1.A.3.d - Water-borne Navigation - Liquid Fuels	CO2	0	176.2789943	5	4.301403713	6.595610199	2.44861E-05	0	0.008189521
1.A.3.d - Water-borne Navigation - Liquid Fuels	CH4	0	0.335545949	5	50	50.24937811	5.1496E-09	0	1.10458E-06
1.A.3.d - Water-borne Navigation - Liquid Fuels	N2O	0	1.41522781	5	140	140.0892573	7.11985E-07	0	0.000151415
1.A.3.e - Other Transportation - Liquid Fuels	CO2	0	7.588476051	5	3.874293348	6.325357614	4.17338E-08	0	1.44027E-05
1.A.3.e - Other Transportation - Liquid Fuels	CH4	0	0.131490387	5	150.2190581	150.3022468	7.07502E-09	0	1.50436E-06
1.A.3.e - Other Transportation - Liquid Fuels	N2O	0	0.529975314	5	200	200.0624902	2.03634E-07	0	4.3278E-05
1.A.4 - Other Sectors - Liquid Fuels	CO2	0	10061.13569	5	6.136158302	7.91532935	0.114878937	0	34.13592595
1.A.4 - Other Sectors - Liquid Fuels	CH4	0	31.51398428	5	200	200.0624902	0.000720023	0	0.153025152
1.A.4 - Other Sectors - Liquid Fuels	N2O	0	15.0781701	5	236.3636364	236.4165151	0.000230177	0	0.048910351
1.B.1 - Solid Fuels	CO2	0	0	5	0	5	0	100	0
1.B.1 - Solid Fuels	CH4	0	0	7.071067812	0	7.071067812	0	100	0
1.B.2.a - Oil	CO2	0.011021489	0	0	0	0	0	0	0
1.B.2.a - Oil	CH4	3.175726672	0	0	0	0	0	0	0
1.B.2.a - Oil	N2O	0	0	0	0	0	0	100	0
1.B.2.b - Natural Gas	CO2	832.122522	0	0	0	0	0	0	0
1.B.2.b - Natural Gas	CH4	10.98401729	0	0	0	0	0	0	0
1.B.2.b - Natural Gas	N2O	4.606392533	0	0	0	0	0	0	0
1.C - Carbon dioxide Transport and Storage	CO2	0	0	12.24744871	0	12.24744871	0	100	0
2 - Industrial Processes and Product Use									
2.A.1 - Cement production	CO2	0	2412.72668	35	0	35	0.129169732	0	54.87013257
2.A.2 - Lime production	CO2	0	0	15	0	15	0	100	0
2.A.3 - Glass Production	CO2	0	0	5	0	5	0	100	0
2.A.4 - Other Process Uses of Carbonates	CO2	0	0	0	0	0	0	100	0
2.B.1 - Ammonia Production	CO2	0	0	5	0	5	0	100	0
2.B.2 - Nitric Acid Production	N2O	0	0	2	0	2	0	100	0
2.B.3 - Adipic Acid Production	N2O	0	0	5	0	5	0	100	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O	0	0	10	0	10	0	100	0
2.B.5 - Carbide Production	CO2	0	0	5	10	11.18033989	0	100	0
2.B.5 - Carbide Production	CH4	0	0	5	10	11.18033989	0	100	0
2.B.6 - Titanium Dioxide Production	CO2	0	0	5	0	5	0	100	0
2.B.7 - Soda Ash Production	CO2	0	0	5	0	5	0	100	0
2.B.8 - Petrochemical and Carbon Black Production	CO2	0	1.73	24.49489743	0	24.49489743	5.42126E-09	0	2.3029E-06
2.B.8 - Petrochemical and Carbon Black Production	CH4	0	0	24.49489743	0	24.49489743	0	100	0
2.B.9 - Fluorochemical Production	CHF3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CH2F2	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CH3F	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CF3CHFCHFCF2CF3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CHF2CF3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CHF2CHF2	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CH2FCF3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CH3CHF2	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CHF2CH2F	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CF3CH3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CF3CHFCF3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CF3CH2CF3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CH2FCF2CHF2	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CF4	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	C2F6	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	C3F8	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	C4F10	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	c-C4F8	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	C5F12	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	C6F14	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	SF6	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CHCl3	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CH2Cl2	0	0	1	0	1	0	100	0
2.B.9 - Fluorochemical Production	CF3 I	0	0	1	0	1	0	100	0
2.C.1 - Iron and Steel Production	CO2	0	0	10	0	10	0	100	0
2.C.1 - Iron and Steel Production	CH4	0	0	10	0	10	0	100	0
2.C.2 - Ferroalloys Production	CO2	0	0	5	0	5	0	100	0
2.C.2 - Ferroalloys Production	CH4	0	0	5	0	5	0	100	0
2.C.3 - Aluminium production	CO2	0	0	2	0	2	0	100	0
2.C.3 - Aluminium production	CF4	0	0	2	0	2	0	100	0
2.C.3 - Aluminium production	C2F6	0	0	2	0	2	0	100	0
2.C.4 - Magnesium production	CO2	0	0	5	0	5	0	100	0
2.C.4 - Magnesium production	SF6	0	0	5	0	5	0	100	0
2.C.5 - Lead Production	CO2	0	0.18794375	10	0	10	6.39829E-11	0	2.71794E-08
2.C.6 - Zinc Production	CO2	0	0	10	0	10	0	100	0

2.D - Non-Energy Products from Fuels and Solvent Use	CO2	0	0	14.14213562	0	14.14213562	0	100	0
2.E - Electronics Industry	C2F6	0	0	14.14213562	0	14.14213562	0	100	0
2.E - Electronics Industry	CF4	0	0	17.32050808	0	17.32050808	0	100	0
2.E - Electronics Industry	CHF3	0	0	10	0	10	0	100	0
2.E - Electronics Industry	C3F8	0	0	10	0	10	0	100	0
2.E - Electronics Industry	SF6	0	0	14.14213562	0	14.14213562	0	100	0
2.E - Electronics Industry	C6F14	0	0	10	0	10	0	100	0
2.F.4 - Aerosols	CH2FCF3	0	0	10	10	14.14213562	0	100	0
2.F.4 - Aerosols	CH3CHF2	0	0	10	10	14.14213562	0	100	0
2.F.4 - Aerosols	CF3CHFCF3	0	0	10	10	14.14213562	0	100	0
2.F.4 - Aerosols	CF3CHFCHFCF2CF3	0	0	10	10	14.14213562	0	100	0
2.F.5 - Solvents	CF3CHFCHFCF2CF3	0	0	10	50	50.99019514	0	100	0
2.F.5 - Solvents	C6F14	0	0	10	50	50.99019514	0	100	0
2.F.6 - Other Applications (please specify)	CHF3	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CH2F2	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CH3F	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CF3CHFCHFCF2CF3	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CHF2CF3	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CHF2CHF2	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CH2FCF3	0	0	10	50	50.99019514	0	100	0
2.F.6 - Other Applications (please specify)	CH3CHF2	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CHF2CH2F	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CF3CH3	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CF3CHFCF3	0	0	10	50	50.99019514	0	100	0
2.F.6 - Other Applications (please specify)	CF3CH2CF3	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CH2FCF2CHF2	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	CF4	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	C2F6	0	0	10	50	50.99019514	0	100	0
2.F.6 - Other Applications (please specify)	C3F8	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	C4F10	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	c-C4F8	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	C5F12	0	0	10	0	10	0	100	0
2.F.6 - Other Applications (please specify)	C6F14	0	0	10	0	10	0	100	0
2.G - Other Product Manufacture and Use	SF6	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	CF4	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	C2F6	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	C3F8	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	C4F10	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	c-C4F8	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	C5F12	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	C6F14	0	0	60	58.30951895	83.66600265	0	100	0
2.G - Other Product Manufacture and Use	N2O	0	0	0	0	0	0	100	0
3 - Agriculture, Forestry, and Other Land Use									
3.A.1 - Enteric Fermentation	CH4	0	3275.561184	0	0	0	0	0	0
3.A.2 - Manure Management	CH4	0	192.6056809	0	0	0	0	0	0
3.A.2 - Manure Management	N2O	0	1097.740566	0	0	0	0	0	0
3.B.1.a - Forest land Remaining Forest land	CO2	0	-2538.807861	0	0	0	0	0	0
3.B.1.b - Land Converted to Forest land	CO2	0	0	0	0	0	0	100	0
3.B.2.a - Cropland Remaining Cropland	CO2	0	0.4466	0	0	0	0	0	0
3.B.2.b - Land Converted to Cropland	CO2	0	0	0	0	0	0	100	0
3.B.3.a - Grassland Remaining Grassland	CO2	0	0	0	0	0	0	100	0
3.B.3.b - Land Converted to Grassland	CO2	0	0	0	0	0	0	100	0
3.B.4.a.i - Peatlands remaining peatlands	CO2	0	0	0	0	0	0	100	0
3.B.4.a.i - Peatlands remaining peatlands	N2O	0	0	0	0	0	0	100	0
3.B.4.b - Land Converted to Wetlands	N2O	0	0	0	0	0	0	100	0
3.B.4.b - Land Converted to Wetlands	CO2	0	0	0	0	0	0	100	0
3.B.5.a - Settlements Remaining Settlements	CO2	0	0	0	0	0	0	100	0
3.B.5.b - Land Converted to Settlements	CO2	0	0	0	0	0	0	100	0
3.B.6.b - Land Converted to Other land	CO2	0	0	0	0	0	0	100	0
3.C.1 - Emissions from biomass burning	CH4	0	158.1831229	0	0	0	0	0	0
3.C.1 - Emissions from biomass burning	N2O	0	0.76276585	0	0	0	0	0	0
3.C.2 - Liming	CO2	0	0	0	0	0	0	100	0
3.C.3 - Urea application	CO2	0	242.3366	0	0	0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils	N2O	0	2170.789718	0	0	0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils	N2O	0	869.0721608	0	0	0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management	N2O	0	183.6757357	0	0	0	0	0	0
3.C.7 - Rice cultivation	CH4	0	0	0	0	0	0	100	0
3.D.1 - Harvested Wood Products	CO2	-838.0139968	0	0	0	0	0	0	0
4 - Waste									
4.A - Solid Waste Disposal	CH4	16086.083	17318.75201	0	0	0	0	107.6629532	0
4.B - Biological Treatment of Solid Waste	CH4	0	0	0	0	0	0	100	0
4.B - Biological Treatment of Solid Waste	N2O	0	0	0	0	0	0	100	0
4.C - Incineration and Open Burning of Waste	CO2	0	47.30309667	0	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	CH4	0	136.4614475	0	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	N2O	0	36.25975604	0	0	0	0	0	0
4.D - Wastewater Treatment and Discharge	CH4	0	1029.46012	0	0	0	0	0	0
4.D - Wastewater Treatment and Discharge	N2O	0	497.4410977	0	0	0	0	0	0
5 - Other									
Total									
		Sum(C): 16122.158	Sum(D): 234961.005				Sum(H): 9.129		Sum(M): 2969.742
							Uncertainty in total inventory: 3.021		Trend uncertainty: 54.495

Annex III - Table 19: Analysis of the Main Category of Emissions within the Inventory in 2019.

Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Contribution to Variance by Category in Year T	Uncertainty ntroduced into the trend in total ational emissions (%)
Sum(C): 16122.158	Sum(D): 234961.005	Sum(H): 9.129	um(M): 2969.742
		Uncertainty in total inventory: 3.021	Trend uncertainty: 54.495

A	B	C	D	E	F
IPCC Category code	IPCC Category	Greenhouse gas	2019 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Lx,t
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	41354.28301	41354.28301	0.26897976
1.A.1	Energy Industries - Gaseous Fuels	CARBON DIOXIDE (CO2)	39833.62099	39833.62099	0.259088951
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	21150.03522	21150.03522	0.137565712
4.A	Solid Waste Disposal	METHANE (CH4)	17318.75201	17318.75201	0.11264598
1.A.4	Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	10061.13569	10061.13569	0.065440425
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	8381.217758	8381.217758	0.054513772
3.A.1	Enteric Fermentation	METHANE (CH4)	3275.561184	3275.561184	0.021305161
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-2538.807861	2538.807861	0.016513113
2.A.1	Cement production	CARBON DIOXIDE (CO2)	2412.72668	2412.72668	0.015693045
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	2170.789718	2170.789718	0.01411942
3.A.2	Manure Management	NITROUS OXIDE (N2O)	1097.740566	1097.740566	0.00714001
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	1029.46012	1029.46012	0.006695895
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	869.0721608	869.0721608	0.005652687
4.D	Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	497.4410977	497.4410977	0.003235495
1.A.3.b	Road Transportation	NITROUS OXIDE (N2O)	380.8096214	380.8096214	0.002476892
3.C.3	Urea application	CARBON DIOXIDE (CO2)	242.3366	242.3366	0.001576225
3.A.2	Manure Management	METHANE (CH4)	192.6056809	192.6056809	0.001252761
3.C.6	Indirect N2O Emissions from manure management	NITROUS OXIDE (N2O)	183.6757357	183.6757357	0.001194678
3.C.1	Emissions from biomass burning	METHANE (CH4)	158.1831229	158.1831229	0.001028867
4.C	Incineration and Open Burning of Waste	METHANE (CH4)	136.4614475	136.4614475	0.000887583
1.A.1	Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	102.7529553	102.7529553	0.000668334
1.A.3.b	Road Transportation	METHANE (CH4)	64.72773203	64.72773203	0.000421007
1.A.3.a	Civil Aviation	CARBON DIOXIDE (CO2)	50.469363	50.469363	0.000328267
4.C	Incineration and Open Burning of Waste	CARBON DIOXIDE (CO2)	47.30309667	47.30309667	0.000307672
4.C	Incineration and Open Burning of Waste	NITROUS OXIDE (N2O)	36.25975604	36.25975604	0.000235844
1.A.1	Energy Industries - Liquid Fuels	METHANE (CH4)	34.8148433	34.8148433	0.000226445
1.A.4	Other Sectors - Liquid Fuels	METHANE (CH4)	31.51398428	31.51398428	0.000204976
1.A.1	Energy Industries - Gaseous Fuels	NITROUS OXIDE (N2O)	22.01144832	22.01144832	0.000143169
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	NITROUS OXIDE (N2O)	21.0378745	21.0378745	0.000136836
1.A.4	Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	15.0781701	15.0781701	9.80726E-05
1.A.1	Energy Industries - Gaseous Fuels	METHANE (CH4)	14.91098112	14.91098112	9.69852E-05
1.A.3.e	Other Transportation	CARBON DIOXIDE (CO2)	7.588476051	7.588476051	4.93576E-05
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	METHANE (CH4)	7.125731687	7.125731687	4.63477E-05
2.B.8	Petrochemical and Carbon Black Production	CARBON DIOXIDE (CO2)	1.73	1.73	1.12524E-05
3.C.1	Emissions from biomass burning	NITROUS OXIDE (N2O)	0.76276585	0.76276585	4.96124E-06
1.A.3.e	Other Transportation	NITROUS OXIDE (N2O)	0.529975314	0.529975314	3.44711E-06
1.A.3.a	Civil Aviation	NITROUS OXIDE (N2O)	0.447014358	0.447014358	2.90751E-06
3.B.2.a	Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	0.4466	0.4466	2.90481E-06
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.407748639	0.407748639	2.65211E-06
2.C.5	Lead Production	CARBON DIOXIDE (CO2)	0.18794375	0.18794375	1.22244E-06
1.A.3.e	Other Transportation	METHANE (CH4)	0.131490387	0.131490387	8.5525E-07
1.A.3.a	Civil Aviation	METHANE (CH4)	0.007570404	0.007570404	4.924E-08
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	NITROUS OXIDE (N2O)	0.000225316	0.000225316	1.46552E-09
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	METHANE (CH4)	0.000152633	0.000152633	9.92769E-10
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.1	Energy Industries - Solid Fuels	METHANE (CH4)	0	0	0
1.A.1	Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.1	Energy Industries - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.1	Energy Industries - Other Fossil Fuels	METHANE (CH4)	0	0	0
1.A.1	Energy Industries - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.1	Energy Industries - Peat	CARBON DIOXIDE (CO2)	0	0	0
1.A.1	Energy Industries - Peat	METHANE (CH4)	0	0	0
1.A.1	Energy Industries - Peat	NITROUS OXIDE (N2O)	0	0	0
1.A.1	Energy Industries - Biomass	CARBON DIOXIDE (CO2)	0	0	0
1.A.1	Energy Industries - Biomass	METHANE (CH4)	0	0	0
1.A.1	Energy Industries - Biomass	NITROUS OXIDE (N2O)	0	0	0
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.2	Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	0	0	0
1.A.2	Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	METHANE (CH4)	0	0	0
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.2	Manufacturing Industries and Construction - Peat	CARBON DIOXIDE (CO2)	0	0	0
1.A.2	Manufacturing Industries and Construction - Peat	METHANE (CH4)	0	0	0
1.A.2	Manufacturing Industries and Construction - Peat	NITROUS OXIDE (N2O)	0	0	0
1.A.2	Manufacturing Industries and Construction - Biomass	CARBON DIOXIDE (CO2)	0	0	0
1.A.2	Manufacturing Industries and Construction - Biomass	METHANE (CH4)	0	0	0
1.A.2	Manufacturing Industries and Construction - Biomass	NITROUS OXIDE (N2O)	0	0	0
1.A.3.c	Railways	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.c	Railways	METHANE (CH4)	0	0	0
1.A.3.c	Railways	NITROUS OXIDE (N2O)	0	0	0
1.A.3.d	Water-borne Navigation - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.d	Water-borne Navigation - Liquid Fuels	METHANE (CH4)	0	0	0
1.A.3.d	Water-borne Navigation - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.3.d	Water-borne Navigation - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.d	Water-borne Navigation - Solid Fuels	METHANE (CH4)	0	0	0
1.A.3.d	Water-borne Navigation - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.3.d	Water-borne Navigation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.d	Water-borne Navigation - Gaseous Fuels	METHANE (CH4)	0	0	0
1.A.3.d	Water-borne Navigation - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	METHANE (CH4)	0	0	0
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.3.d	Water-borne Navigation - Peat	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.d	Water-borne Navigation - Peat	METHANE (CH4)	0	0	0
1.A.3.d	Water-borne Navigation - Peat	NITROUS OXIDE (N2O)	0	0	0
1.A.3.d	Water-borne Navigation - Biomass	CARBON DIOXIDE (CO2)	0	0	0
1.A.3.d	Water-borne Navigation - Biomass	METHANE (CH4)	0	0	0
1.A.3.d	Water-borne Navigation - Biomass	NITROUS OXIDE (N2O)	0	0	0
1.A.4	Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.4	Other Sectors - Solid Fuels	METHANE (CH4)	0	0	0
1.A.4	Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.4	Other Sectors - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.4	Other Sectors - Gaseous Fuels	METHANE (CH4)	0	0	0
1.A.4	Other Sectors - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0
1.A.4	Other Sectors - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0
1.A.4	Other Sectors - Other Fossil Fuels	METHANE (CH4)	0	0	0
1.A.4	Other Sectors - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0

1.A.4	Other Sectors - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.4	Other Sectors - Peat	METHANE (CH4)	0	0	0	1
1.A.4	Other Sectors - Peat	NITROUS OXIDE (N2O)	0	0	0	1
1.A.4	Other Sectors - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.4	Other Sectors - Biomass	METHANE (CH4)	0	0	0	1
1.A.4	Other Sectors - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Liquid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Liquid Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Liquid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Gaseous Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Gaseous Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Gaseous Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Other Fossil Fuels	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Other Fossil Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Peat	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Peat	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Peat	NITROUS OXIDE (N2O)	0	0	0	1
1.A.5	Non-Specified - Biomass	CARBON DIOXIDE (CO2)	0	0	0	1
1.A.5	Non-Specified - Biomass	METHANE (CH4)	0	0	0	1
1.A.5	Non-Specified - Biomass	NITROUS OXIDE (N2O)	0	0	0	1
1.B.1	Solid Fuels	CARBON DIOXIDE (CO2)	0	0	0	1
1.B.1	Solid Fuels	METHANE (CH4)	0	0	0	1
1.B.1	Solid Fuels	NITROUS OXIDE (N2O)	0	0	0	1
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	0	0	0	1
1.B.2.a	Oil	METHANE (CH4)	0	0	0	1
1.B.2.a	Oil	NITROUS OXIDE (N2O)	0	0	0	1
1.B.2.b	Natural Gas	CARBON DIOXIDE (CO2)	0	0	0	1
1.B.2.b	Natural Gas	METHANE (CH4)	0	0	0	1
1.B.2.b	Natural Gas	NITROUS OXIDE (N2O)	0	0	0	1
1.C	Carbon dioxide Transport and Storage	CARBON DIOXIDE (CO2)	0	0	0	1
2.A.2	Lime production	CARBON DIOXIDE (CO2)	0	0	0	1
2.A.3	Glass Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.A.4	Other Process Uses of Carbonates	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.1	Ammonia Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.2	Nitric Acid Production	NITROUS OXIDE (N2O)	0	0	0	1
2.B.3	Adipic Acid Production	NITROUS OXIDE (N2O)	0	0	0	1
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NITROUS OXIDE (N2O)	0	0	0	1
2.B.5	Carbide Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.5	Carbide Production	METHANE (CH4)	0	0	0	1
2.B.6	Titanium Dioxide Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.7	Soda Ash Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.B.8	Petrochemical and Carbon Black Production	METHANE (CH4)	0	0	0	1
2.B.9	Fluorochemical Production	SF6, PFCs, HFCs and other halogenat	0	0	0	1
2.C.1	Iron and Steel Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.1	Iron and Steel Production	METHANE (CH4)	0	0	0	1
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.2	Ferroalloys Production	METHANE (CH4)	0	0	0	1
2.C.3	Aluminium production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.3	Aluminium production	PFCs (PFCs)	0	0	0	1
2.C.4	Magnesium production	CARBON DIOXIDE (CO2)	0	0	0	1
2.C.4	Magnesium production	Sulphur Hexafluoride (SF6)	0	0	0	1
2.C.6	Zinc Production	CARBON DIOXIDE (CO2)	0	0	0	1
2.D	Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	0	0	0	1
2.E	Electronics Industry	SF6, PFCs, HFCs and other halogenat	0	0	0	1
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	0	0	0	1
2.F.2	Foam Blowing Agents	HFCs (HFCs)	0	0	0	1
2.F.3	Fire Protection	HFCs, PFCs	0	0	0	1
2.F.4	Aerosols	HFCs, PFCs	0	0	0	1
2.F.5	Solvents	HFCs, PFCs	0	0	0	1
2.F.6	Other Applications (please specify)	HFCs, PFCs	0	0	0	1
2.G	Other Product Manufacture and Use	SF6, PFCs	0	0	0	1
2.G	Other Product Manufacture and Use	NITROUS OXIDE (N2O)	0	0	0	1
3.B.1.b	Land Converted to Forest land	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.4.a.i	Peatlands remaining peatlands	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.4.a.i	Peatlands remaining peatlands	NITROUS OXIDE (N2O)	0	0	0	1
3.B.4.b	Land Converted to Wetlands	NITROUS OXIDE (N2O)	0	0	0	1
3.B.4.b	Land Converted to Wetlands	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.5.a	Settlements Remaining Settlements	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.5.b	Land Converted to Settlements	CARBON DIOXIDE (CO2)	0	0	0	1
3.B.6.b	Land Converted to Other land	CARBON DIOXIDE (CO2)	0	0	0	1
3.C.2	Liming	CARBON DIOXIDE (CO2)	0	0	0	1
3.C.7	Rice cultivation	METHANE (CH4)	0	0	0	1
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	0	0	0	1
4.B	Biological Treatment of Solid Waste	METHANE (CH4)	0	0	0	1
4.B	Biological Treatment of Solid Waste	NITROUS OXIDE (N2O)	0	0	0	1
Total						
			148667.34644	153744.96217	1	

A	D	E	F
IPCC Category code	2019 Ex, t (Gg CO2 Eq)	|Ex, t| (Gg CO2 Eq)	Lx, t
Total Greenhouse Gases	148667.34644	153744.96217	1