IRAQ'S FIRST BIENNIAL TRANSPARENCY REPORT

SUBMITTED TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

2025

جمهورية العراق

وزارة البيئة

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FOREWARD

The Republic of Iraq is pleased to present its First Biennial Transparency Report (BTR), which marks a key milestone in Iraq's journey toward building a sustainable and effective national system for monitoring, tracking, and evaluating climate efforts, in alignment with the Enhanced Transparency Framework (ETF) stipulated in Article 13 of the Paris Agreement.

The Government of Iraq, as a non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC), has reaffirmed its commitment to global climate action. Iraq acceded to the UNFCCC and became a Party to the Kyoto Protocol upon ratification on July 28, 2009. It signed the Paris Agreement on December 8, 2016, and formally ratified it on November 1, 2021. Since then, the Government of Iraq has embarked on establishing comprehensive institutional arrangements to implement the ETF under Article 13 and to prepare its first BTR. These arrangements include the formation of specialized working groups within government departments responsible for collecting, analyzing, and reporting data in accordance with the requirements of the ETF.

This first report has been carefully prepared using recommended tabular formats to ensure clarity and consistency. It is the result of diligent work and collaborative efforts among various national institutions and international partners, particularly the United Nations Environment Programme (UNEP). The report provides an accurate picture of greenhouse gas emissions, mitigation and adaptation actions, and progress made in implementing the Nationally Determined Contributions (NDCs). It also highlights the challenges Iraq faces in the field of climate transparency and identifies the technical, financial, and institutional needs required to strengthen its capabilities and implement its national plans and programs related to climate change issues.

Our commitment to climate transparency goes beyond reporting—it includes strengthening the institutions responsible for climate action, developing electronic monitoring and reporting systems, and empowering national personnel to ensure the sustainability of our climate efforts. We emphasize here that international cooperation and technical and financial support will be the cornerstone of achieving our national goals in addressing climate change and protecting our environment for future generations.

I take this opportunity to extend my thanks to all parties who contributed to the preparation of this report, especially UNEP and the Global Environment Facility (GEF), and I call on all partners to continue supporting Iraq on its path toward building a more sustainable and environmentally secure future.

Dr. Hallo Mustafa Kaka Radha Al Askari
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List of Abbreviations

Abbreviation	Full Form
AF	Adaptation Fund
BaU	Business as Usual
BRT	Bus Rapid Transit
BUR	Biennial Update Report
CAFs	Community Agriculture Facilitators
CCAC	Climate and Clean Air Coalition
DFAT	Department of Foreign Affairs and Trade (Australia)
DSGE	Dynamic Stochastic General Equilibrium
EbA	Ecosystem-Based Adaptation
ETF	Enhanced Transparency Framework
FAO	Food and Agriculture Organization
FCDO	Foreign, Commonwealth and Development Office (UK)
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GoI	Government of Iraq
IEA	International Energy Agency
IIASA	International Institute for Applied Systems Analysis
IPPU	Industrial Processes and Product Use
IUCN	International Union for Conservation of Nature
LAP	Local Adaptation Plans
L&D	Loss and Damage
LULUCF	Land Use, Land-Use Change, and Forestry
MRV	Monitoring, Reporting, and Verification
MoE	Ministry of Environment
NAMA	Nationally Appropriate Mitigation Actions
NDA	National Designated Authority
NAP	National Adaptation Plan
NBSAP	National Biodiversity Strategy and Action Plan
NDCP	NDC Partnership
NDC	Nationally Determined Contributions
NG	Natural Gas
NGCC	Natural Gas Combined Cycle
NGO	Non-Governmental Organization
PPP	Purchasing Power Parity
QALY	Quality Adjusted Life-Year
RCP	Representative Concentration Pathway
ReFAATO	Reconstruction Fund for Areas Affected by Terrorist Operations
RES	Renewable Energy Sources
SBC	Solar Water Heater Production Plant
SSIP	Shared Socioeconomic Pathways
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VSL	Value of Statistical Life
VOLY	Value of a Life Year
WAM	With Additional Measures
WM	With Measures
WFP	World Food Programme

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The following document constitutes the First Biennial Transparency Report (BTR) submitted by the Government of Iraq based on the guidelines adopted by the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement.

Chapter 1: National Circumstances and Institutional Arrangements

The Government of Iraq is demonstrating its commitment to global climate action as a Non-Annex I Party to the UNFCCC. Iraq is working to implement the Enhanced Transparency Framework (ETF) under Article 13, which includes preparing its first BTR. Dedicated institutional arrangements have been established to ensure comprehensive data collection, analysis, and reporting, aligning with international climate guidelines.

Iraq spans 435,052 km² in the Middle East and has a semi-arid climate heavily influenced by the Mediterranean. Climate change has significantly impacted Iraq, with rising temperatures, increasing droughts, and altered rainfall patterns. Projections indicate further warming, more frequent heatwaves, and reduced snowfall, which will adversely affect water availability, agriculture, and overall climate resilience. With a rapidly growing population exceeding 40 million and heavy reliance on oil revenues, Iraq faces economic vulnerabilities from global energy transitions. Iraq aims to diversify its economy and increase renewable energy to improve sustainability and reduce emissions.

Institutional mechanisms and stakeholder engagement are central to Iraq's climate response. The Ministry of Environment leads climate policy and has partnered with international organizations. Iraq prioritizes inclusivity, engaging youth, women, and rural communities in policy development and implementation.

Chapter 2: National Inventory Report of Anthropogenic Emissions by Source and Sink of GHGs

Methodologies tier1 of the 2006 IPCC guidelines was applied for all emissions sources except for Ammonia production (CRT 2B) and forest increment (CRT 4A1). Iraq's total national emissions, excluding Land Use, Land-Use Change, and Forestry (LULUCF), rose from 198,677 ktCO2e in 2020 to 203,653 ktCO2e in 2021. Including LULUCF removals—amounting to 1,219 ktCO2e in 2020 and 1,674 ktCO2e in 2021—the net emissions are reduced to 197,457 ktCO2e in 2020 and 201,979 ktCO2e in 2021.

The Energy sector, which represents the largest source of emissions, saw an increase from 149.7 $MtCO_2eq$ (Million tons CO_2eq) in 2020 to 153 $MtCO_2eq$ in 2021. The Industrial Processes and Product Use (IPPU) sector showed a marginal increase, from 22.5 $MtCO_2eq$ in 2020 to 24.2 $MtCO_2eq$ in 2021. Emissions from the Agriculture sector decreased slightly, from 12 $MtCO_2eq$ in 2020 to 11.8 $MtCO_2eq$ in 2021, reflecting a small reduction in agricultural activities. The Waste sector experienced a small increase, rising from 14.4 $MtCO_2eq$ in 2020 to 15 $MtCO_2eq$ in 2021. The LULUCF sector shows a 34% increase in carbon removals – removing around 450 $ktCO_2eq$ – indicating a modest improvement in its ability to offset emissions. However, this change remains minimal compared to the more pronounced trends in other sectors, such as the Energy sector's significant rise of nearly 3,000 ktCO2e and the Waste sector's increase of over 500 ktCO2e during the same period.

Chapter 3: Information Necessary to Track Progress Made in Implementing and Achieving Nationally Determined Contributions Under Article 4 of the Paris Agreement

Iraq's updated Nationally Determined Contribution (NDC), submitted on January 1, 2021, represents a significant step forward in its climate policy. This updated NDC sets an unconditional target of reducing Greenhouse Gas (GHG) emissions by 1–2% by 2030 and a more ambitious conditional target of a 15% reduction by the same year, contingent on securing $100 billion in international climate finance. These targets highlight Iraq's dual commitment to sustainable development and climate action, emphasizing key sectors such as energy, oil and gas, and transportation.

To achieve these reductions, Iraq has committed to eliminating gas flaring, transitioning from high-carbon fuels to natural gas, and expanding its use of renewable energy. The updated NDC also includes adaptation measures aimed at addressing critical challenges like water scarcity and food security through enhanced resource management and climate-smart agriculture. Iraq's intention to engage in cooperative approaches under Article 6 of the Paris Agreement reflects its proactive stance in leveraging international funding and technology to support its climate ambitions.

To track its progress, Iraq uses "National total net GHG emissions and removals" as its primary metric. The baseline year for the Business-as-Usual (BaU) scenario is 2020, with emissions projections and mitigation impacts measured against this reference. Flexibility provisions under the Paris Agreement allow Iraq to adapt its reporting processes to evolving capacities and data availability, ensuring a transparent and accountable system for monitoring climate actions.

Iraq has developed three scenarios to analyze future GHG emissions. The BaU Scenario assumes no additional climate policies beyond existing measures, serving as a benchmark for assessing mitigation impacts. The With Measures (WM) Scenario incorporates partial implementation of climate policies, targeting a 15% reduction in emissions by 2030. The With Additional Measures (WAM) Scenario envisions full implementation of all proposed policies, achieving up to a 21% reduction by 2030.

Iraq has identified four key mitigation pathways to reduce GHG emissions:

- The first pathway focuses on reducing electricity transmission losses and improving power generation efficiency. By upgrading infrastructure and optimizing systems, Iraq aims to lower electricity losses from 22% to 10% by 2050.
- The second pathway involves phasing out fossil fuel power plants while retaining and expanding natural gas capacity, a critical step in transitioning to a cleaner energy mix.
- The third pathway targets the capture and utilization of associated gas, with a goal of reducing flaring by 50% by 2030. This approach not only reduces emissions but also increases the availability of natural gas for productive use.
- The fourth pathway emphasizes the expansion of renewable energy, including solar, wind, and hydro, to diversify Iraq's energy mix and reduce its dependence on fossil fuels. By 2030, renewable energy is expected to account for 8.5% of the total energy mix, with a target of 12% by 2050.

These pathways demonstrate Iraq's commitment to adopting innovative solutions and leveraging its natural resources to build a sustainable energy future. The WM scenario achieves a 15% reduction in emissions by 2030, while the WAM scenario delivers a more ambitious 21% reduction, illustrating the transformative potential of full policy implementation.

Four mitigation pathways for GHG mitigation have been identified and analyzed, focusing on primary energy, renewable energy, and energy efficiency.

- The first pathway centers on reducing losses in electricity transmission and distribution by improving generation efficiency and minimizing system losses. Transmission losses are projected to decline from 22% in 2020 to 15% by 2030 and further to 10% by 2050. Key actions include optimizing distribution systems, upgrading infrastructure, and modernizing oil wells and refineries. These measures are expected to deliver an annual mitigation impact of 22,681 ktCO_2eq by 2050.
- The second pathway focuses on the gradual and secure transition of energy sources and diversification of the energy mix and the transition to Natural Gas Combined Cycle (NGCC) plants. Diesel-operated plants are set to cease operations by 2026, with all simple-cycle plants converted to NGCC by 2035. This transition includes 21 projects, which will collectively add 8,789 MW of capacity by 2030 and achieve an annual mitigation impact of 36,642 ktCO_2eq in 2030.
- The third pathway addresses emissions from gas flaring by targeting a 50% reduction in flared gas volumes by 2030. Captured gas will be redirected for productive uses in energy production, industrial processes, and exports. Four key projects aim to capture 820 MMSCFD of associated gas, resulting in a mitigation impact of 6,412 ktCO_2eq annually by 2030, increasing to 22,300 ktCO_2eq by 2050.
- The fourth pathway focuses on expanding Iraq's renewable energy capacity. Renewable sources are expected to constitute 8.5% of the energy mix by 2030, rising to 12% by 2050. Solar energy projects across nine regions will add 7,755 MW of new capacity by 2030, reducing emissions by 6,474 ktCO_2eq annually in 2030 and 8,254 ktCO_2eq in 2050.

The mitigation pathways deliver significant, quantifiable emissions reductions:

- Pathway 1: Electricity efficiency measures will reduce emissions by 19,519 ktCO_2eq annually in 2045.
- Pathway 2: Transition to NGCC plants will achieve an annual mitigation of 36,075 ktCO_2eq in 2035.
- Pathway 3: Gas capture projects will mitigate 15,809 ktCO_2eq annually in 2045.
- Pathway 4: Renewable energy initiatives will reduce emissions by 7,364 ktCO_2eq annually in 2040.

Each pathway is supported by specific initiatives with clear objectives, timelines, and outcomes:

- Pathway 1: Includes installing 40 air inlet cooling systems and increasing generation capacity by 792 MW.
- Pathway 2: Involves 21 projects to transition plants to Natural Gas Combined Cycle (NGCC) technology and decommission diesel units.
- Pathway 3: Implements four projects capturing flared gas from key fields such as Rumaila and Zubair.
- Pathway 4: Develops solar energy projects in Basra, Samawah, and other regions, supported by international investors such as TOTAL and Masdar.

Chapter 4: Information Related to the Impacts of Climate Change and Adaptation Under Article 7 of the Paris Agreement

The Iraqi economy is highly vulnerable to acute and chronic climate change effects stemming from water scarcity, increasing temperatures, dust desert storms and other related events. This is exacerbated by several endogenous and exogenous barriers including the structure of the economy, which relies among others on the oil value chain, the intense urbanization, population growth, the quality of the health services which require improvements and the water diplomacy with neighboring countries.

Climate change adaptation priorities focus strategically on four sectors: water management, agriculture, health and biodiversity. The climate change adaptation legislative framework is structured around several key policy documents. Iraq is advancing in implementing climate change adaptation actions. As of the end of 2024, the country has been engaged in implementing at least nine national adaptation projects with a cumulative budget of over $75 million. The country is also advancing on the development of a monitoring and evaluation methodological framework for climate change adaptation. This stems from the priorities established in each of the adaptation sectors and is developed around specific, measurable and relevant key performance indicators. The Monitoring and Evaluation framework will operate in parallel to the proposed loss and damage framework. The latter will be based on data collection to assess loss and damage in each of the priority sectors and the application of macroeconomic modelling for assessing the total cost for Iraq, including indirect impact related also with the interdependencies of the economic sectors of the Iraqi economy.

Chapter 5: Information on Financial, Development, and Technology Transfer Support, and Capacity Building Needed and Received Under Articles 9 to 11 of the Paris Agreement

Iraq has made substantial progress in addressing climate change through financial, technological, and capacity-building support, in alignment with Articles 9–11 of the Paris Agreement. The country has mobilized approximately $4.33 billion USD in total climate finance to date, supporting a range of adaptation, mitigation, and cross-cutting initiatives.

For adaptation, Iraq has secured about $1.89 billion USD to strengthen water resource management, climate-resilient agriculture, and infrastructure. Mitigation efforts have received around $200.78 million USD, targeting renewable energy expansion, energy efficiency improvements, and emissions reduction through technologies such as solar power and methane capture. Cross-cutting projects—addressing both adaptation and mitigation—have attracted approximately $2.24 billion USD, focusing on institutional resilience, governance reforms, and infrastructure rehabilitation.

In addition, Iraq has benefited from an estimated $2.1 billion USD in technology development and transfer, supporting the adoption of clean technologies and modern climate-smart systems. Meanwhile, capacity-building initiatives—aimed at enhancing technical expertise, policy development, and stakeholder engagement—have received approximately $61.05 million USD. Despite this progress, further investment remains critical to meet Iraq’s growing climate ambitions and ensure a sustainable, low-carbon, and climate-resilient future.

CHAPTER 1

NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

1. National Circumstances and Institutional Arrangements

1.1 Background and contextual overview

The Government of Iraq (GOI), as a non-annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC), has demonstrated its commitment to global climate action. Iraq signed the Paris Agreement on December 8, 2016, and subsequently ratified it on November 1, 2021. Additionally, Iraq became a Party to the Kyoto Protocol, ratifying it on July 28, 2009.[1]

The GOI finalized the preparation of its Second National Communication Report and First Biennial Update Report in 2024. The GOI has also initiated the establishment of comprehensive institutional arrangements for implementing the Enhanced Transparency Framework (ETF) under Article 13 and preparing the submission of its first biennial transparency reports (BTR). These arrangements include setting up dedicated teams within key government departments to oversee data collection, analysis, and reporting in line with ETF requirements. This initial BTR report has been meticulously prepared, adopting recommended tabular formats to ensure clarity and consistency.

1.2 Geographic context

Iraq spans an area of 435,052 km² and is located in the Middle East, bordered by Turkey to the north, Iran to the east, Syria, Jordan, and Saudi Arabia to the west, and the Arabian Gulf, Kuwait, and Saudi Arabia to the south. The country is divided into four main geographical regions including the mountainous region in the north, covering the Iraqi Kurdistan provinces; the undulating region between northern and northeastern highlands and the southern lowlands, including Nineveh, Kirkuk, Salahuddin, and Diyala; the western desert plateau, covering Anbar and parts of Najaf, Karbala, and Muthanna; and the fertile alluvial plain, encompassing Baghdad, Wasit, Karbala, Najaf, Dhi Qar, Maysan, Al-Qadisiyyah, and Basra (Figure 1-1).

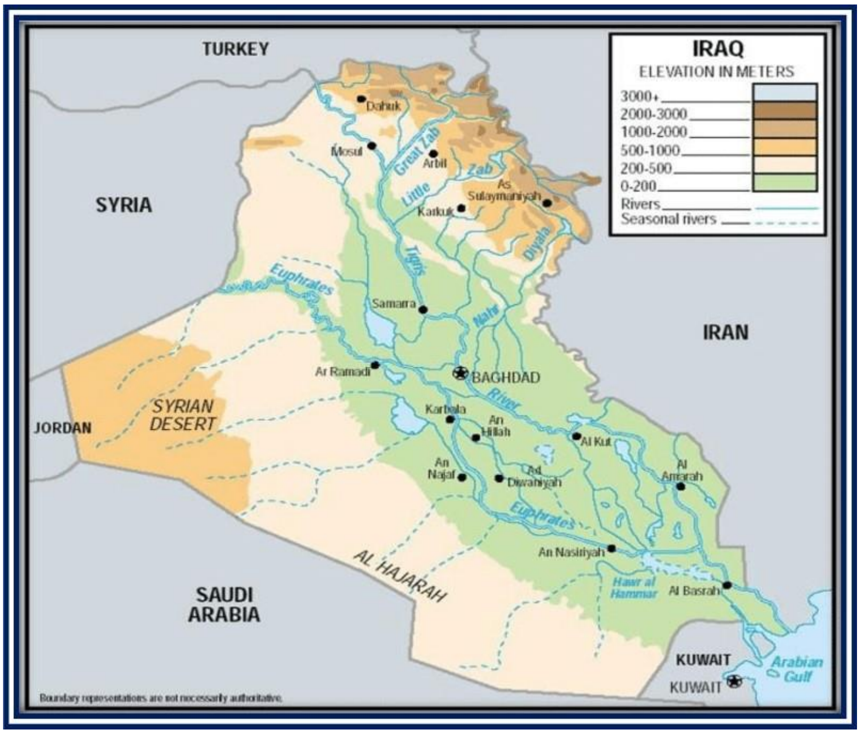


Figure 1-1: Topographic map of Iraq (Al-Ansari, 2021)[2]

1 https://unfccc.int/node/180426

2 Al-Ansari, N. 2021. Topography and Climate of Iraq.Journal of Earth Sciences and Geotechnical Engineering, Vol. 11, No. 2, 2021, 1-13

1.3 Climatic context

1.3.1 Climate

Iraq lies in the northern temperate zone, with a semi-arid continental climate influenced by the Mediterranean. The climate features large daily and seasonal temperature variations due to limited water bodies and rainfall, which decreases from the northeast to the southwest. Rain falls in winter, affected by Mediterranean low-pressure systems, are mainly from November to April in the north and northeast, with an average annual precipitation of about 216 mm. Winters are rainy and cold, with daytime temperatures around 16°C, dropping to 2°C at night, with occasional frost in the north. Summers are dry and extremely hot, with temperatures often exceeding 43°C and reaching up to 50°C in July and August, while nighttime temperatures drop to around 26-30°C. Iraq experiences prevailing northwesterly winds most of the year, with Gulf influences causing hot, humid air and higher temperatures during low-pressure events in the central and southern regions.[3]

Iraq's climate can be divided into three types: The Mediterranean climate which dominates the mountainous Kurdistan region, with cold, snowy winters (400-1000 mm annual precipitation) and mild summers (up to 35°C); Steppe climate which is transitional between mountainous and desert regions, with 200-400 mm of annual rainfall; and Hot desert climate which covers the alluvial plain and western plateau (70% of Iraq's area), with 50-200 mm of annual rainfall and temperatures reaching 45-50°C. Figure 1-2 presents the climate zones across Iraq

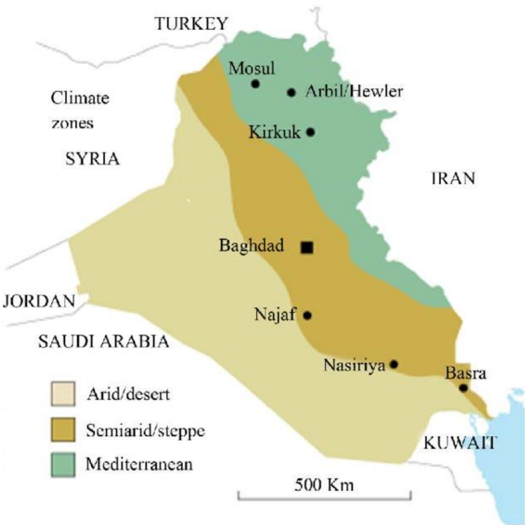


Figure 1-2: Climate zones of Iraq (Al-ansari, 2013)[4]

1.3.2 Climate trend

In recent decades, Iraq has observed an increase in average temperatures, more frequent and severe droughts, and shifting precipitation patterns. Figure 1-3 and Figure 1-4 show how temperatures have varied between the years from 1951 to 2020. Average surface air temperature 1991-2020 increased by 2ºC compared to 1951-1980. It is apparent that temperature trends have been significantly increasing across Iraq with a steeper increase between 1991 and 2020.

3 Iraqi Ministry of Planning - Annual Statistics, 2020-2021.
4 A. Al-Ansari (2013). Management of Water Resources in Iraq: Perspectives and Prognoses. Engineering, 2013, 5, 667-684.

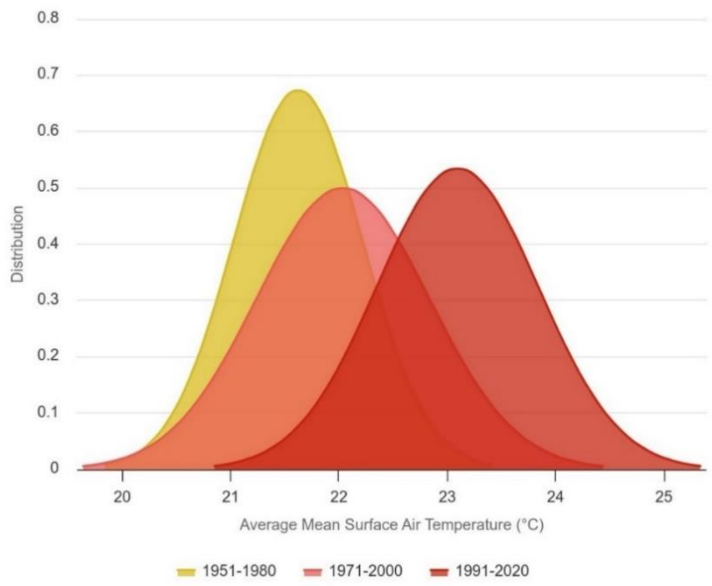


Figure 1-3: Change in Distribution of Average Mean Surface Air Temperature (1951-2020) (World Bank)[5]

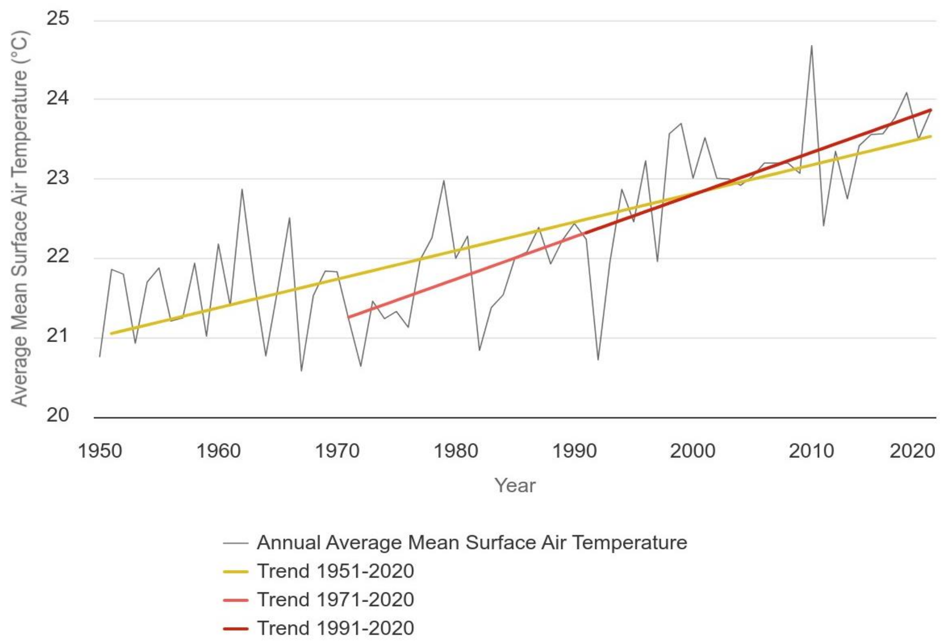


Figure 1-4: Iraq Average Mean Surface Air Temperature Trends (1951-2020) (World Bank)[6]

1.3.3 Climate projections

Climate projections indicate that Iraq will continue to experience rising temperatures, with potential decreases in annual precipitation. Based on the Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR)[7], Figure 1-5 shows that under SSP5-8.5, average annual temperature will increase by 2.14C by mid-term (2041-2060), compared to the reference period (1995-2014). The largest increases in temperature are

5 Climate data Extracted from Climate change Knowledge Portal https://climateknowledgeportal.worldbank.org/country/iraq/trends-variability-historical

6 Climate data Extracted from Climate change Knowledge Portal (https://climateknowledgeportal.worldbank.org/country/iraq/trends-variability-historical)

7 Swedish Meteorological and Hydrological Institute 2021. Future climate projections for the Mashreq region: methodology. RICCAR Technical Note, Beirut. E/ESCWA/CL1.CCS/2021/RICCAR/TECHNICAL NOTE.5.

in the Zagros Mountains in northeastern Iraq. The increases in temperature will also increase heat waves, including days exceeding 50ºC (Figure 1-6). This is without consideration of humidity, urban heat island effect and similar factors which can increase apparent temperatures. Iraq will experience at least 6 days/year exceeding 50ºC in some areas by mid-term (2041-2060).[8]

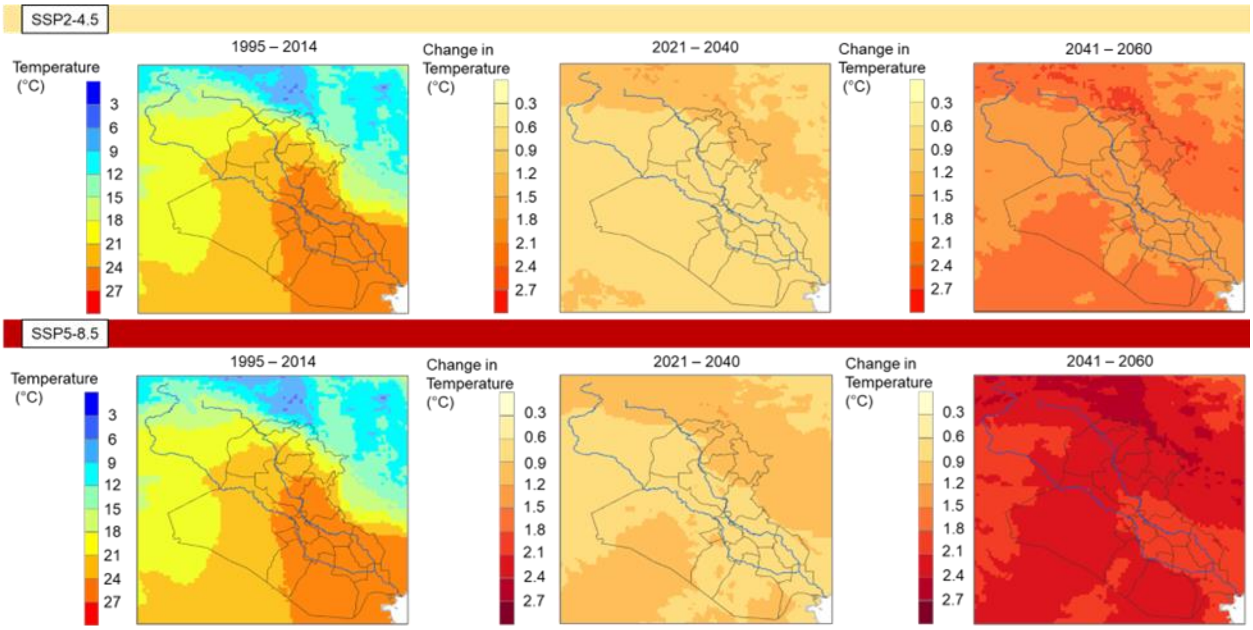


Figure 1-5: Change in annual mean temperature (RICCAR,2024)

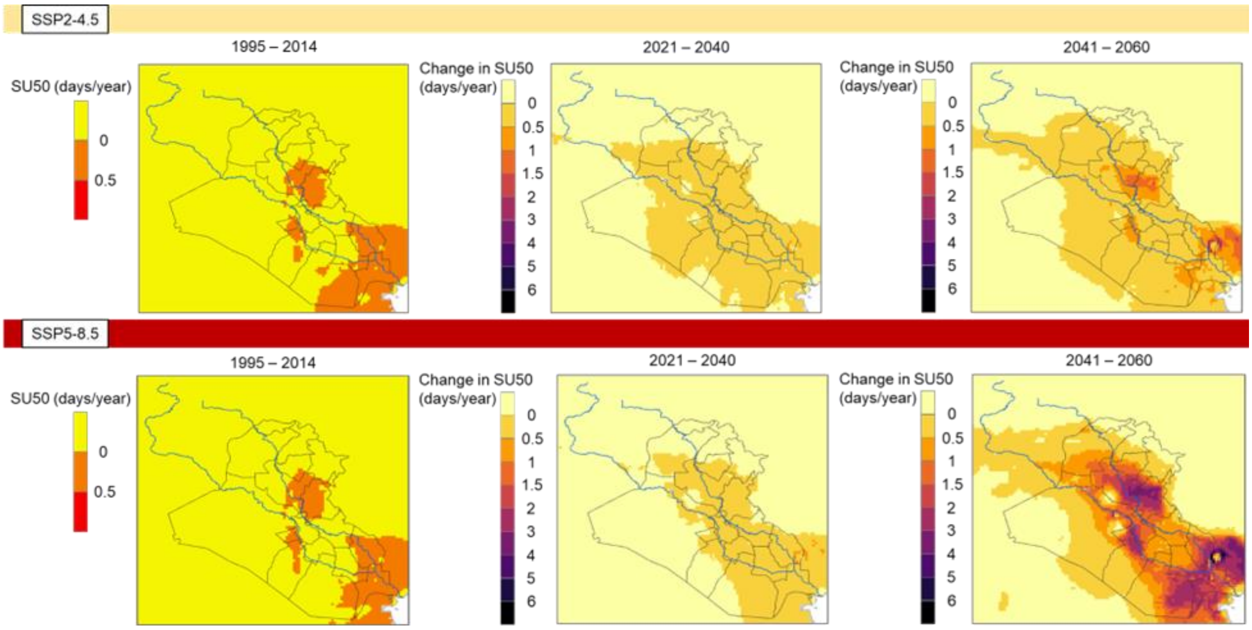


Figure 1-6:Change in number of days when Tmax over 50C (RICCAR, 2024)

Precipitation is slightly projected to increase but is expected to continue experiencing seasonal and interannual variability. The increasing precipitation reflects a slight increase in volume overall, but rainfall patterns are expected to change due to climate change resulting in more periods of extreme rainfall and drought. The extreme rainfall potential is reflected in the increase in precipitation days of more than 10 mm (Figure 1-7). Precipitation is expected to decline in northeastern Iraq including a

8 RICCAR, 2024

reduction in winter snowfall. This decline in snowfall will decrease seasonal runoff with adverse impacts on agriculture and water resources.[9]

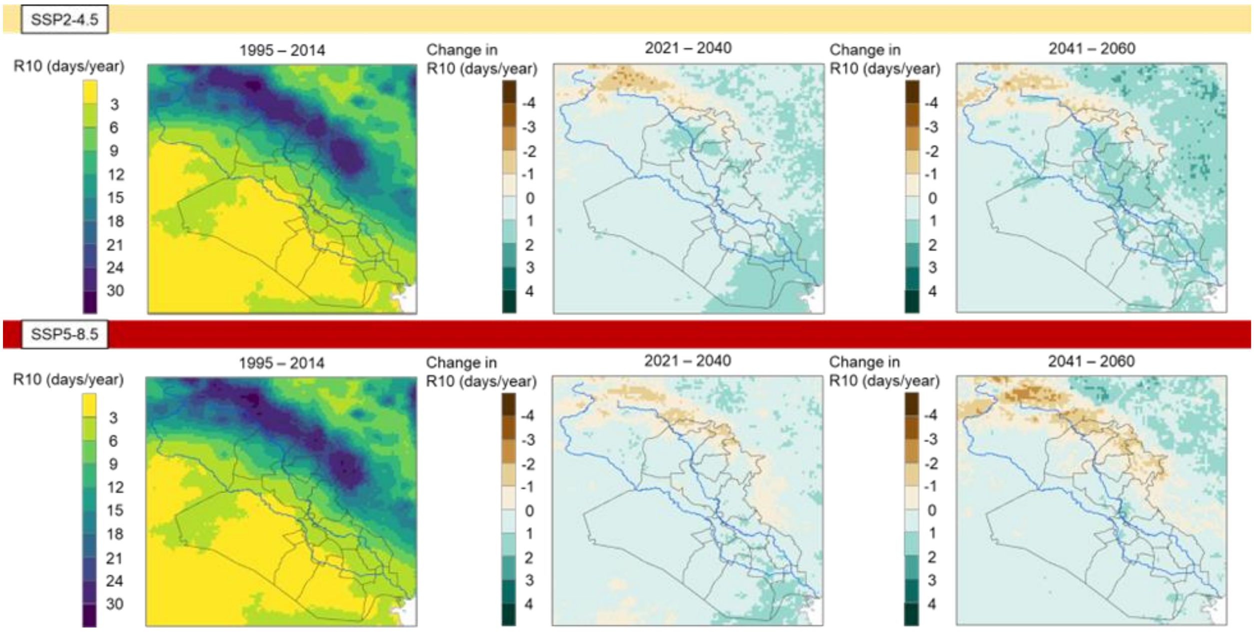


Figure 1-7: Change in number of 10 mm precipitation days (RICCAR,2024)

Declining water resources, including decreasing precipitation, decreasing runoff and increasing evaporation are most apparent in Northeastern Iraq. Seasonal time series analysis for runoff is shown in Figure 1-8 and Figure 1-9. Runoff is projected to slightly decrease, which will have adverse impacts on water resources.[10]

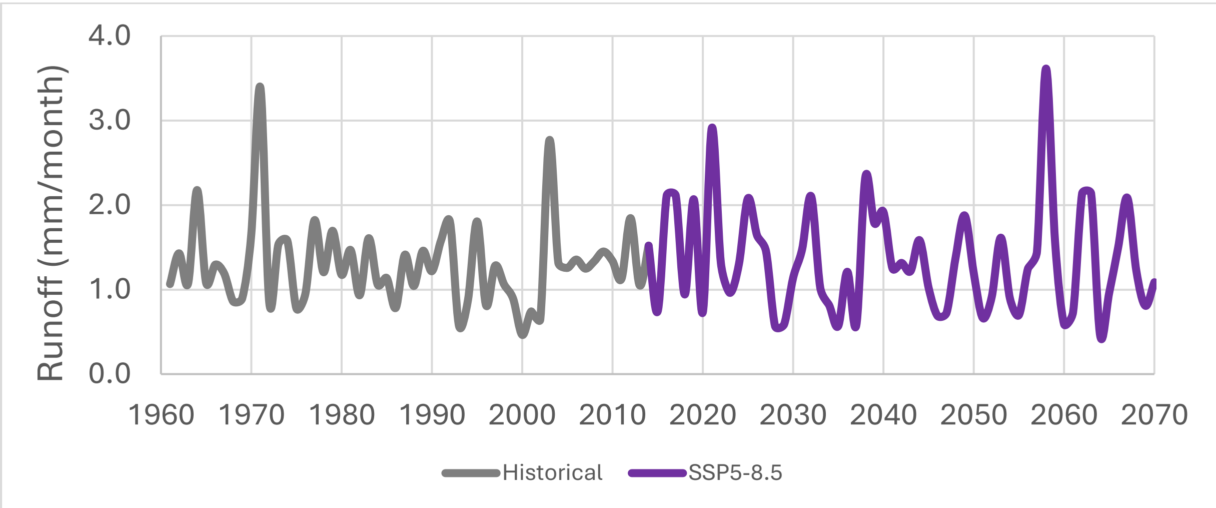


Figure 1-8: Runoff time series (May-Oct) (RICCAR,2024)

9 RICCAR, 2024
10 RICCAR, 2024

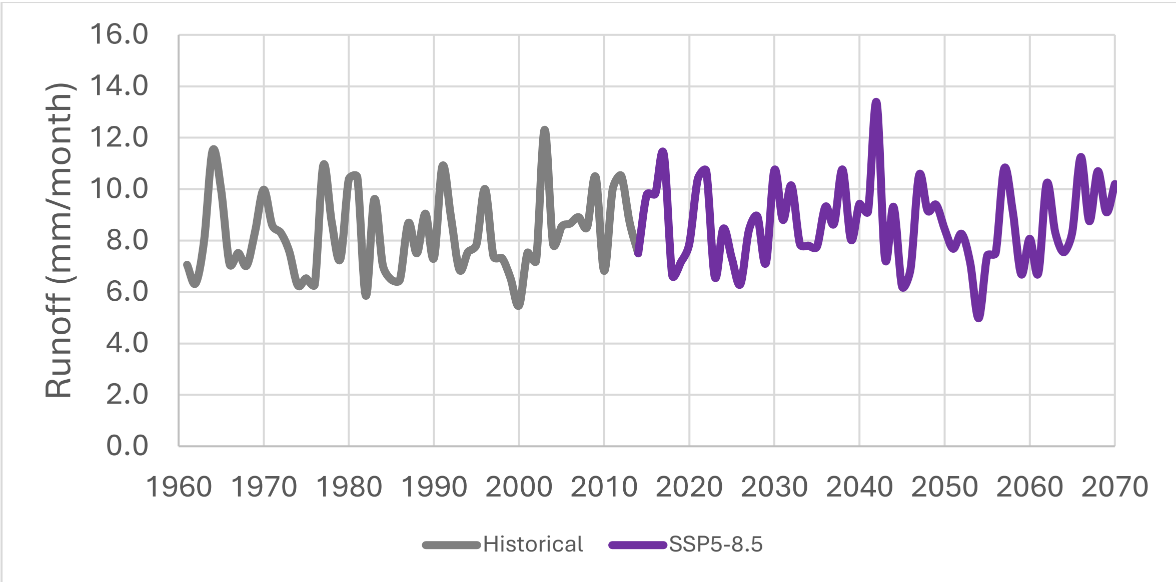
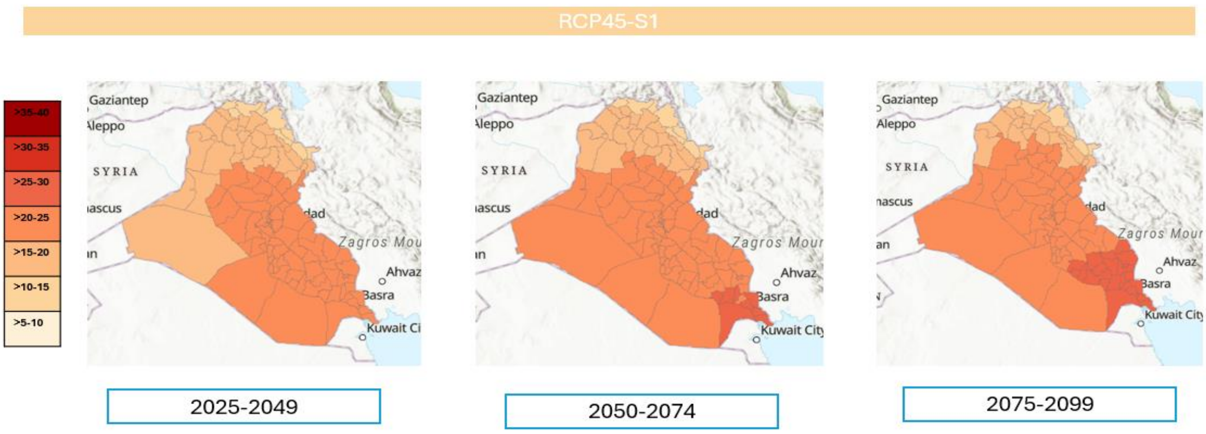


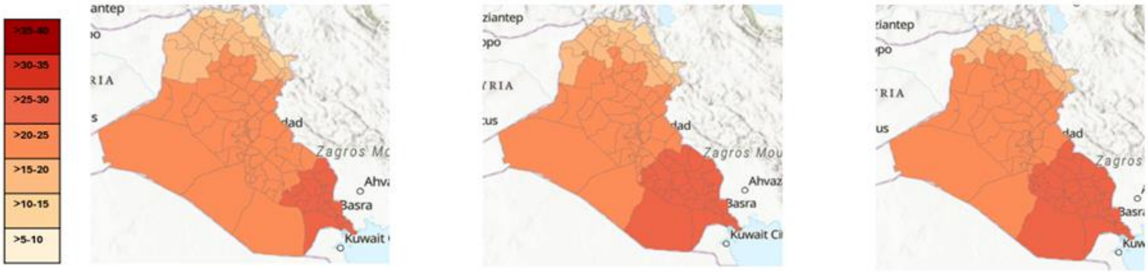
Figure 1-9: Runoff time Series (Nov-Apr) (RICCAR,2024)

The UNEP Iraq Climate GIS Data Portal[11] was developed in tandem with Climate Risk Assessment for Iraq contributing to the delivery of climate change adaptation in the Asian region through the Green Climate Fund funded National Adaptation Plan (NAP) for Iraq project. Projected temperatures for periods 2025-2049, 2050-2074, and 2075-2099 over RCP 4.5 and 8.5 are presented for 3 different scenarios (S1, S2, and S3) in Figure 1-10. All projections show that temperatures are increasing with the highest increase in the south region. By the end of the century, the increasing change in temperature is projected to be more evident across the entire country. hazard indices have been selected to cover a broad range of climate risks of practical relevance for adaptation. Figure 1-11 presents the projected change in the number of warm and dry days[12] and number of days with temperature greater than 32^0C [13] compared to the historical mean (1981-2005). It is evident from the different scenarios presented that more warm and dry days are expected across Iraq as well as more days with Temperature exceeding 32^0C.



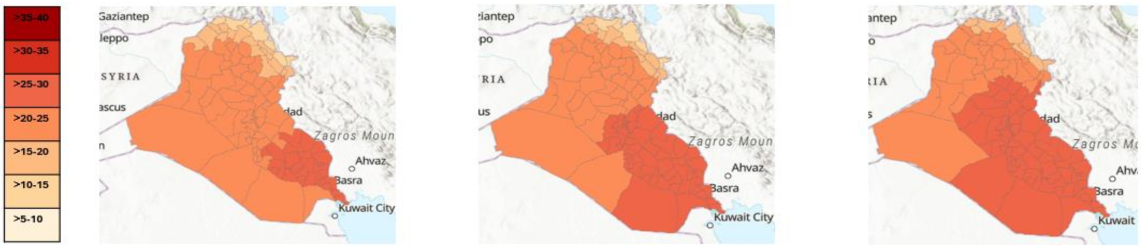
11 UNEP IRAQ Climate GIS Data Portal: https://home-unep-iraq.hub.arcgis.com/pages/cordex-maps
12 daily mean temperature above the historical 75th percentile (warm) and daily amount of rain below the historical 25th percentile (dry).
13 Hot and Humid Extremes' are estimated as the number of days in a year with Heat Index (HI) above 32ºC

RCP45-S2



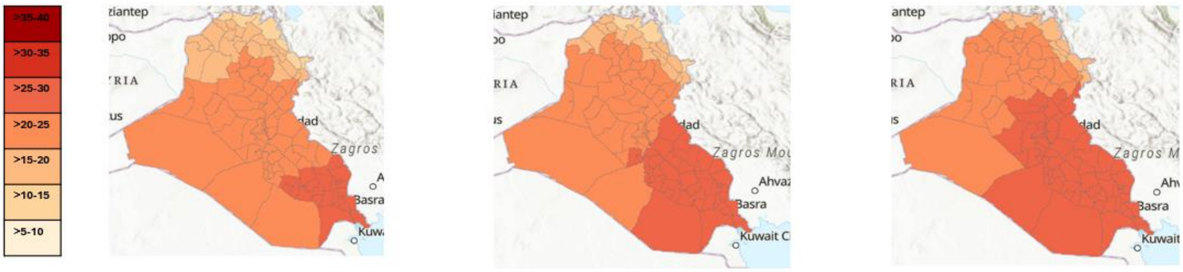
2025-2049 | 2050-2074 | 2075-2099

RCP85-S1



2025-2049 | 2050-2074 | 2075-2099

RCP85-S2



2025-2049 | 2050-2074 | 2075-2099

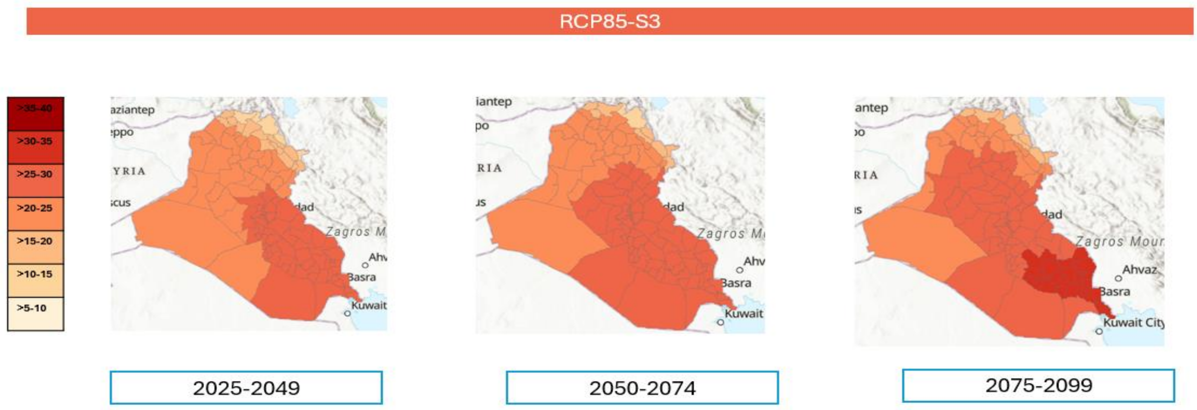


Figure 1-10 Projected Temperatures under RCP4.5 (S1, S2) and RCP 8.5 (S1, S2, and S3) for Iraq (UNEP IRAQ climate GIS Portal)

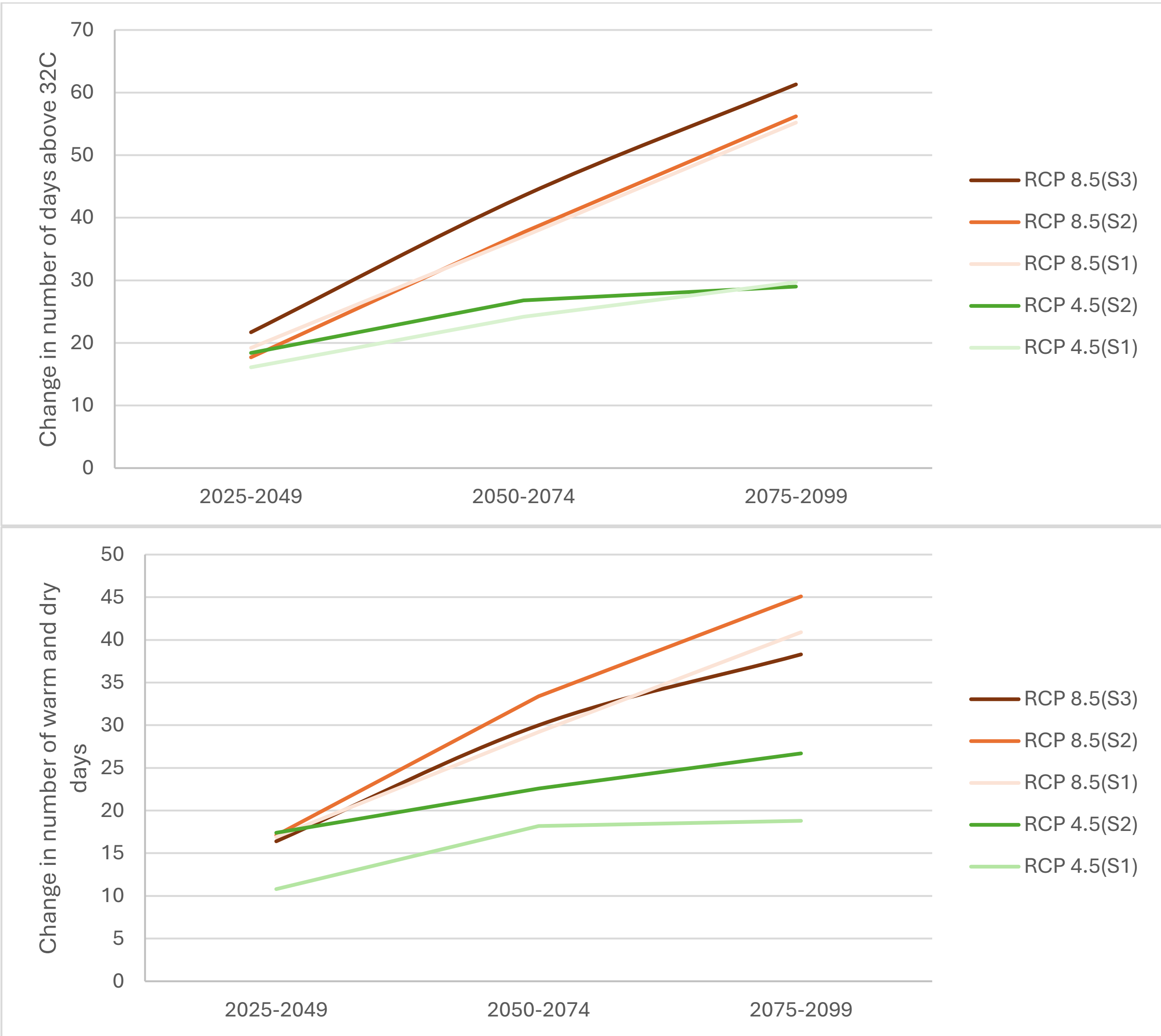


Figure 1-11: Projected change in number of hot and dry days and number of days with temperature above 32^{0}C (UNEP Iraq Climate GIS portal)

1.4 Socioeconomic context

1.4.1 Demography

Iraq's population reached 40,225,503 in 2020, with an annual growth rate of 2.58%, according to the Ministry of Planning 2020 records. This rapid population growth strains the state's ability to provide adequate services. The country's demographic structure is youthful, with 37.8% aged 1–14 years, 65.5% aged 15–64, and only 3.1% over 65. High youth unemployment, at 35%, coupled with limited access to education and reproductive health services, highlights the significant challenges faced by younger generations.[14] Gender distribution in Iraq is nearly balanced, with men constituting 50.5% and women 49.5%, underscoring women's important role in society. Population density is highest in key urban centers like Baghdad, Mosul, Erbil, Basra, and Najaf, especially along the Tigris and Euphrates, where economic, commercial, and tourism activities are concentrated.[15] In 2022, Iraq's Human Development Index was 0.673 ranking it in the 128th position globally out of 191 nations.[16]

1.4.2 Economy

Iraq is classified as an upper-middle-income country, with an economy heavily reliant on oil. Nonetheless, overreliance on oil sector revenue makes Iraq highly vulnerable to shocks.

Before 2014, Iraq's economy grew due to high oil prices and increased production, with oil contributing 97% of budget revenue in 2013. However, falling oil prices and conflict led to economic decline in 2015 and 2016. Indeed, economic losses due to conflict have been enormous amounting to US$45.7 billion in only seven governorates, whereas reconstruction and recovery needs have totaled US$88.2 billion.[17]

The cost of the war depleted financial resources for priorities related to development, reconstruction and social spending. In 2018, Iraq allocated more than $18 billion to security and defense, that is 21% of its budget, impacting non-oil infrastructure development.[18] Despite this, gross domestic product (GDP) grew by 13.3% in 2018 and 1.3% in 2021, partly due to non-oil sectors. In December 2020, the Central Statistics Office of Iraq reported that its GDP had dropped by 21.5%, compared to the same period of the previous year.[19] At the same time the Central Bank of Iraq devalued the Iraqi currency by 20 % against the USD. The decision resulted in price increases for all imports, as well as some market upheaval. The Government 2020 budget balance fell to -16.8% of GDP due to declining government oil revenue. The ratio of public debt to GDP stood at 84 % in 2020.[20] In 2021, Iraq's economy grew by 5.9% driven by several factors, including the economic reform plan announced by the government in October 2020 and the recovery in hydrocarbon markets and investments in reconstruction since 2021.[21]

Poverty rates have also increased by 7-14% due to the devaluation of the dinar and rising food prices, worsening living conditions for many Iraqis and adding 2.7 to 5.5 million more Iraqis to the ranks of the poor, in addition to the 6.9 million already living in poverty before the COVID-19 crisis. The poverty rate in Iraq reached 40% of the population in 2020.[22]

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14 Ministry of Planning - Central Statistical for the year 2022
15 Ministry of Planning / Central Bureau of Statistics / Annual Statistical Collection 2021
16 2023-2024 Human Development Report (https://hdr.undp.org/system/files/documents/global-report-document/hdr2023-24overviewen.pdf).
17 World Bank, 2018. Iraq Reconstruction and Investment. Damage Needs Assessment of affected Governorates. Part 2.
18 Environmental statistics for Iraq (industry sector) for the year 2021, Ministry of Planning - Central Statistical Organization 2022
19 Iraq Common Country Analysis, 2021
20 Iraq Common Country Analysis, 2021
21 Iraq Common Country Analysis, 2022
22 World Bank 2021. Poverty & Equity Brief. Iraq Middle East & North Africa. April 2021

Countries are moving towards renewable energy and reducing reliance on fossil fuels as part of their response to the UNFCCC and the Paris Agreement. This shift could lead to a decline in global oil prices, affecting Iraq's ability to recover and address the risks of climate change. It is thus evident that Iraq's economy needs to diversify its income sources and address climate challenges to improve living conditions and achieve economic stability.

1.4.3 Energy

1.4.3.1 Energy Supply

Iraq's energy generation relies heavily on fossil fuels, mainly crude oil and natural gas. Since 2009, increased gas production and collection efforts have helped reduce oil use and boost exports, but a shortfall persists due to limited gas processing and transport infrastructure, and an aging pipeline network. Efforts to expand energy production led to an increase from 10-12 GW to 14.069 GW by 2019, but demand remains unmet, resulting in widespread use of costly, polluting private generators.
Government targets include generating 705 MW of additional capacity by 2025, using gas-fired plants and cooling systems to improve efficiency. Long-term plans aim to reach 12 GW of solar power by 2030. Iraq's 2021 climate commitment outlines ambitions for clean energy and reduced emissions, with recent initiatives aligning with international climate agreements like the Paris Agreement.

1.4.3.2 Domestic Energy production, Exports and Transformation

Iraq holds the fifth-largest conventional oil reserves in the world, estimated at 144.3 billion barrels, with production concentrated in 33 oil fields. Domestic energy production supports both local consumption and export demands, though the sector faces infrastructure and efficiency challenges.

Iraq faces a persistent electricity supply-demand gap, partly filled by private generators that add cost and pollution but lack sufficient capacity, especially as demand for air conditioning grows. Following 2003, oil consumption rose, driven by a surge in transportation and economic growth, while aging refineries and frequent pipeline disruptions have hindered production. Demand pressures from demographic shifts, urbanization, and rising temperatures pushed peak demand to 26 gigawatts in 2019, 58% above capacity. Despite a projected 4.7% GDP decline, demand could exceed 37 gigawatts and potentially reach 50 gigawatts by 2030, underscoring the need for sustainable energy solutions. Iraq is pursuing a more sustainable energy mix, focusing on low-carbon technologies, increased natural gas use, and renewable energy.

1.4.3.3 Electricity generation

Electricity in Iraq is primarily generated from oil and gas sources, with significant issues related to grid efficiency and outages. The National Integrated Energy Strategy, launched in 2013, aimed to increase electricity production to 20 gigawatts, but by 2019, only 16.5 gigawatts were achieved. The growing gap between electricity demand and supply has led to reliance on costly, polluting private generators. In addition to fossil fuels, Iraq has potential for renewable energy but currently generates only 1.74% of electricity from renewable sources. Technical transmission and distribution losses are also a significant issue, with losses reaching 22% of generated electricity. Increasing electricity demand necessitates expansion and modernization of generation capacities. Iraq aims to address this by increasing renewable energy to 6% of its total by 2030, with plans for solar projects totaling 12 GW.

1.4.3.4 Energy consumption per sector

The energy consumption in Iraq is divided across sectors including residential, industrial, and commercial, with the residential sector accounting for the highest consumption. The industrial sector struggles with inadequate infrastructure and outdated technology, hindering its potential for growth and alignment with climate standards. The transportation sector also faces challenges from aging infrastructure and overreliance on private transport, contributing to increased carbon emissions. Iraq's unregulated waste management system contributes to higher energy consumption due to inefficient collection, sorting, and disposal. With only 30% of landfill sites regulated, waste is often transported long distances, increasing fuel use and emissions. Efforts to improve energy efficiency, such as modernizing irrigation systems, upgrading industrial infrastructure, improving waste management and promoting green transportation, are limited but essential for reducing energy consumption, enhancing productivity, and aligning with climate goals outlined in the Paris Agreement.

1.5 Institutional Arrangements and Legal Mechanisms

1.5.1 National Strategic Mechanisms

The Ministry of Environment (MoE) serves as the primary entity responsible for implementing climate-related policies and overseeing environmental protection. Initially empowered under the Environmental Protection and Improvement Law No. 76 of 1986, the ministry's role has evolved through successive legislative updates, culminating in the Environmental Protection and Improvement Law No. 27 of 2009, which remains in force today.[23] This law established a framework for planning, execution, and regulatory oversight to protect Iraq's environment while addressing climate challenges.

To enhance its capabilities, the MoE has formed specialized committees, such as the Ministerial Committee for Climate Change Law Reform, tasked with revising and updating existing legislation. These committees are currently drafting a comprehensive national climate law to address gaps in the legal framework, particularly in areas such as mitigation, adaptation, and international climate financing mechanisms.[24]

Regional environmental protection mechanisms, such as Kurdistan Regional Government's Environmental Laws No. 3 of 2010 and No. 8 of 2008, provide an additional layer of governance, focusing on specific regional environmental challenges. These laws complement national efforts by addressing region-specific issues, such as water resource management and biodiversity.

Iraq has established national strategies focused on environmental protection and climate resilience. These strategies guide long-term sustainable development and integrate climate action into national planning. The National Environmental Strategy and Action Plan (NESAP), developed with UNEP and UNDP, aims to address critical environmental challenges such as air and water quality, land degradation, waste management, and biodiversity protection. It also focuses on tackling oil and radioactive pollution, hazardous chemicals, and strengthening the legal framework for environmental protection. The NESAP is being updated to reflect current challenges, including the impacts of the war against ISIL and the COVID-19 pandemic, and to align with Iraq's international environmental commitments. The National Integrated Energy Strategy, launched in 2013, seeks to increase energy production to 20 gigawatts, focusing on energy security, renewable energy investment, energy efficiency, and public-private partnerships. However, full implementation has been hindered by the country's challenges. In addition, Iraq has developed sector-specific strategies, including the National Agriculture Strategy, National Water Strategy, and National Biodiversity Strategy, which focus on adaptation measures to reduce climate risks and strengthen resilience in key sectors.

23 Environmental Protection and Improvement Law No. 27 of 2009. Ministry of Environment, Republic of Iraq. Available at: http://moen.gov.iq/env-law27-2009
24 Ministry of Environment. National Environmental Strategy and Action Plan. Baghdad: Ministry of Environment, 2023. Available at: http://moen.gov.iq/env-strategy-action-plan-2023

1.5.2 Financial Mechanisms

Iraq's approach to climate financing reflects a dual focus on mobilizing international resources and establishing domestic financial frameworks. The Ministry of Finance (MoF) and the MOE play a critical role in managing climate finance flows, as they are the main entities through which international climate-related funds are channeled. Climate finance in Iraq is mobilized through multiple sources, including the Green Climate Fund (GCF), the Global Environment Facility (GEF), the World Bank, bilateral development agencies, and multilateral institutions.

The National Designated Authority (NDA) to the GCF plays a central role in securing international financial support. The NDA ensures that funding proposals align with national priorities, endorses project proposals, and monitors compliance with GCF requirements.[25] This has enabled Iraq to secure financing for key initiatives such as adaptation planning, disaster risk reduction, and renewable energy expansion.

Domestically, the MoE has introduced policy proposals for creating a sustainable funding mechanism for climate action. These proposals include incentives for renewable energy investments and mechanisms for waste-to-energy projects under the forthcoming Renewable Energy Regulation Law.
The government has also prioritized financial tools to reduce greenhouse gas emissions, such as the planned Municipal Solid Waste Management Law and the Sustainable Transportation Law, which aim to mitigate emissions by promoting clean energy and efficient transportation systems.

Furthermore, Iraq has collaborated with international organizations such as the World Bank, UNEP, and UNDP to mobilize additional resources. Notable successes include the establishment of climate financing facilities that integrate private sector investments with public funds, targeting projects in renewable energy, water resource management, and community resilience.[26]

1.5.3 Institutional Arrangements

Iraq's legal and institutional evolution highlights its commitment to strengthening national capacity to address climate change. By fostering international partnerships and integrating climate priorities into its legal framework, Iraq is positioning itself to meet its Nationally Determined Contributions (NDCs) and contribute meaningfully to global climate action. Iraq joined the Paris Agreement under Law No. 31 of 2020, and based on that, submitted its NDC document. As part of the focus on climate change issues in Iraq, the Climate Change Directorate was established within the Ministry of Environment. This directorate is considered the sectoral body responsible for managing the climate change portfolio in Iraq at both the national and international levels.

1.5.4 Stakeholder Engagement

Stakeholder engagement is a cornerstone of Iraq's strategy to achieve its Vision 2030 and climate commitments under the Paris Agreement. By fostering collaborative action across government agencies, private sector entities, civil society organizations, and youth networks, Iraq ensures a shared sense of commitment and accountability toward sustainable development goals.

Youth play a pivotal role in Iraq's climate and development agenda, as they represent both the largest demographic group and a key driver of innovation and advocacy. By equipping youth with the skills and tools needed to engage in climate adaptation and mitigation strategies, Iraq is laying the groundwork for

25 Green Climate Fund. National Designated Authority Reports for Iraq. Geneva: GCF Secretariat, 2023. Available at: http://www.greenclimate.fund/documents/NDA-reports-iraq
26 World Bank. Iraq Climate Financing Review. Washington, D.C.: World Bank Group, 2023. Available at: http://documents.worldbank.org/curated/en/Iraq-Climate-Financing-Review-2023

long-term sustainability and resilience. [27] A key aspect of Iraq's approach is the inclusion of traditionally underrepresented groups, such as women and rural communities, to address the diverse impacts of climate change.

Moreover, Iraq recognizes the importance of leveraging the expertise of academic institutions and research organizations to enhance the evidence base for climate policies. Collaboration with these entities supports the design of innovative solutions tailored to Iraq's specific challenges, such as water scarcity and desertification.[28] In addition, partnerships with international organizations, ensure that global best practices and technical expertise inform Iraq's strategies for climate adaptation and mitigation.

27 United Nations Development Programme (UNDP). Empowering Youth for Climate Action in Iraq. New York: UNDP, 2023. Accessible at: UNDP Iraq Youth Climate Action

28 World Bank. Macro Poverty Outlook for Republic of Iraq: April 2024. Washington, D.C.: World Bank Group, 2024. Accessible at: Macro Poverty Outlook for Republic of Iraq : April 2024

CHAPTER 2

NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCE AND SINK OF GHGS

2. National Inventory Report of Anthropogenic Emissions by Source and Sink of GHGs

2.1 National circumstances, institutional arrangements and cross-cutting information

2.1.1 Background information on GHG inventories and climate change (e.g. as it pertains to the national context, to provide information to the general public)

Iraq has faced growing challenges related to climate change, including increased temperatures, prolonged droughts, reduced water availability, and desertification. As a signatory to the UNFCCC and the Paris Agreement, Iraq has committed to addressing climate change by reducing greenhouse gas (GHG) emissions and enhancing resilience to climate impacts.

Iraq's GHG inventory provides a comprehensive accounting of emissions from key sectors such as energy, industrial processes, agriculture, forestry, and waste. By establishing a robust inventory system, Iraq aims to meet its reporting obligations under the UNFCCC and its nationally determined contributions (NDCs) to mitigate and adapt to climate change.

2.1.2 A description of national circumstances and institutional arrangements

The Ministry of Environment serves as Iraq's national focal point for climate change and GHG reporting. Within the ministry, the Climate Change Directorate coordinates activities related to climate policies, including the preparation of GHG inventories, development of NDCs, and submission of reports to the UNFCCC. It also liaises with other ministries, local governments, and international organizations to implement climate mitigation and adaptation strategies.

The preparation of Iraq's GHG inventory follows 2006 guidelines established by the Intergovernmental Panel on Climate Change (IPCC) to ensure accuracy, consistency, transparency, and completeness. The inventory process involves the collection, analysis, and interpretation of data from the required sectors (Energy Sector, Industrial Processes and Product Use, Agriculture, Land Use, Land-Use Change, and Forestry, and Waste Management).

Data collection is coordinated through a specific task force representing the different relevant ministries, including Ministry of Oil, Ministry of Electricity, Ministry of Transportation, Ministry of Agriculture, Ministry of Industry and Minerals, and Ministry of Construction, Housing, Municipalities and Public Works. Furthermore, the task force was represented by ministries from the Kurdistan Region including the Environment Protection and Improvement Board/Kurdistan Regional Government, Ministry of electricity, Ministry of Agriculture and Water Resources, and Ministry of Municipalities. Stakeholder meetings took place in person and virtually with the task force to outline their roles and responsibilities in providing activity data and emissions factors for current and future cycles. A standardized reporting template was provided to the task force tailored to IPCC 2006 frameworks to facilitate gathering comprehensive, information for estimating Iraq's emissions. The Ministry of Environment facilitated the full process of gathering of data from various sources and sectors and acted as the national focal point to collect and archive GHG inventory database.

Once the draft GHG inventory was prepared, it underwent a review and approval process. Sector-specific task forces review the data for consistency and accuracy and the Ministry of Environment reviews and approves before submission to the UNFCCC.

2.1.3 Brief general description of methodologies (including tiers used) and data sources used

In view of the capacity of Iraq, Tier 1 methodologies of the 2006 IPCC guidelines were applied for all emissions sources except for Ammonia production (CRT 2B) and forest increment (CRT 4A1) where Tier 2 was applied.

The decision to apply Tier 1 methodologies, even for key categories, was driven by the limited availability of data and the short timeframe, which made it difficult to collect sufficient data for reporting at a higher tier level.

2.1.3.1 Brief description of key categories

A key category analysis (KCA) was conducted based on the contribution of GHG emissions (expressed in CO_2e) for each CRT category. The approach 1 level assessment was applied, where key categories are defined as emission sources that have a significant influence on the inventory as a whole, in terms of the absolute level of emissions.[29] In view of its capacity, Iraq has decided to apply the flexibility mechanism and consider key categories with a threshold no lower than 85%.

Table 2-1 summarizes the key source categories, for the latest inventory year (2021). These key categories are ranked based on their contribution to total emissions, with "Energy Industries" ranked first, followed by the others in descending order.

Table 2-1: Key category analysis based on level of emissions for 2021 (excluding LULUCF)

CRT Category	2021 ($KtCO_2eq$)	Contribution	Cumulative Total of contribution	KCA rank T1 in level
1.A.1 - Energy Industries	68 532	33,7%	33,7%	1
1.A.3 - Transport	33 853	16,6%	50,3%	2
1.B - Fugitive emissions from fuels	24 080	11,8%	62,1%	3
1.A.2 - Manufacturing Industries and Construction	16 388	8,0%	70,1%	4
2.C.1 - Steel production	14 434	7,1%	77,2%	5
1.A.4 - Other Sectors	9 751	4,8%	82,0%	6
2.A.1 - Cement production	7 875	3,9%	85,9%	7
5D. Wastewater treatment	6 925	3,4%	89,3%	8
5A. SWDS	6 385	3,1%	92,4%	9
3.A - Enteric fermentation	5 676	2,8%	95,2%	10
3.D - Agricultural soils	4 909	2,4%	97,6%	11
5C. Open burning and Incineration	1 695	0,8%	98,5%	12
2.A.2 - Lime production	1 266	0,6%	99,1%	13
2.B.1 - Ammonia production	667	0,3%	99,4%	14
3.C - Rice cultivation	661	0,3%	99,7%	15
3.B - Manure management	284	0,1%	99,9%	16
3.H - Urea application	271	0,1%	100,0%	17
1.A.5 - Non-Specified	-	0,0%	100,0%	18
Total without LULUCF	**203,653**	**100%**		

29 KCA analysis on uncertainty or trend was not conducted since only two years are reported and the discussion on uncertainty was only qualitative.

In 2021, out of 18 total categories, the first 7 categories are considered "key categories" (KCA) due to their significant contributions to overall emissions. These 7 categories account for a cumulative total of 85.9% of the emissions, with the highest contribution coming from the "Energy Industries" sector (33.7%), followed by "Transport" (16.6%) and "Fugitive emissions from fuels" (11.8%). Other major contributors include "Manufacturing Industries and Construction" (8%) and "Steel production" (7.1%). Additionally, "Other Sectors" (4.8%) and "Cement production" (3.9%) complete the top 7 categories.

When including the LULUCF sector in the KCA, the key categories remain unchanged, with LULUCF contributing only 0.8% of the total emissions, and ranking 13th as shown in Table 2-2.

Table 2-2: Key category analysis based on level of emissions for 2021 (including LULUCF)

CRT Category	2021 (KtCO_2eq)	Contribution	Cumulative Total of contribution	KCA rank T1 in level
1.A.1 - Energy Industries	68 532	33,4%	33,4%	1
1.A.3 - Transport	33 853	16,5%	49,9%	2
1.B - Fugitive emissions from fuels	24 080	11,7%	61,6%	3
1.A.2 - Manufacturing Industries and Construction	16 388	8,0%	69,6%	4
2.C.1 - Steel production	14 434	7,0%	76,6%	5
1.A.4 - Other Sectors	9 751	4,7%	81,4%	6
2.A.1 - Cement production	7 875	3,8%	85,2%	7
5D. Wastewater treatment	6 925	3,4%	88,6%	8
5A. SWDS	6 385	3,1%	91,7%	9
3.A - Enteric fermentation	5 676	2,8%	94,4%	10
3.D - Agricultural soils	4 909	2,4%	96,8%	11
5C. Open burning and Incineration	1 695	0,8%	97,7%	12
4. LULUCF	1 675	0,8%	98,5%	13
2.A.2 - Lime production	1 266	0,6%	99,1%	14
2.B.1 - Ammonia production	667	0,3%	99,4%	15
3.C - Rice cultivation	661	0,3%	99,7%	16
3.B - Manure management	284	0,1%	99,9%	17
3.H - Urea application	271	0,1%	100,0%	18
1.A.5 - Non-Specified	-	0,0%	100,0%	19
Total with LULUCF	**205,328**	**100%**		

2.1.3.2 Brief general description of QA/QC plan and implementation

In light of its capacities, Iraq has not yet developed a proper QA/QC plan and is thus applying the flexibility mechanism described in paras. 34 and 35 of the MPGs.

2.1.3.3 General uncertainty assessment

The uncertainty in emissions estimates primarily stems from data sources and assumptions used in the inventory.

For the Energy sector, activity data are derived from the UN Energy Balance database, which provides comprehensive coverage and consistent reporting standards. However, limitations may arise due to the aggregated nature of the data and potential fuel uses specificities that may not be fully captured in international databases. As such, while the UN data are regarded as reliable and broadly representative, certain assumptions were required to adapt this information to the national context, contributing to a degree of uncertainty.

In the IPPU sector, activity data were gathered from local sources, but the dataset is incomplete in several key categories. This data gap requires reliance on assumptions or proxy data, which may not accurately reflect actual industrial processes and product use within the reporting year. The absence of full data coverage introduces higher uncertainty, particularly for emissions associated with smaller or non-reporting facilities. Additionally, variations in data reporting methodologies and standards across sources may further impact the accuracy of IPPU sector estimates. These uncertainty ranges indicate the need for ongoing improvement in data collection, especially within local industrial processes, to enhance the reliability of future emissions inventories.

For the agriculture sector, activity data are sourced from the National Ministry of Agriculture. While this data is considered reliable and comprehensive, potential inaccuracies may arise from reporting errors, data aggregation, and regional variability that may not be fully captured in national statistics. Moreover, the calculation methodologies follow the IPCC Guidelines, employing Tier 1 approaches with default emission factors and parameters provided by the IPCC. These default values are designed to be globally applicable but may not fully reflect national or local conditions.

The Land Use, Land-Use Change, and Forestry (LULUCF) sector estimates are based on high-resolution land use and land cover maps developed using remote sensing and machine learning techniques, complemented by land-use change data from the UNCCD PRAIS 2022 framework. These advanced methods enhance the accuracy of activity data, but uncertainties persist due to potential classification errors, limitations in resolution, and challenges in capturing localized land-use dynamics. Moreover, default carbon stock values from the 2006 IPCC Guidelines and the 2019 Refinement are used to estimate emissions and removals. While these values are globally recognized, they may not fully represent national conditions, such as variations in vegetation types, soil properties, and land management practices.

For the waste sector, activity data were partially gathered from local sources, but the dataset is incomplete in several key categories. Additionally, some datasets and assumptions were derived from the 'Data Collection Study on Solid Waste Management' published by the Japan International Cooperation Agency. This data gap necessitates reliance on assumptions or proxy data, which may not accurately reflect actual waste management in Iraq during the reporting years. The absence of comprehensive data coverage introduces higher uncertainty, particularly regarding emissions from smaller or non-reporting facilities (such as industrial or hazardous waste). Default values from the IPCC guidelines have also been used, which can contribute to additional uncertainty. These uncertainties highlight the need for ongoing improvements in data collection, particularly for industrial, hazardous, and clinical waste, to enhance the reliability of future emissions inventories.

2.1.3.4 General assessment of completeness

2.1.3.4.1 Information on completeness

Temporal coverage: The emission inventories presented in this document cover the years 2020-2021.
Geographical scope: The present inventory relates to Iraq, including the region of Kurdistan, located in Northern Iraq. Indeed, data was either unavailable, incomplete, or the timeframe was insufficient to complete data collection for the years prior to 2020 and for 2022."

Categories included elsewhere (IE):

- All categories from "Manufacturing Industries and Construction" CRT 1A2a to 1A2gvii are included in the CRT 1A2gviii "Non-specified Industry".
- "Commercial and institutional activities" (CRT 1A4a) as well as "Agriculture, forestry and fishing" (CRT 1A4c), are included in "Residential" (CRT 1A4b).

Description of insignificant categories
In view of the difficulty to obtain activity data, and in view of the country's capacity, the following emissions sources remained not estimated (NE) for Iraq:

- CRT 2A – Mineral industry, emissions related to the production of bricks,
- CRT 2B – Chemical industry, emissions related to petrochemical production,
- CRT 2C – Metal industry, emissions related to lead production,
- CRT 2D – Non energy products from fuels and solvent use,
- CRT 2F – Product uses as substitutes for ODS,
- CRT 3G – Liming,
- CRT 3I – Other carbon-containing fertilizers,
- CRT 4 – depending on the category, Direct N2O Emissions from N Mineralization / Immobilization, Indirect N2O emissions from soils and biomass burning emissions are currently not estimated in the Iraqi inventory for most categories.
- CRT 5 – all categories related to industrial waste treatment, as well as hazardous waste treatment,
- CRT 5D2 – industrial wastewater treatment.

2.1.3.4.2 Total aggregate emissions considered insignificant

The total aggregate emissions considered insignificant are not estimated for Iraq.

2.1.3.5 Metrics

Aggregate emissions and removals of all GHGs are expressed in CO_2 equivalents. The 100-year time-horizon global warming potential (GWP) values from the IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) was used to report those aggregate emissions and removals of GHGs.

2.1.3.6 Summary of any flexibility applied

As per paras. 4–6 of the MPGs, Iraq used the flexibilities detailed in Table 2-3 in terms of GHG emission inventory estimation and reporting.

Table 2-3: Flexibilities d in terms of GHG emission inventory estimation and reporting.

MPG flexibility provision	Year	Sector	Category	Gas	Description of the application of flexibility	Clarification of capacity constraint	Progress made in addressing areas of improvement
Key categories (para. 25)	All	All	All	All	Iraq has elected to use a threshold for the key category analysis of 85%.	It was chosen to focus on limited resources to improve reporting on the most important key categories, and particularly where data collection could be done relatively quickly.	This is the first BTR submission. Progress will be documented in the second BTR.
Uncertainty assessment (para. 28)	All	All	All	All	Iraq provided a qualitative discussion of the latest inventory year/trend	Iraq does not have sufficient resources to develop a proper uncertainty assessment.	
Completeness (para. 32)	All	All	All	All	Iraq considered emissions to be insignificant when the likely level of emissions was below 0.1% of total GHG emissions or 1000 kt CO_{2eq}.	Resources were insufficient to collect all data and estimate all categories.	
QA/QC (paras. 34 and 35)	All	All	All	All	Iraq has not yet developed a QA/QC plan.	Iraq does not have sufficient resources to develop a QA/QC plan.	
Gases (para. 48)	All	All	All	All	Iraq included only the 3 following gases: CO_2, CH_4 and N_2O.	Iraq does not have sufficient data and resources to estimate all gases and collect the corresponding activity data.	
Time series (paras 57 and 58)	2024	All	All	All	• Report data cover the annual time series of 2020 onward. • Iraq included the most recent year of 2021 in its 2024 BTR submission (i.e. three years prior to the year of submission)	Activity data were not available for all sectors for years prior to 2020 and for 2022, two years prior to the year of submission.	

2.2 Trends in greenhouse gas emissions and removals

2.2.1 Description of emission and removal trends for aggregated GHG emissions and removals

Overall, Iraq's national total emissions, excluding Land Use, Land-Use Change, and Forestry (LULUCF), increased from 198,677 ktCO2e in 2020 to 203,653 ktCO2e in 2021. When accounting for LULUCF removals—1,219 ktCO2e in 2020 and 1,674 ktCO2e in 2021—the net emissions are reduced to 197,457 ktCO2e in 2020 and 201,979 ktCO2e in 2021.Description of emission and removal trends by sector and by gas follow.

2.2.1.1 By sector

Data on aggregated GHG emissions for Iraq in 2020 and 2021 reveals several notable trends across various sectors (Table 2-4 and Figure 2-1). The Energy sector, which represents the largest source of emissions, saw an increase from 149.7 $MtCO_2eq$ (Million tons CO_2eq) in 2020 to 153 $MtCO_2eq$ in 2021. The Industrial Processes and Product Use (IPPU) sector showed a marginal increase, from 22.5 $MtCO_2eq$ in 2020 to 24.2 $MtCO_2eq$ in 2021. Emissions from the Agriculture sector decreased slightly, from 12 $MtCO_2eq$ in 2020 to 11,8 $MtCO_2eq$ in 2021, reflecting a small reduction in agricultural activities. The Waste sector experienced a small increase, rising from 14.4 $MtCO_2eq$ in 2020 to 15 $MtCO_2eq$ in 2021. The LULUCF sector shows a 34% increase in carbon removals – removing around 450 $ktCO_2eq$ – indicating a modest improvement in its ability to offset emissions. However, this change remains minimal compared to the more pronounced trends in other sectors, such as the Energy sector's significant rise of nearly 3,000 ktCO2e and the Waste sector's increase of over 500 ktCO2e during the same period.

Table 2-4: Iraq's GHG emissions for the year 2020 and 2021 by sector (kt CO_2eq)

Sector	2020	2021
Energy	149 677	152 604
IPPU	22 500	24 243
Agriculture	12 081	11 802
Waste	14 419	15 005
National total, without LULUCF	**198 677**	**203 653**
LULUCF	- 1 219	- 1 674
National total, incl. LULUCF	**197 457**	**201 979**

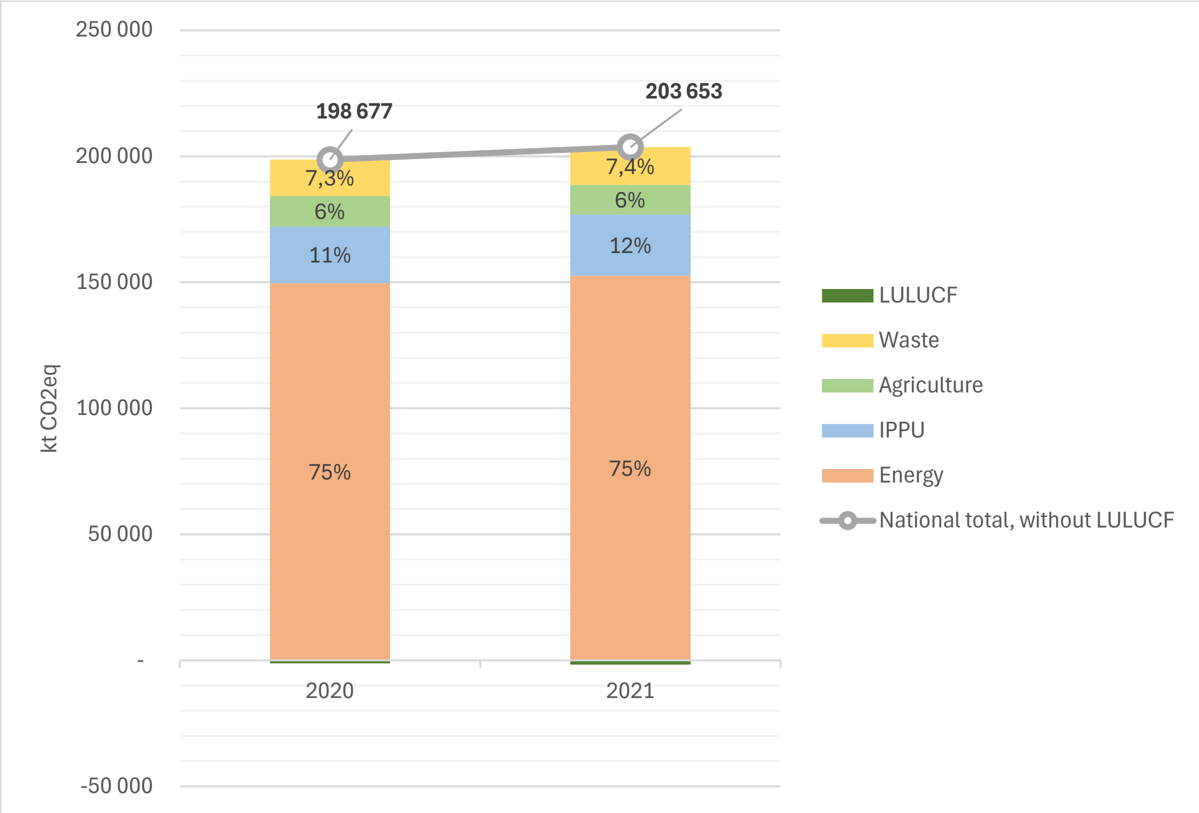


Figure 2-1: Iraq's GHG emissions for the year 2020 and 2021 (in ktCO_2eq) and repartition (excluding LULUCF) by sector (%)

2.2.1.2 By gas

Table 2-5 presents Iraq's national emissions by type of gas in 2020 and 2021. The proportion of the three gases CO_2, CH_4, and N_2O remains consistent between the two reporting years (Figure 2-2).

Table 2-5: Iraq's national emissions by type of gas in 2020 and 2021

		2020			2021		
	Units	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Energy	kt gas	136 312	458	2,0	139 095	463	2,1
IPPU	kt gas	22 500	NO	NO	24 243	NO	NO
Agriculture	kt gas	261	226	20,7	271	234	18,8
Waste	kt gas	931	468	1,5	1 094	483	1,5
Energy	kt CO2eq	136 312	12 823	542	139 095	12 955	554
IPPU	kt CO2eq	22 500	NO	NO	24 243	NO	NO
Agriculture	kt CO2eq	261	6 325	5 494	271	6 560	4 971
Waste	kt CO2eq	931	13 101	387	1 094	13 519	391
Total	**kt CO2eq**	**159 767**	**32 249**	**6 423**	**162 896**	**33 034**	**5 916**

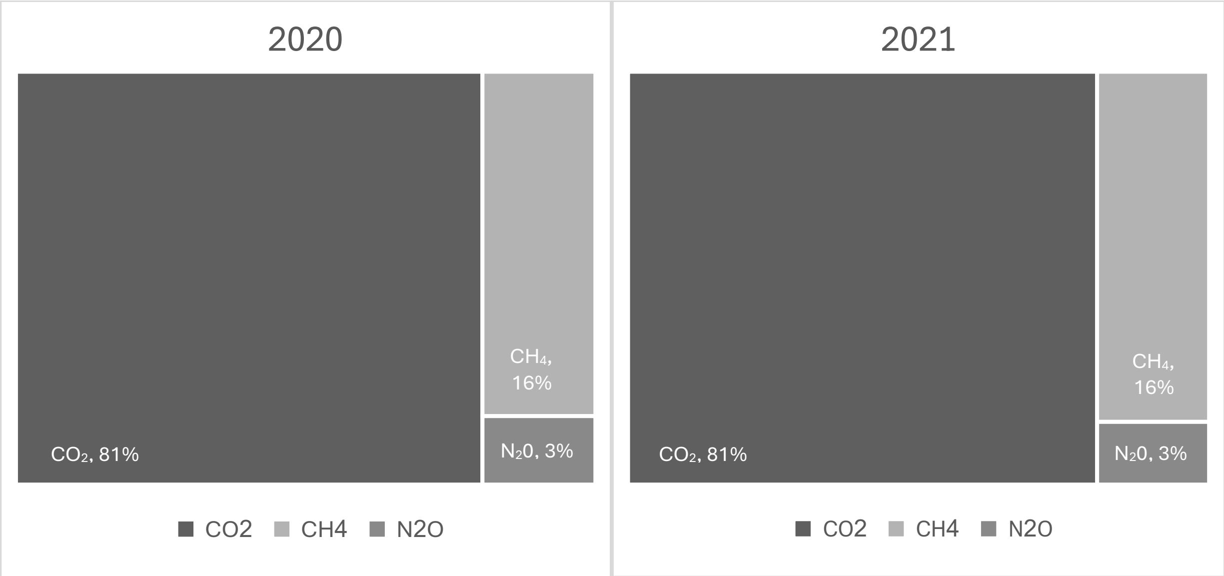


Figure 2-2: Iraq's national emissions repartition by type of gas (%) in 2020 and 2021

Figure 2-3 presents CO_2 emissions, the most significant contributor to overall emissions, saw a substantial increase across sectors, notably in the Energy sector, where CO_2 emissions increased by 2%, from 136,312 kt CO_2eq in 2020 to 139,095 kt CO_2eq in 2021. This highlights the importance of the Energy sector, as it is a major source of CO_2 emissions, and its reduction plays a critical role in overall emission control. The IPPU sector remained steady in CO_2 emissions. Finally, the Agriculture sector, while not as significant in CO_2emissions, showed a slight increase in CO_2 emissions (a 3.8% rise).

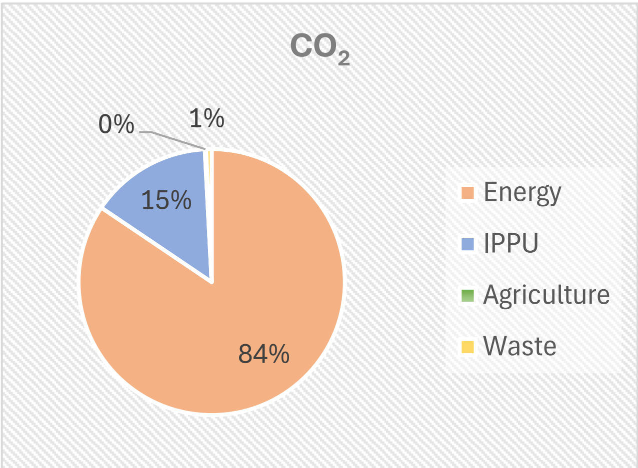


Figure 2-3:Repartition of CO2 emissions by sector in 2021

Figure 2-4 presents CH_4 emissions, which are particularly significant in sectors like Waste, Energy, and Agriculture, saw a slight increase across these areas. The Waste sector, which accounts for 41% of total methane emissions, experienced a small rise in CH_4 emissions between the two reporting years, increasing from 13,101 kt CO_2eq to 13,519 kt CO_2eq (a 3.2% increase). This reflects ongoing challenges in managing methane from landfills and wastewater treatment.

In the Energy sector, CH_4 emissions remained notably high, nearly on par with those from the Waste sector, standing at 12,823 kt CO_2eq in 2020 and 12,955 kt CO_2eq in 2021, a modest decrease of about 1.2%. Methane emissions in this sector are primarily due to fugitive emissions from the production, transportation, refining and distribution of oil and natural gas.

In agriculture, CH_4 emissions rose by 3.7%, from 6,325 kt CO_2eq to 6,560 kt CO_2eq, largely due to methane released from livestock and other agricultural activities. Reducing CH_4 emissions should remain a top priority, as methane has a far greater warming potential than CO_2 over a short time frame.

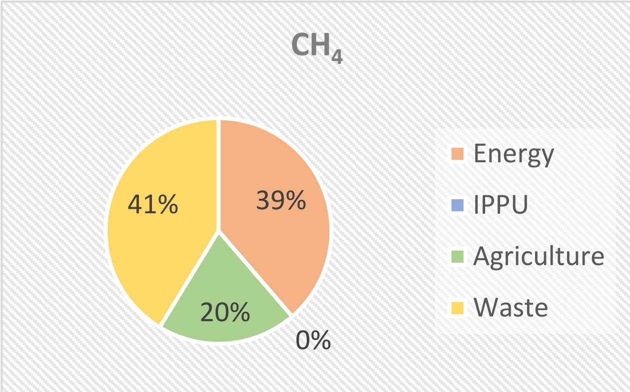


Figure 2-4: Repartition of CH_4 emissions by sector in 2021

Figure 2-5 presents N_2O emissions showed a notable increase between 2020 and 2021 even though the agriculture sector, which is by far the largest contributor to N_2O emissions, accounting for 84% of total emissions, saw a reduction of 9.5% in its N_2O emissions, from 5.5 kt CO_2eq in 2020 to 5 kt CO_2eq in 2021. In contrast, the Energy sector, which contributes only 9% of global N_2O emissions, saw an increase of 2.3% in N_2O emissions, from 542 kt CO_2eq to 554 kt CO_2eq. The Waste sector, responsible for 6.6% of N_2O emissions, saw a smaller rise in emissions, from 388 kt CO_2eq to 391 kt CO_2eq.

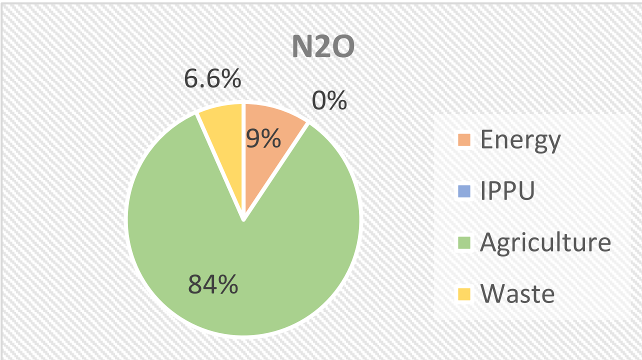


Figure 2-5: N_2O emissions repartition by sector in 2021

2.3 Energy (CRT sector 1)

2.3.1 Overview of the sector and background information

The CRT 1 category covers the following sectors:

- Energy industries (1A1), including thermal power plants, oil refineries and production of solid and gaseous fuels,
- Manufacturing industry (1A2),
- Transport (1A3),
- Other sectors (1A4), including residential heating,
- Non-Specified (1A5),
- Fugitive emissions from solid fuels (charcoal) (1B1),
- Fugitive emissions from oil and natural gas (1B2).

The CO_2 transport and storage (1C) does not occur in Iraq.

The main reference used for the Energy sector is the energy balance collected from the UN Energy database of the Energy Statistics Database of the United Nations Statistics Division (UNSD).[30] This source was preferred to sectorial energy data collected at the level of the different Iraqi ministries because of incompleteness of sectorial data. However, when available, bottom-up data were used and a balance on the overall consumption from the energy balance was applied so that the energy balance remains the main reference of the Energy sector. The same methodology is applied for the years 2020 and 2021.

When available, the following categories were taken into consideration from the UN Energy Balance as the basis for fuel consumption in the Iraq inventory (unit: mt):
1. Production
2. Imports
3. Exports
4. International marine and aviation bunkers
5. Stock changes
Statistical differences
Transfers and recycled products
Transformation
6. Electricity production
7.a. Oil refineries
7.b Other transformation
8.a. Energy industries own use
8.b. Losses

FINAL CONSUMPTION - TOTAL
Energy use - total
- Manufacturing - Industry
- Transport
- Road
- Domestic aviation
- Railways
- Domestic navigation
- Commercial and public services
- Households
- Agriculture
- Other

Non-energy use – total
Transport sector: bottom-up data was used for the gas/diesel consumption as shown in Table 2-6

Table 2-6: Gas/diesel consumption in 2020 and 2021

	Railways (gas/diesel) (TJ)	Domestic navigation (gas/diesel) (TJ)
2020	5117	595
2021	199	615

These gas/diesel consumptions were then subtracted of the gas/diesel consumption of the road sector, so that the total gas-diesel consumption would remain align with the UN Energy Balance.

30 http://data.un.org/Explorer.aspx

Industry sector: bottom-up data was used for natural gas energy consumption used for the ammonia production (Table 2-7)

Table 2-7: Natural Gas Consumption (TJ) in 2020 and 2021

	Natural gas consumption (TJ)
2020	17,867
2021	15,015

This natural gas consumption was then subtracted from the total energy use natural gas consumption in the industrial sector.

Tier 1 methodologies were applied to all categories in the Energy sector, even for categories. This decision was driven by the limited availability of data and the short timeframe, which made it difficult to collect sufficient data for reporting at a higher tier level.

Emissions estimates (Figure 2-6) indicate a slight increase in total emissions from the Energy sector between 2020 and 2021. In 2020, fuel combustion contributed 125.7 $MtCO_2eq$, accounting for 84% of the sector's total emissions, while fugitive emissions added 24 $MtCO_2eq$, or 16%. By 2021, fuel combustion emissions rose to 128.5 $MtCO_2eq$, still representing 84% of the sector's emissions, with fugitive emissions remaining steady at around 24 $MtCO_2eq$.

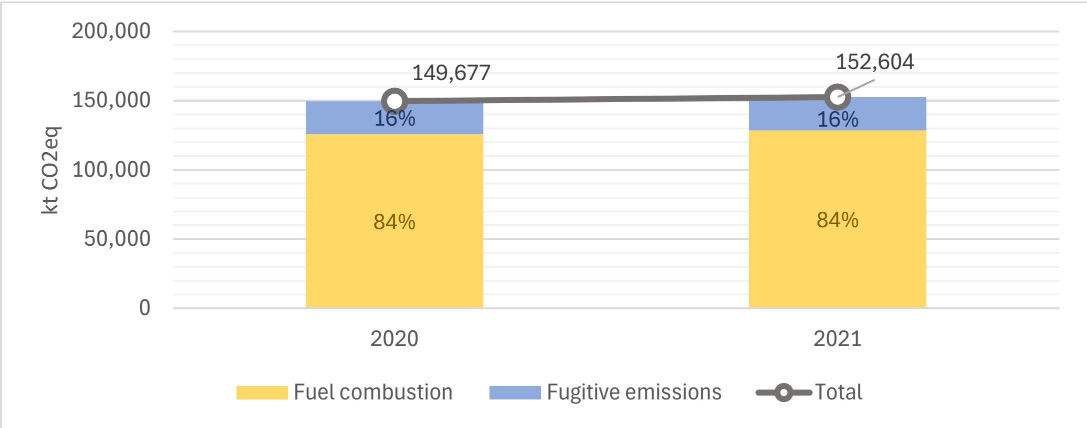


Figure 2-6: Emissions evolution of the Energy sector and its repartition between fuel combustion emissions (1A) and fugitive emissions (1B) in 2020 and 2021(in kt CO_{2eq} and %)

Figure 2-7 shows fuel combustion emissions for the different sub-sectors in 2020 and 2021, along with their percentage contributions to total emissions. In both years, Energy Industries were the largest source of emissions, though they saw a decrease from 70.4 $MtCO_2eq$ in 2020 to 68.5 $MtCO_2eq$ in 2021, resulting in a drop in their share from 56% to 53% of total emissions. The Transport sector experienced a significant increase in emissions, rising from 29.4 $MtCO_2e$ in 2020 to 33.9 $MtCO_2eq$ in 2021, which raised its share from 23% to 26%, making it the second-largest contributor. Manufacturing Industries and Construction emissions remained stable, with a slight increase from 16.4 $MtCO_2eq$ to 16.4 $MtCO_2eq$, maintaining a 13% share. Other Sectors also remained steady, with emissions increasing slightly, keeping their share at 7.6%. This data highlights a shift in the distribution of fuel combustion emissions, with Transport gaining a larger share, while Energy Industries' contribution has slightly declined.

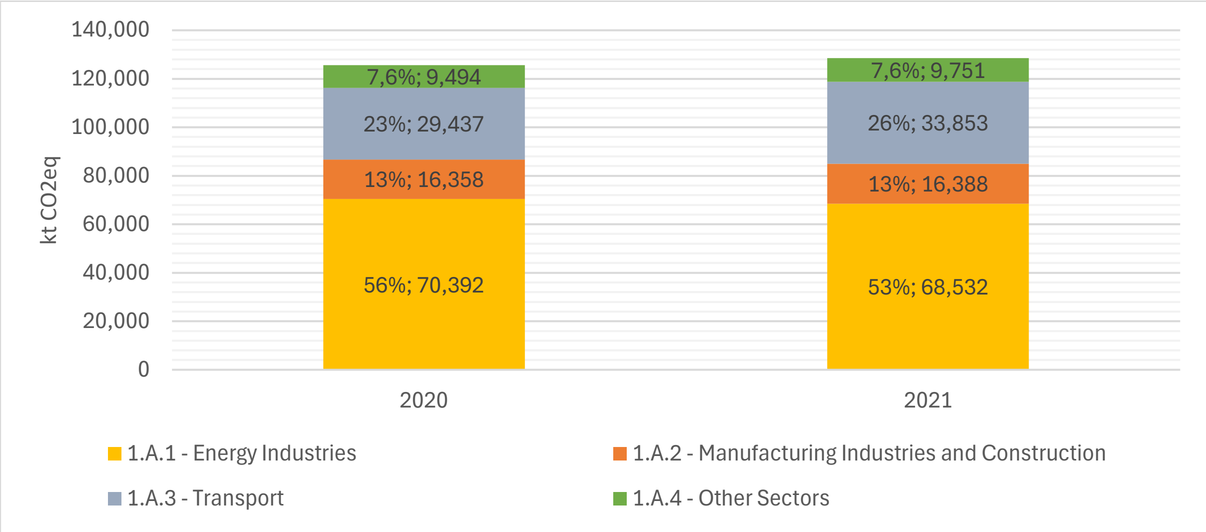


Figure 2-7: GHG emission trends for the Fuel combustion Energy sector (CRT 1A), per main subsector (in kt CO_2e)

2.3.2 Fuel combustion (CRT 1.A)

2.3.2.1 Comparison of the sectoral approach with the reference approach

The IPCC guidelines recommend using the reference approach, which involves comparing fuel consumption data for the Energy sector (CRT 1A) from energy balances—accounting for production, imports, exports, and stock changes (reference approach)—with fuel consumption data used in the emissions inventory (sectoral approach). Finally, CO_2 emissions calculated from both approaches are compared to ensure consistency.

Table 2-8: Comparison of the CO_2 emissions from the reference and sectoral approaches for Iraq, for the years 2020 and 2021

		Reference Approach				Sectoral Approach		Difference	
Year	Fuel	Apparent Consumption (TJ)	Excluded consumption (TJ)	Apparent Consumption (excluding non-energy use and feedstocks) (TJ)	CO_2 Emissions (Gg)	Energy Consumption (TJ)	CO_2 Emissions (Gg)	Energy Consumption (%)	CO_2 Emissions (%)
2020	Liquid fuels	1 190 059	-	1 190 059	85 114	1 199 295	86 715	-0.77	-1.85
	Gaseous fuels	713 640	17 867	695 773	39 033	679 045	38 094	2.46	2.46
	Total	**1 903 699**	**17 867**	**1 885 832**	**124 147**	**1 878 341**	**124 809**	**0.40**	**-0.53**
2021	Liquid fuels	1 137 494	-	1 137 494	80 737	1 226 093	88 194	-7.23	-8.46
	Gaseous fuels	734 540	15 015	719 525	40 365	701 937	39 379	2.51	2.51
	Total	**1 872 034**	**15 015**	**1 857 019**	**121 102**	**1 928 030**	**127 572**	**-3.68**	**-5.07**
Average of both years								-1.64	-2.80

Overall, for both 2020 and 2021, the difference between the two approaches is -2.80% (Table 2-8). The differences are consistently negative, indicating that CO_2 emissions associated with fuel consumption in the reference approach are lower than those in the sectoral approach. This discrepancy is well within the IPCC's recommended threshold of 5%.

The difference between the two approaches can largely be attributed to statistical differences in the energy balances for both liquid and gaseous fuels. It is important to note that in the reference approach, non-energy uses of natural gas are aligned with the sectoral approach. These non-energy uses are identified exclusively for ammonia production (CRF 2B1). In 2020, the difference in emissions is relatively small at -0.53%, whereas in 2021, it increases significantly to -5.1%. This larger discrepancy in 2021 is primarily driven by the substantial statistical difference observed in the energy balance for liquid fuels, with a -7.2% variation in energy consumption leading to an -8.5% difference in CO_2 emissions between the two approaches for this type of fuel.

2.3.2.2 International bunker fuels

In the GHG inventory, emissions reported on international bunkers concern emissions relating to international civil aviation and international maritime traffic based on fuel sales in Iraq.

International aviation bunkers concern fuel consumptions of international flights refueling in Iraq. There is as well international maritime traffic.

Both are reported as memo items in the Inventory.

2.3.2.3 Feedstocks and non-energy use of fuels

Fossil fuels can be consumed for different uses such as combustion for energy needs or as raw material, intermediate or reducing agent (non-energy uses).

During operations, emissions may occur both at the combustion stage and as an industrial process. However, it is not always possible, partly for practical reasons, to report these two types of emissions separately.

In the 2006 IPCC Guidelines, the following rule is formulated:
Combustion emissions from fuels obtained directly or indirectly from the feedstock for an IPPU process will normally be allocated to the part of the source category in which the process occurs. These source categories are normally 2B and 2C. However, if the derived fuels are transferred for combustion in another source category, the emissions should be reported in the appropriate part of Energy Sector source categories (normally 1A1 or 1A2).

Thus, in the Iraqi inventory this rule was applied to ammonia production, where natural gas is used as feedstock. The associated CO_2 emissions are accounted for in the CRT category 2B1.

2.3.2.4 Energy industries (CRT 1A1)

2.3.2.4.1 Category description (e.g. characteristics of sources)

In 2021, the energy industry contributed 34% of Iraq's total national GHG emissions, excluding LULUCF, and made up 45% of the Energy category (CRT 1). These figures were 35.5% and 47%, respectively, in 2020 (Figure 2-8).

This category includes:

- Electricity generation (CRT 1A1.a) – represents 82.7% of the Energy industries emissions in both 2020 and 2021 and although there was a slight decrease in fuel consumption between the two years.
- Petroleum refining (CRT 1A1.b) – standing at around 11,5% of the Energy industries emissions.
- Manufacture of Solid fuels and Other Energy Industries (CRT 1A1.c)
  - Other Energy Industries (CRT 1A1.c.ii) (around 6% of the Energy industries emissions)

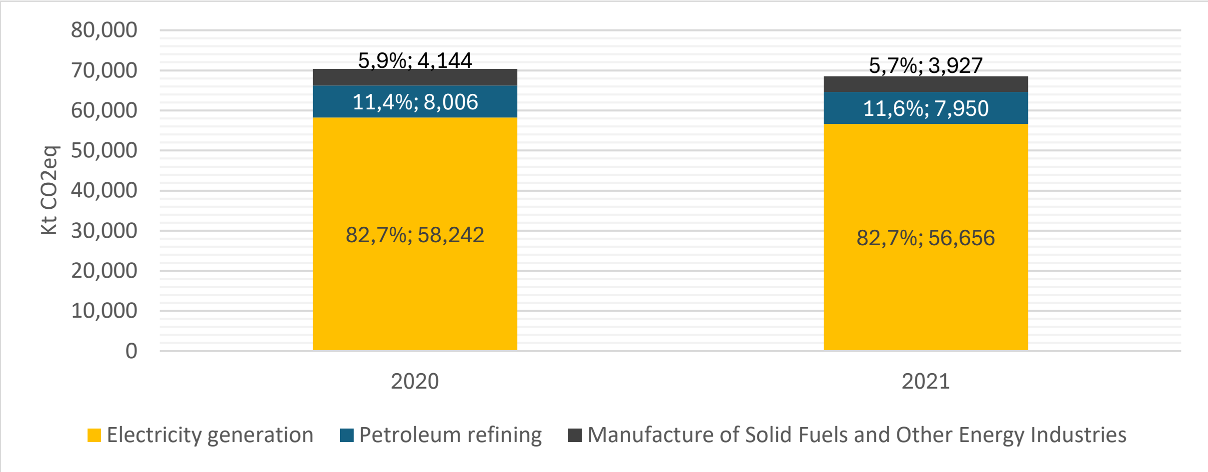


Figure 2-8: Energy industries emissions in Kt CO_2eq

2.3.2.4.2 Methodological issues

Tier 1 method of the 2006 IPCC Guidelines was applied for all subcategories of the Energy Industries sector and emissions factors default values, corresponding to the different fuel consumed, were used for CO_2, CH_4 and N_2O (Table 2-9).

The following activity data – from the UN Energy Statistics Database Energy balance – was used:

- For electricity generation: all primary and secondary products indicated in the Energy balance (i.e. crude oil, gas/diesel oil, fuel oil and natural gas)
- For petroleum refining: consumption of crude oil indicated in the "Energy industries own use" of the Energy balance
- For other energy industries: consumption of refinery gas and fuel oil indicated in the "Energy industries own use" of the Energy balance

Table 2-9: Fuel consumption of the Energy Industries (CRT 1A1), in TJ

	2020	2021
Electricity generation (TJ)		
Liquid fuels	399 380	367 643
Gaseous fuels	508 891	523 523
Petroleum refining (TJ)		
Liquid fuels	108 858	108 096
Other energy industries (TJ)		
Liquid fuels	55 641	53 157

2.3.2.4.3 Uncertainty assessment and time-series consistency

General discussion on uncertainty in the Energy sector provided in earlier section

2.3.2.4.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.3.2.4.5 Category-specific planned improvements

The objectives for the next submissions are:

- Preparation of an energy balance by the different relevant government entities, in order to use only country data, and not rely on the UN Energy Balance
- Data collection regarding the fuel consumption by refineries to estimate properly the emissions associated, as fuel consumption by refineries is not a category detailed in energy balances.

2.3.2.5 Manufacturing industries and construction (CRT 1A2)

2.3.2.5.1 Category description (e.g. characteristics of sources)

Manufacturing Industries and Construction include emissions from fuel combustion in different industries:

- Iron and steel (CRT 1A2a),
- Non-ferrous metals (CRT 1A2b),
- Chemicals (CRT 1A2c),
- Pulp, paper and print (CRT 1A2d),
- Food processing, beverages and tobacco (CRT 1A2e),
- Non-metallic minerals (CRT 1A2f),
- Transport equipment (CRT 1A2g),
- Machinery (CRT 1A2gi),
- Mining (excluding fuels) and Quarrying (CRT 1A2gii),
- Wood and wood products (CRT 1A2giv),
- Construction (CRT 1A2gv),
- Textile and Leather (CRT 1A2gvi),
- Off-road vehicles and other machinery (CRT 1A2gvii),
- Non-specified Industry (CRT 1A2gviii).

The main industries in Iraq are related to the production of cement, lime and ammonia, and to a minor extent of bricks. It should be noted that there was no production by the General Iron and Steel Company during the last period, as it was halted for rehabilitation and investment work. However, there are some steel production in the Kurdistan region.

Unfortunately, bottom-up data on fuel consumption was incomplete for the reporting years, as government entities only have access to data from state-owned companies. Therefore, the fuel consumption figures from the UN Energy Balance were used instead, as they are considered more comprehensive and complete. However, there is no distinction between the different types of industries, thus all emissions were reported in the “non-specified industry” (CRT 1A2gviii).

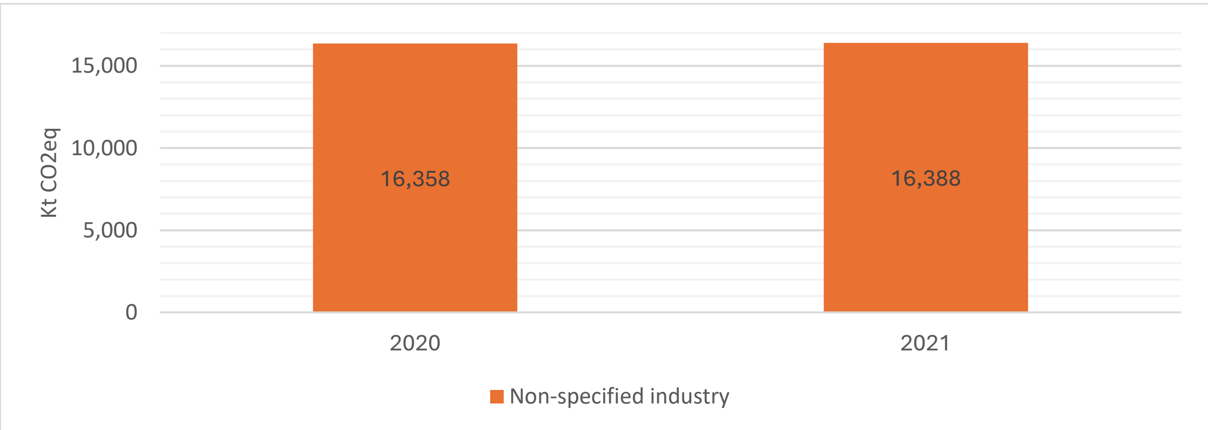


Figure 2-9: Manufacturing industries emissions in kt CO_2eq

In both years, the manufacturing industries combustion contributes around 8% of the total national GHG emissions without considering LULUCF, and it contributes around 11% of the Energy category (CRT 1) in Iraq (Figure 2-9).

2.3.2.5.2 Methodological issues

The Tier 1 method from the 2006 IPCC Guidelines is applied to calculate GHG emissions. Default emission factors (EF) for CO_2, CH_4, and N_2O, also sourced from the 2006 IPCC Guidelines, are used in the calculations (Table 2-10)

Table 2-10: Emission Factors

Fuel type	CO_2 EF (kg CO_2/TJ)	CH_4 EF (kg CH_4/TJ)	N_2O EF (kg N_2O/TJ)
Natural gas	56100	1	0.1
Gas/Diesel oil	74100	3	0.6
Residual fuel oil	77400	3	0.6

The activity data represent fuel consumption as indicated in the UN Energy Balance, in the category “Final energy consumption of Manufacturing, construction and mining” (Table 2-11). Note that non-energy fuel consumption is not reported in the 1A2 sector but rather in the CRT 2 - Industrial Processes sector.

Table 2-11: Fuel consumption of the Manufacturing Industries (CRT 1A2), in TJ

Fuel type	2020	2021
Natural gas	170,155	178,414
Gas/Diesel oil	85,743	81,438
Residual fuel oil	5,515	4,052

Total fuel consumption is stable between 2020 and 2021 (+1%), but liquid fuels consumption has decreased by -6.5% while natural gas increased by 5.9%. The manufacturing sector is using predominantly natural gas (around 65%) (Figure 2-10)

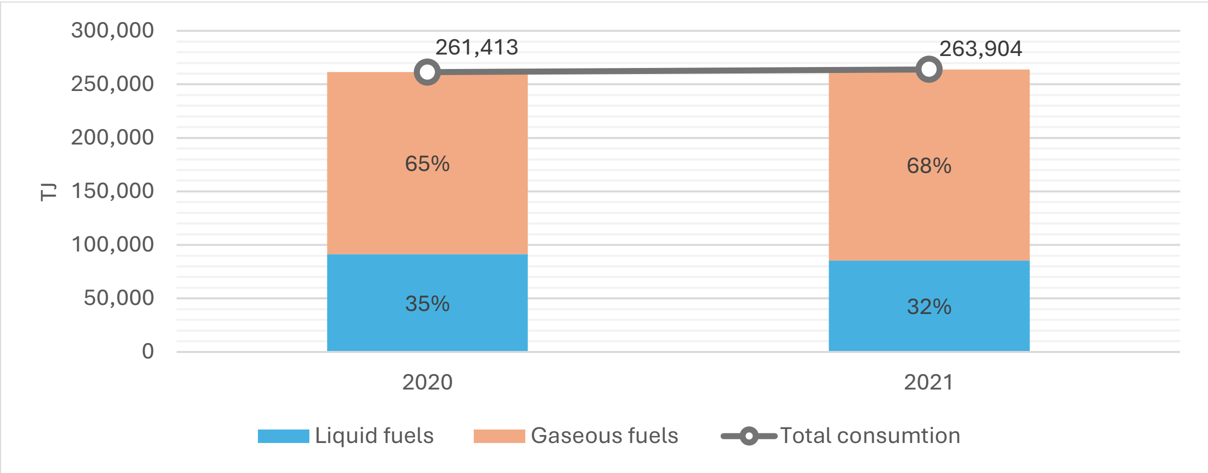


Figure 2-10: Total fuel consumption of the Manufacturing and construction sector (in TJ)

2.3.2.5.3 Uncertainty assessment and time-series consistency

General discussion on uncertainty in the Energy sector is provided in earlier section.

2.3.2.5.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.3.2.5.5 Category-specific planned improvements

Efforts are needed to collect fuel consumption data at the level of each specific industry in order to disaggregate the different emissions sources. A system should also be developed to capture data on the consumption of private industries, not just state-owned ones, ensuring that estimates are comprehensive and not underestimated.

2.3.2.6 Transport (CRT 1A3)

2.3.2.6.1 Category description

This category covers the emission from combustion and evaporation of fuel for all transport activities. This sector includes the emission from:

- Air transport (CRT 1A3a),
- Road transport (CRT 1A3b),
- Rail transport (CRT 1A3c),
- Marine transport (CRT 1A3d).

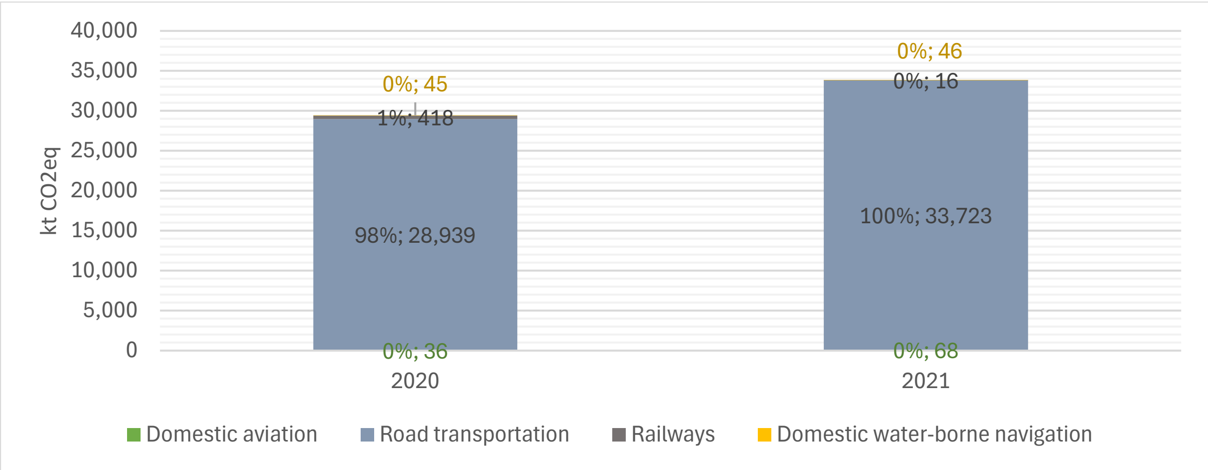


Figure 2-11: Transport emissions in kt CO2eq

In 2021, the transport sector contributed 16.8% to the total national GHG emissions (excluding LULUCF) and accounted for 22% of the emissions in the Energy category (CRT 1) in Iraq. This marks a slight increase from 14.8% and 20% in 2020, respectively (Figure 2-11).

2.3.2.6.2 Methodological issues

The Tier 1 method, along with default emission factors for CO_2, CH_4, and N_2O from the 2006 IPCC Guidelines, is applied to calculate GHG emissions.

The activity data used consist of fuel consumption as indicated in the UN Energy Balance under the category "Final Energy Consumption of Transport," refined with bottom-up data related to railway transport and domestic navigation (both of which were not included in the UN Energy Balance). To balance the total final energy consumption in the transport sector, the consumption of gas and diesel oil for these modes was subtracted from the road transport consumption.

In road transport, fuel consumption is not differentiated by vehicle type but rather by fuel type (gasoline or gas/diesel oil), resulting in an aggregate figure that encompasses cars, buses, trucks, taxis, and two-wheeled vehicles (Table 2-12).

Table 2-12: Fuel consumption in the Transport sector (in TJ)

	2020	2021
Transport (TJ)		
Domestic aviation	497	945
Road transportation	397 157	464 980
Railways	5 117	199
Domestic water-borne navigation	595	615
Total consumption	**403 367**	**466 739**

Figure 2-12 shows transport sector energy consumption (in TJ) across different modes in 2020 and 2021. Total consumption increased significantly, from 403,367 TJ in 2020 to 466,739 TJ in 2021, reflecting a 16% rise in overall transport activity. Road transportation is the largest contributor, accounting for over 98% of total consumption in both years. It saw a notable increase from 397,157 TJ in 2020 to 464,980 TJ in 2021, likely due to a rebound in road travel. Domestic aviation more than doubled its energy consumption, rising from 497 TJ in 2020 to 945 TJ in 2021, which may indicate a recovery in domestic flights following pandemic-related restrictions. On the contrary, railways experienced a sharp decline in energy use, dropping from 5,117 TJ in 2020 to just 199 TJ in 2021, suggesting a significant reduction in rail activity. Domestic water-borne navigation remained relatively stable, with a slight increase from 595 TJ to 615 TJ.

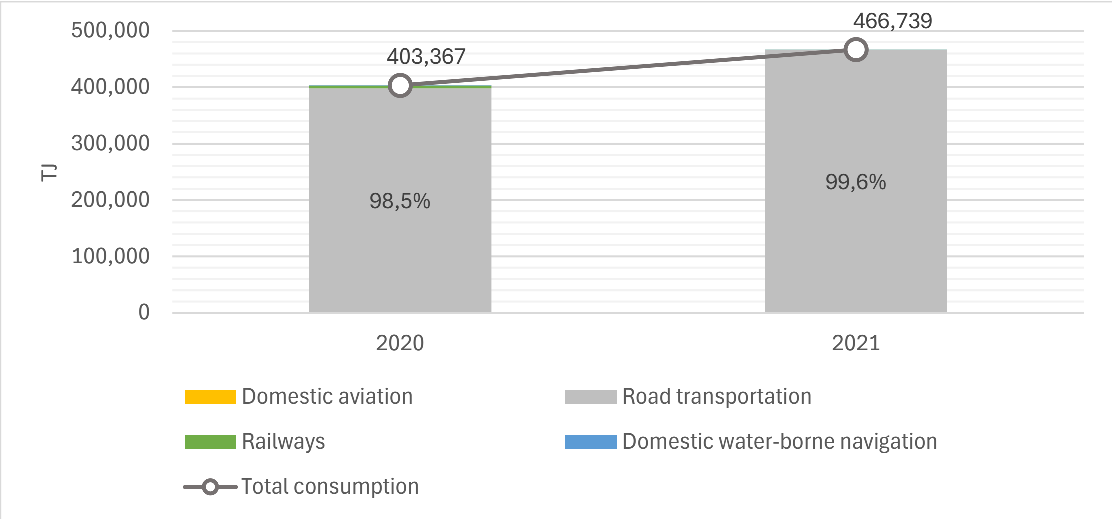


Figure 2-12: Fuel consumption of the Transport sector (in TJ)

2.3.2.6.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the Energy sector is presented in previous section

2.3.2.6.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.3.2.6.5 Category-specific planned improvements

To enhance estimates for the transport sector, it is essential to:

- Develop a system that collects fuel consumption data for the entire transport sector, including both private and state-owned vehicles.
- Differentiate fuel consumption by vehicle type.

2.3.2.7 Other sectors (CRT 1A4)

2.3.2.7.1 Category description (e.g. characteristics of sources)

This category generally covers the emission from combustion of fuel for other activities, including:

- Commercial and institutional activities (CRT 1A4a),
- Residential (CRT 1A4b),
- Agriculture, forestry and fishing (CRT 1A4c).

However, all emissions are reported under the residential sector, as data regarding fuel consumption for commercial and institutional activities, as well as agriculture, are not reported separately. Furthermore, the UN Energy Balance data suggests that the primary energy source for these sectors is electricity.

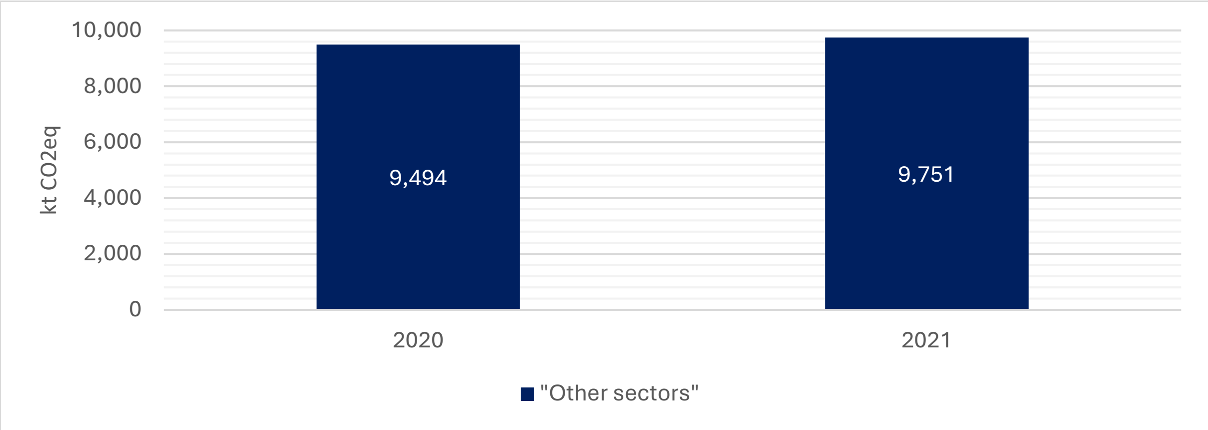


Figure 2-13:Other sectors emissions in kt CO2eq

In 2020 and 2021, the "other sectors" contribute to 4.8% of the total national GHG emissions without considering LULUCF, and to 6.3% of the Energy category (CRT 1) in Iraq (Figure 2-13).

2.3.2.7.2 Methodological issues

The Tier 1 method, along with default emission factors for CO_2, CH_4, and N_2O from the 2006 IPCC Guidelines, is applied to calculate GHG emissions.

The activity data used consist of fuel consumption as indicated in the UN Energy Balance under the category "Other - Households". The residential sector consumes LPG and other kerosene (around 55% / 45% respectively) (Figure 2-14)

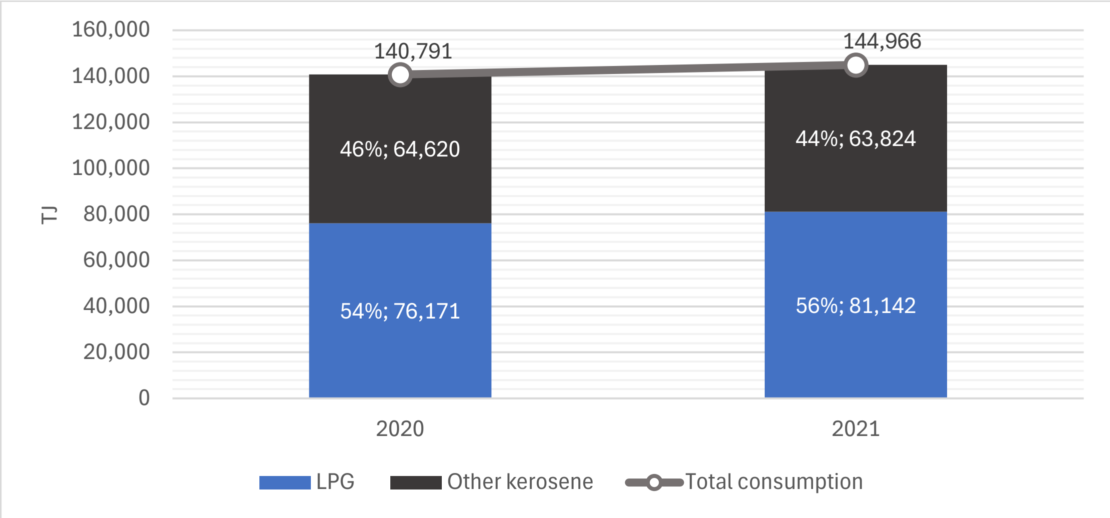


Figure 2-14: Fuel consumption of the Residential sector (in TJ)

2.3.2.7.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the Energy sector is presented earlier.

2.3.2.7.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle

2.3.2.7.5 Category-specific planned improvement

Future improvements for the next BTRs will involve investigating fuel consumption in the commercial/institutional and agriculture sectors. However, since these categories are not currently key categories, they might be addressed at a later stage.

2.3.3 Fugitive emissions from solid fuels and oil and natural gas and other emissions from energy production (CRT 1.B)

2.3.3.1 Category description

The intentional or unintentional release of greenhouse gases can occur during the extraction, processing, and delivery of fossil fuels to their point of final use. These releases are known as fugitive emissions. In Iraq, fugitive emissions are associated with:

- Solid fuel transformation (CRT 1B1), particularly in charcoal production
- Oil systems (CRT 1B2a): including oil production, upgrading, transport, venting, and flaring
- Natural gas systems (CRT 1B2b): encompassing natural gas production, processing, transmission, storage, distribution, as well as venting and flaring

Figure 2-15 present the evolution of the main activities of the different subsectors of the fugitive emissions between 2020 and 2021:

- Solid fuels (CRT 1B1): Charcoal production increased by 7% between 2020 and 2021.
- Liquid fuels (CRT 1B2a): The production and transport of crude oil remained relatively stable, showing a slight decrease of 1%.
- Gaseous fuels (CRT 1B2b): Natural gas production surged, with a 30% increase from one year to the next.

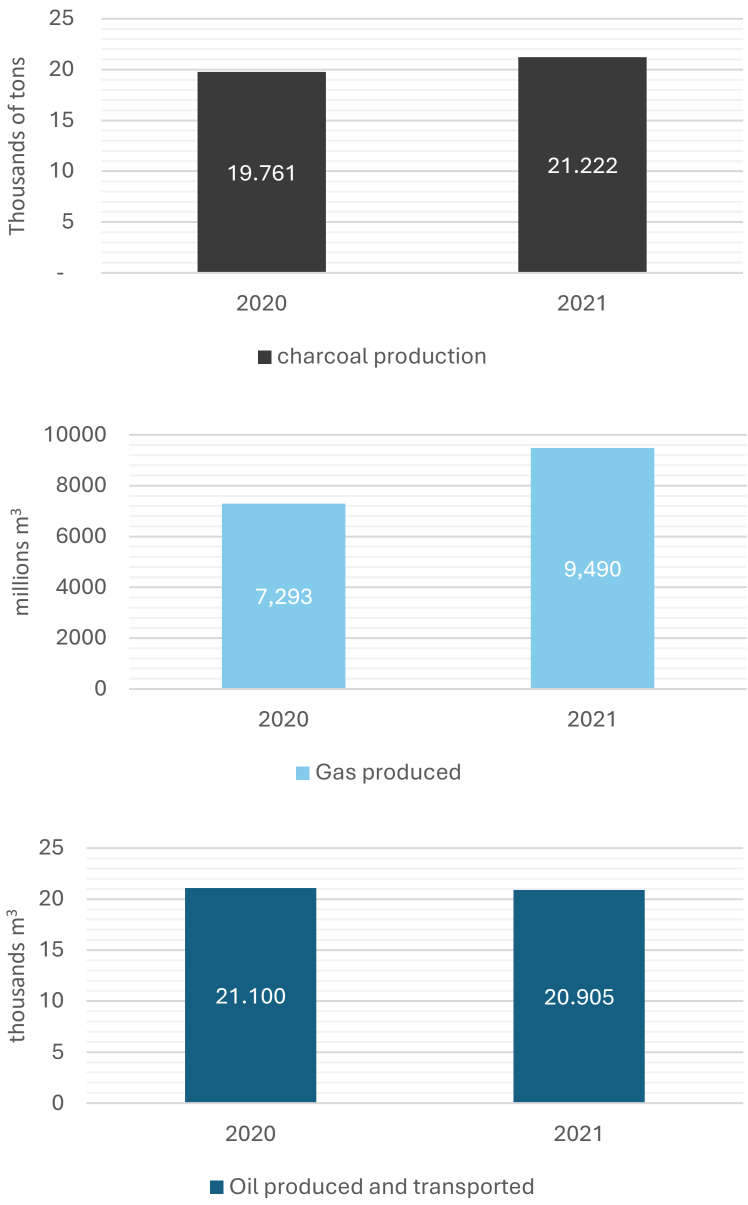


Figure 2-15: Activity level of charcoal (in thousands of tons), oil (in thousands of m^3), and natural gas production (in millions m^3) (from top to bottom)

In 2020 and 2021, fugitive emissions contributed around 12% of the total national GHG emissions without LULUCF, and it contributed around 16% of the Energy category (CRT 1) in Iraq.

Emissions are primarily due to oil production, which accounts for approximately 93% of total fugitive emissions, followed by natural gas production at around 6–7%, with the remainder coming from charcoal production (Figure 2-16).

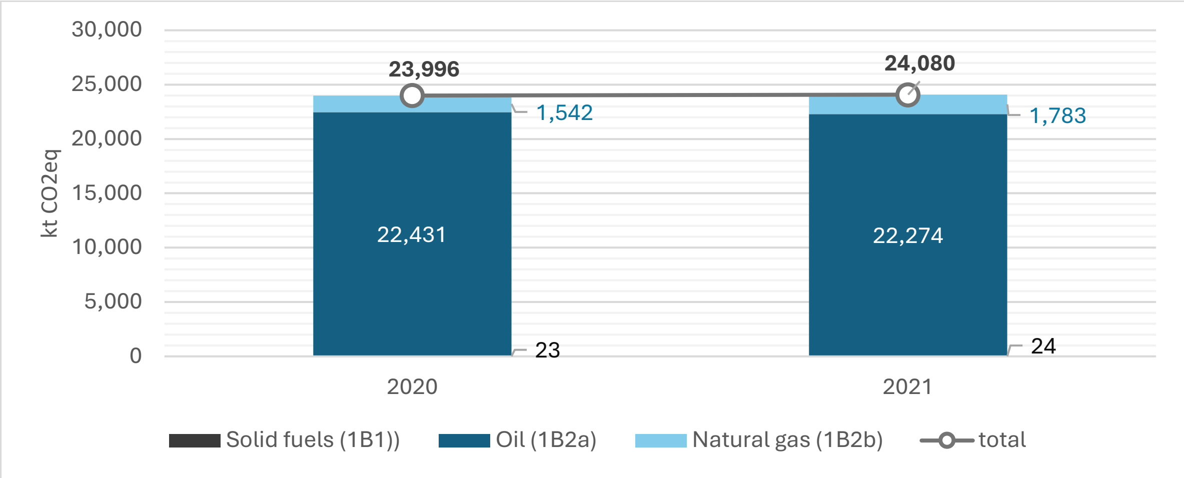


Figure 2-16: Emissions of fugitive emissions according to the source (in kt CO_2eq)

2.3.3.2 Methodological issues

Emissions were estimated using the Tier 1 method outlined in the 2006 IPCC Guidelines, with default emission factors selected based on values for developed countries. This choice was made for two reasons:

1) A national workshop was organized to strengthen the capacity of national ministries and entities, present the available data collected, and discuss specific parameters for the Iraqi inventory across various sectors. On this occasion, national experts indicated that all oil and gas companies operating domestically are foreign-owned and utilize the technologies of developed countries.
2) A comparison of emission factors in the 2006 Guidelines with those in the 2019 refinement revealed that the "high-emitting technology" default values in the 2019 refinement are comparable to the developed country values in the 2006 Guidelines. In contrast, the default values for developing countries in the 2006 Guidelines—significantly higher by a factor 1,000—are no longer recommended in the 2019 refinement, suggesting they may be outdated. Consequently, these values were not used in the present inventory.

The main assumptions influencing the choice of default values and the use of available activity data were as follows:

- Oil production is considered onshore
- Oil transport is conducted only by pipeline
- Oil density = 0.898 – representing the average of density of extra heavy and medium crude oil, which corresponds to the characteristics of Iraqi crude oil.[31]
- Natural gas density = 0.0008

Activity data used depends on the sub-category and stage of production and are summarized in Table 2-13.

31 Microsoft Word - The second split - Basrah Medium and the challenge of Iraqi crude quality_AM FINAL.docx

Table 2-13: Summary of activity data used

CRF code	Activity data considered	Source
1.B.1.c. Fuel transformation		
1.B.1.c.i – Charcol production	Charcoal produced (in kg)	UN Energy balance
1.B.2.a. Oil		
1.B.2.a.i – Venting	Total amount of oil produced and transported (10^3 m^3)	UN Energy balance
1.B.2.a.ii – Flaring	Total amount of oil produced and transported (10^3 m^3)	UN Energy balance
1.B.2.a.iii.1 – Exploration	NE (data on number of wells not available)	-
1.B.2.a.iii.2 – Production and upgrading of oil	Production of Crude Oil	UN Energy balance
1.B.2.a.iii.3 – Transport of oil (pipeline)	Crude oil transported (= produced + imported crude oil)	UN Energy balance
1.B.2.a.iii.4 – Refining	Refined oil (= produced + imported – exported crude oil)	UN Energy balance
1.B.2.a.3 – Distribution of products	NA (no default values are indicated for CO2, CH4 and N20 emissions – default emission factor is only indicated for NMVOC emissions of distributed gasoline)	-
1.B.2.b. Natural gas		
1.B.2.b.i – Venting	> Produced natural gas (10^6 m^3): to estimate emissions from venting at the stage of gas processing > Marketable gas (10^6 m^3): to estimate emissions from venting at the stage of gas transmission and storage	UN Energy balance
1.B.2.b.ii – Flaring	Total amount of natural gas produced (10^6 m^3)	UN Energy balance
1.B.2.b.iii.1 – Exploration	NE (data on number of wells not available)	-
1.B.2.b.iii.2 – Production	Production of Natural gas (10^6 m^3)	UN Energy balance
1.B.2.b.iii.3 – Processing	Production of Natural gas (10^6 m^3)	UN Energy balance
1.B.2.b.iii.4 – Transmission and storage	Marketable gas (= produced + imported natural gas) (10^6 m^3)	UN Energy balance
1.B.2.b.iii.5 – Distribution	Utility sales (= produced + imported – exported natural gas) (10^6 m^3)	UN Energy balance

2.3.3.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the Energy sector is presented earlier.

2.3.3.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.3.3.5 Category-specific planned improvements

Future improvements will require to include:

- Collecting precise activity data, including information on the density of produced crude oil and natural gas and developing country specific default emission factors in order to have results which are more reflective of the national/regional makeup.
- Estimating emissions based on the 2019 IPCC Refinement

2.4 Industrial processes and product use (CRT sector 2)

2.4.1 Overview of the sector (e.g. quantitative overview and description, including trends and methodological tiers by category) and background information

This CRT 2 category covers all the industrial activities where the industrial process can imply GHG emissions which do not result from the combustion of fuels, as well as the use of industrial products such as lubricants, fluorinated gases and others. In overall, the following sectors were estimated:

- Mineral industry (2A), including cement and lime productions,
- Chemical industry (2B), with ammonia productions,
- Metal industry (2C), including steel production.

Other industries are occurring in the country; however, accessing data is challenging due to the lack of a centralized information system. Consequently, emissions were not estimated:

- In the Mineral industry (2A), related to the production of bricks and glass production,
- In the Chemical industry (2B), related to petrochemical production,
- In the Metal industry (2C), related to lead production,
- Non energy products from fuels and solvent use (2D),
- Product uses as substitutes for ODS (2F).

Tier 1 methodologies were applied to all categories in the IPPU sector, even for key categories. This decision was driven by the limited availability of data and the short timeframe, which made it difficult to collect sufficient data for reporting at a higher tier level.

Figure 2-17 presents the GHG emission evolution for the industrial processes and product uses in Iraq, for the years 2020 and 2021, per subcategory. Emissions are dominated by steel production (which represent 64.2% of the sectorial emissions in 2020 and 59.5% in 2021), followed by cement production (27% and 32.5% in 2020 and 2021 respectively). The remaining is constituted by emissions from lime production (around 5.5%) and ammonia production (at 2.8-3.6%).

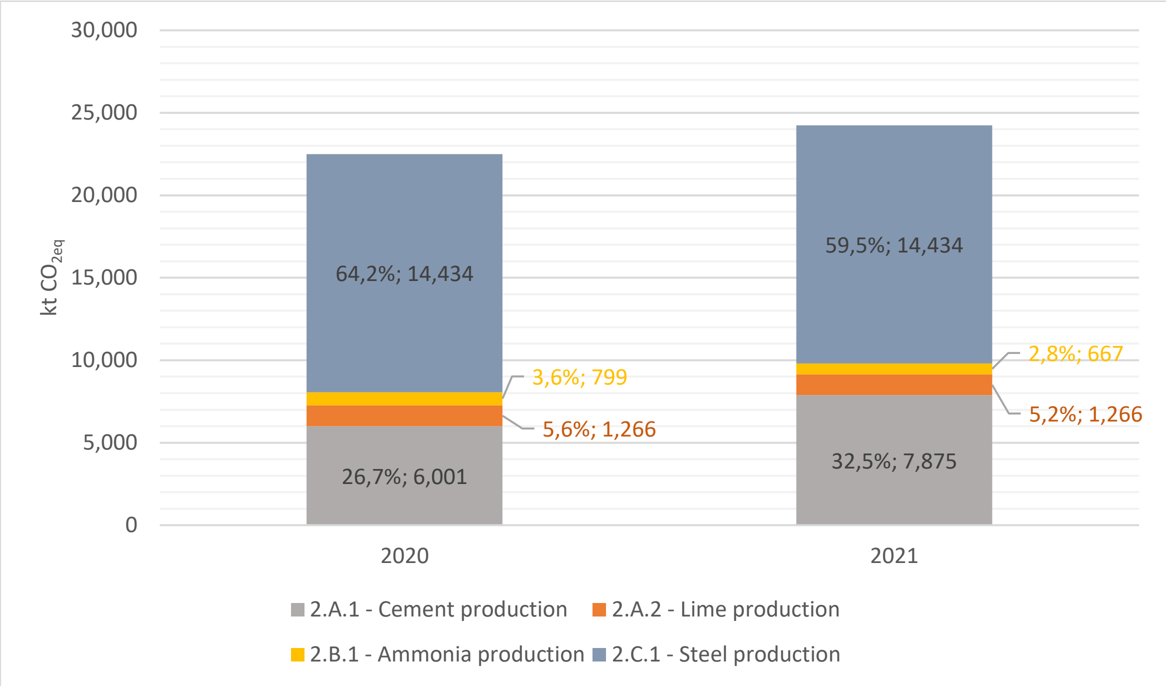


Figure 2-17: Emissions of the IPPU sector per sub-category (in ktCO_2eq)

Excluding the LULUCF contribution, the CRT 2 sector contributed to the national total emissions by 11% in terms of GHG emissions in 2020 and 2021.

2.4.2 Mineral industry (CRT 2A)

2.4.2.1 Category description

GHG emissions from the mineral industries (only CO_2) are dominated by the cement industry, which contributes to around 82-86% of the sector's total in 2020 and 2021 (Figure 2-18). The remaining emissions come from the lime industry, as emissions from brick production could not be estimated due to a lack of data.

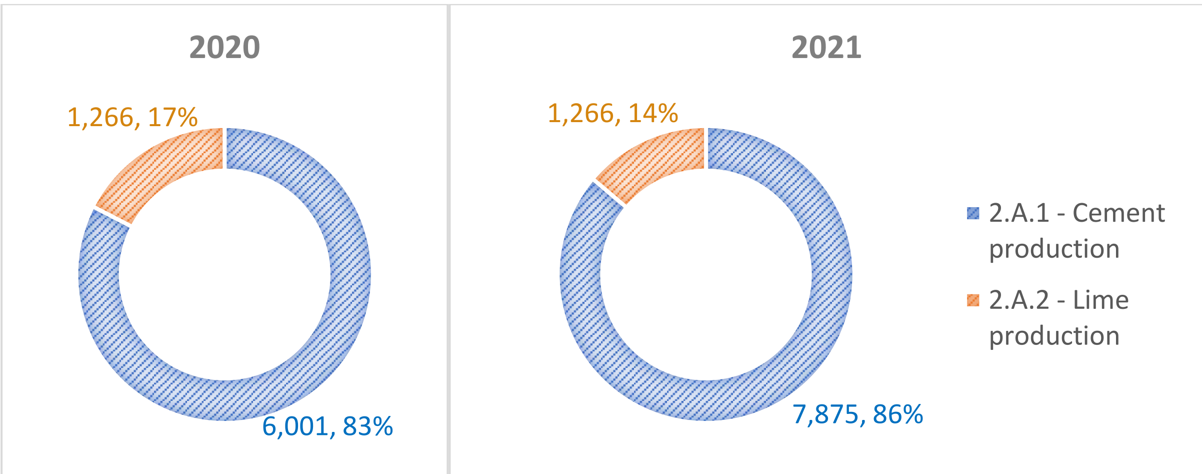


Figure 2-18: Mineral industry emissions in 2020 and 2021 (in tCO_2eq and %)

Mineral industry represented 3.0% of national GHG emissions in 2020 and 3.9% in 2021, excluding LULUCF.

2.4.2.2 Methodological issues

The Tier 1 methodology of the 2006 IPCC guidelines was used in order to estimate emissions from cement and lime production.

Cement production:
The following activity data was available:

- Data was available for factories under the Iraqi General Cement Company, a government entity. Although there are also private-sector companies producing cement, no official data exists on their fuel consumption or clinker and cement production. However, the combined maximum production capacity of both public and private sectors is estimated to approach 32 million tons of cement annually, including imported clinker. Government production by the Iraqi General Cement Company across all its factories accounts for approximately 36–40% of national output, including the Kurdistan region.
- Data related to factories located in the Kurdistan Region. This data was not used in determining the national cement production

The share of cement produced from imported clinker is not considered in Table 2-14. To adopt a conservative approach, national production was estimated based on the assumption that Iraqi General Cement production accounted for 36% of the total.

Table 2-14: Cement production in Iraq for 2020 and 2021 (in tons)

Cement production (in tons)	2020	2021
Iraqi General Cement Company production	5 537 269	7 266 812
National production, including the Kurdistan Region	15 381 302	20 185 588

In absence of country-specific data, the following parameters were used to estimate the emissions:

- Type of cement: unspecified
- Clinker fraction in cement (fraction): 0.75, as per the 2006 IPCC guidelines.
- 2006 IPCC Guidelines CO_2 default emission factor for clinker: 0.52 t CO_2/t clinker

Lime production:
For lime production, actual production data is unavailable. The figures used are based on the design capacities reported by 185 private-sector lime factories, totaling 1.7 Mt (millions tons) of lime produced a year, as reported by the Ministry of Industry. Since these factories typically operate below design capacity, actual production is likely lower than the estimates used. However, in the absence of more accurate data, these figures were applied as a conservative estimate.

The emission factor used is the CO_2 default emission factor indicated in the 2006 IPCC Guidelines: 0.75 t CO_2/t lime produced (corresponding to “all lime production”).

2.4.2.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the IPPU sector is presented within section 1 of this chapter.

2.4.2.4 Category-specific recalculations

The present report is Iraq’s first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.4.2.5 Category-specific planned improvements

Efforts are needed to:

- Develop a system to capture data on the production of private industries, not just state-owned ones.
- Regarding the cement production:
  - Collect information on the clinker production, and not just the cement production.
  - Collect data regarding the composition of the cement to precise the emissions factor to be used.
- Regarding lime production:
  - Collect information on actual production.
  - Refine the estimation by differentiating the type of lime produced.

2.4.3 Chemical industry (CRT 2B)

2.4.3.1 Category description

In 2021, the chemical industry accounted for 3% of GHG emissions from Industrial Processes and Product Use and 0.3% of national GHG emissions, excluding LULUCF. In Iraq, the only estimated chemical activity is ammonia production, which is entirely used to produce urea for fertilizer.

Ammonia is produced through catalytic steam reforming of natural gas, where hydrogen is separated from natural gas and combined with nitrogen to produce ammonia (NH_3). CO_2 emissions are generated during this process and are either vented to the atmosphere or used as feedstock for downstream applications, such as urea production. The CO_2 emissions used for urea production are not included in this category but are allocated to the category in which the urea is ultimately consumed (Agriculture sector, CRT 3H).

In Iraq, the only available ammonia production data is from the General Company for Southern Fertilizers, a state-owned company, and was provided by the Ministry of Industry. Since production data from private companies is unavailable, total production is likely underestimated (Table 2-15)

Table 2-15: Ammonia production data in 2020 and 2021 (in tons)

Ammonia production (in tons)	2020	2021
General Company for Southern Fertilizers	166 500	143 311

2.4.3.2 Methodological issues

Tier 2 methodology was used, with CO_2 emission estimates calculated using Equation 3.2 from the ammonia production section of the 2006 IPCC Guidelines.

EQUATION 3.3
CO_2 EMISSIONS FROM AMMONIA PRODUCTION – TIER 2 AND 3

$$E_{CO2} = \sum_i \left(TFR_i \bullet CCF_i \bullet COF_i \bullet 44/12 \right) - R_{CO2}$$

With:

TFR, Total fuel requirement –

The "total requirement fuel" (natural gas) was obtained from the state-owned company General Company for Southern Fertilizers (Table 2-16)

Table 2-16: Total fuel requirement (in GJ) for ammonia production in 2020 and 2021

Total fuel requirement (in GJ)	2020	2021
General Company for Southern Fertilizers	17 867 372	15 014 932

- CCF, carbon content factor of the fuel – for natural gas, the value of 15.3 kg C/GJ was used (IPCC default value)
- COF, carbon oxidation factor of the fuel – the value of 1 was used (IPCC default value)
- RCO_2, CO_2 recovered for downstream use – the amount of CO_2 emissions recovered for urea production, which is not included in the 2B1 category, is estimated using urea production data from the General Company for Southern Fertilizers and a conversion factor between the molar masses of urea and CO_2 (44/60). It is assumed that all urea production in Iraq is derived from CO_2 recovery during ammonia production(Table 2-17).

Table 2-17: Amount of urea produced (in t) in 2020 and 2021

Amount of urea produced (in t)	2020	2021
General Company for Southern Fertilizers	277 500	238 852

When comparing the fuel requirement per ton of ammonia produced, it was found to be significantly higher than international standard values: approximately 100 GJ/t of ammonia, whereas the standard is around 30 to 40 GJ/t NH_3 (Table 3.1 of the 2006 IPCC Guidelines). This discrepancy may indicate a mistake that requires further investigation. However, national data are used in calculations.

Natural gas is used as a raw material/feedstock (non-energy use), and its consumption is deducted from the energy balance (1A2-Energy) to avoid double-counting.

2.4.3.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the IPPU sector was presented earlier.

2.4.3.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.4.3.5 Category-specific planned improvements

Efforts will require to:

- Develop a system to capture data on the production of private industries, not just state-owned ones, ensuring that estimates are comprehensive and not underestimated.
- Investigate data related to the total fuel used for ammonia production

2.4.4 Metal industry (CRT 2C)

2.4.4.1 Category description

In 2020 and 2021, the metal industry – which includes only steel production – accounted for around 64% of GHG emissions from the Industrial Processes and Product Use sector and around 7% of national GHG emissions, excluding LULUCF.

There was no production by the General Iron and Steel Company (the state-owned company) during the last period, as it was halted for rehabilitation and investment work. However, there was steel production in the Kurdistan region.

2.4.4.2 Methodological issues

The Tier 1 method from the 2006 IPCC Guidelines is used to calculate CO_2 and CH_4 emissions (Equations 4.4).

EQUATION 4.4
CO_2 EMISSIONS FROM IRON AND STEEL PRODUCTION (TIER 1)

$$\text{Iron \& Steel: } E_{CO2,\,non-energy} = BOF \bullet EF_{BOF} + EAF \bullet EF_{EAF} + OHF \bullet EF_{OHF}$$

With:

- BOF= quantity of BOF crude steel produced, tonnes
- EAF = quantity of EAF crude steel produced, tonnes
- OHF = quantity of OHF crude steel produced, tonnes

The BOF, EAF, and OHF quantities were estimated based on:
In absence of production-specific data, the type of steelmaking method assumed was the global average factor (65% BOF, 30% EAF and 5% OHF).

Actual production data was unavailable. Consequently, the figures used are based on the maximum capacities reported by the different factories (15 in total- Table 2-18), totaling 13.6 Mt (millions of tons) of steel produced a year. Actual production is likely lower than the estimates used. However, in the absence of more accurate data, these figures were applied as a conservative estimate.

Default CO_2 emission factors from the 2006 IPCC Guidelines are used for steel production (1.06 t CO2/t steel produced, corresponding to the global average factor steelmaking method).

Table 2-18 Steel factories and associated production capacity (in t) in the Kurdistan Region

Product capacity	Unit	Type of project product	Name of the factory	N.	Governorates
3,000 6,000	Ton	Erbil Steel Factory for smelting iron and producing various types of steel	Erbil Steel Company	1	Erbil
900,000	Ton	India company for iron smelting and Oxygen, Nitrogen and Argon Non-Medical production/ Limited	Poltix Iron Production Factory	2	
84,000	Ton	Steel manufacturing	DAREN STEEL	3	
55,000	Ton	Steel manufacturing	GK	4	
7,500	Ton	Steel manufacturing	World bridg	5	
1,055,500	Ton	Total Erbil			
10,000	Ton	Manufacturing of steel and building materials (cold)	zhilamo Factory	1	Sulaymaniyah
15,000	Ton	Iron manufacturing (Steel and BRC)	Karman Company	2	
50,000	Ton	Smelting and preparing iron used for making steel	Steel City	3	
12,500,000	Ton	Iron and steel	Mass steel	4	
85,000	Ton	Smelting and preparation of iron used for making industrial steel	Pordill	5	
-	Ton	Smelting and production of iron	Kurdistan	6	
224,400	Ton	Iron smelting factory for making industrial Steel	Sulaimani Steel Company for Steel Production	7	
24,000	Ton	Super Steel Factory for melting iron and making steel	Super steel company	8	

48,000					
12,441,400	Ton	Total Sulaymaniyah			
56,100	Ton	Iron manufacturing	Ezaddin Mohiuddin Yasin and Mohammed Tahir Sheikh Mohammed	1	Duhok
64,200	Ton	OTC Kuwait Company (Mohammed Taib Ahmed)	duhok steel factory for iron production	2	
120,300	Ton	Total Duhok			
13,617,200	Ton	Total Kurdistan Region			

2.4.4.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the IPPU sector was presented earlier.

2.4.4.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.4.4.5 Category-specific planned improvements

Efforts are required to gather information on actual production.

2.5 Agriculture (CRT sector 3)

2.5.1 Overview of the sector and background information

The Agriculture sector gathers all emissions related to agricultural activities other than the fuel combustion for the mobile engines, the heating of the buildings, the heating of greenhouses, etc., which are included in the CRT category 1A4c. In addition, the CO_2 emissions related to the carbon from soils and biomass related with agricultural activities are included in the LULUCF sector (CRT 4). This CRT3 category covers the following sectors:

3.A. Enteric fermentation
3.B. Manure management
3.C. Rice cultivation
3.D. Agricultural soils
3.E. Prescribed burning of savannahs
3.F. Field burning of agricultural residues
3.G. Liming
3.H. Urea application
3.I. Other carbon-containing fertilizers
3.J. Other

The activities of Prescribed burning of savannas (3E) do not occur in Iraq. The emissions of liming (3G) and the other carbon-containing fertilizers (3I) are not estimated (NE), due to a lack of available activity data.

Tier 1 methodologies were applied to all categories in the Agriculture sector, even for key categories. This decision was driven by the limited availability of data and the short timeframe, which made it difficult to collect sufficient data for reporting at a higher tier level.

In 2021, without considering the LULUCF contribution, the CRT 3 category contributed to the national total GHG emissions by 6%.

The agriculture sector is an important emissions source of methane and nitrous oxide, however it is almost negligible in terms of carbon dioxide, with only the application of urea (CRT 3G) being an emission source of this GHG.

Figure 2-19 presents the overall GHG emission trend for the agriculture in Iraq, for the years 2020 and 2021, detailed by subsector. Emissions are dominated by the enteric fermentation and N2O from agricultural soils.

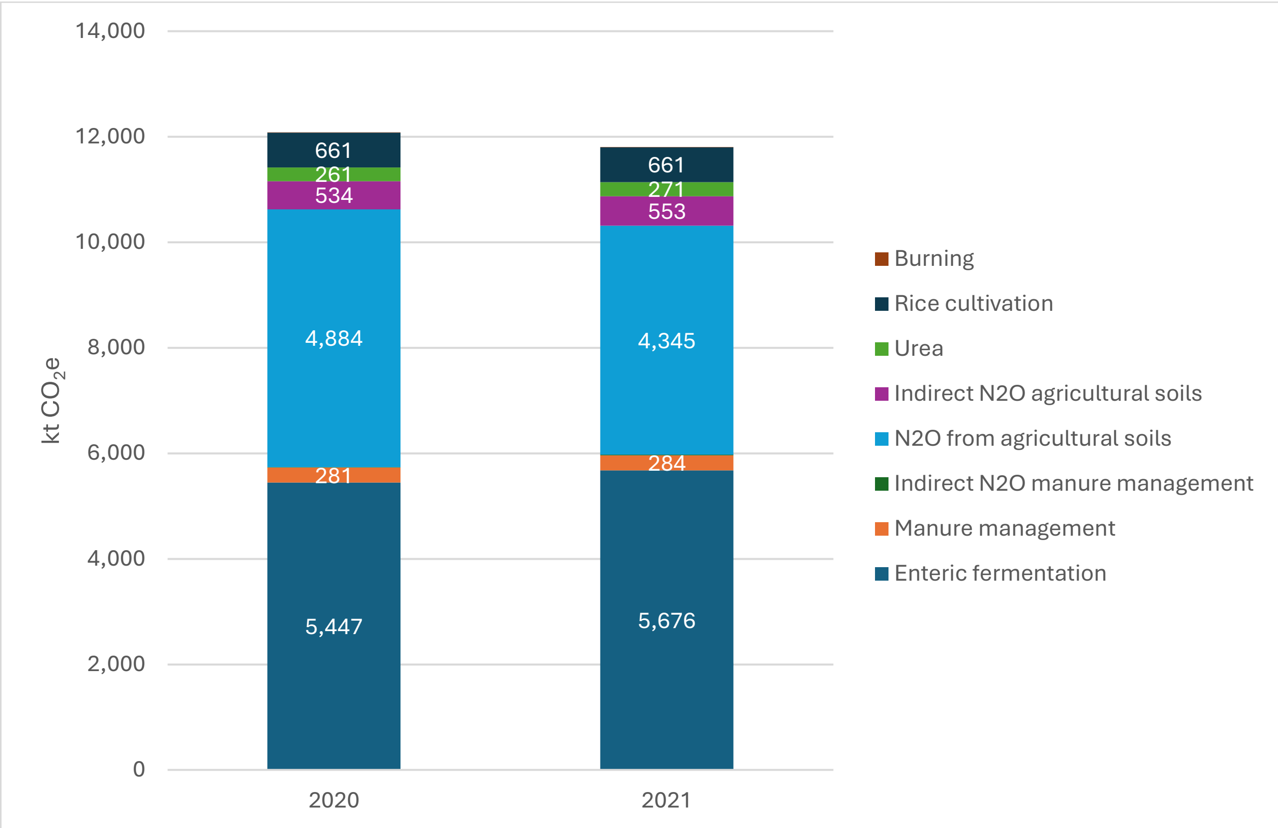


Figure 2-19: Emissions of the Agriculture sector (in ktCO_2eq)

2.5.2 Enteric fermentation (CRT 3A)

2.5.2.1 Category description

The enteric fermentation category covers the emissions of methane (CH_4) from the different animal species – cattle, sheep, buffalo, goats and camels. There is no enteric fermentation accounted for in the IPCC Guidelines for poultry.

Among the enteric fermentation, the sheep category is the main source of emissions, which has an increasing contribution from 34% of the sector emissions in 2020 to 37% in 2021. The next most predominant subsector is cattle livestock, which represented 24% of the sector's emissions in 2020 and with a slight decrease to 22% in 2021. The cattle category is constituted only by the "other cattle" category (i.e. non-dairy cows). Finally, the other contributing subsectors are the buffalo and other livestock (including camels and goats), which have rather stable contributions between the two years, about 10% and 8%, respectively (Figure 2-20).

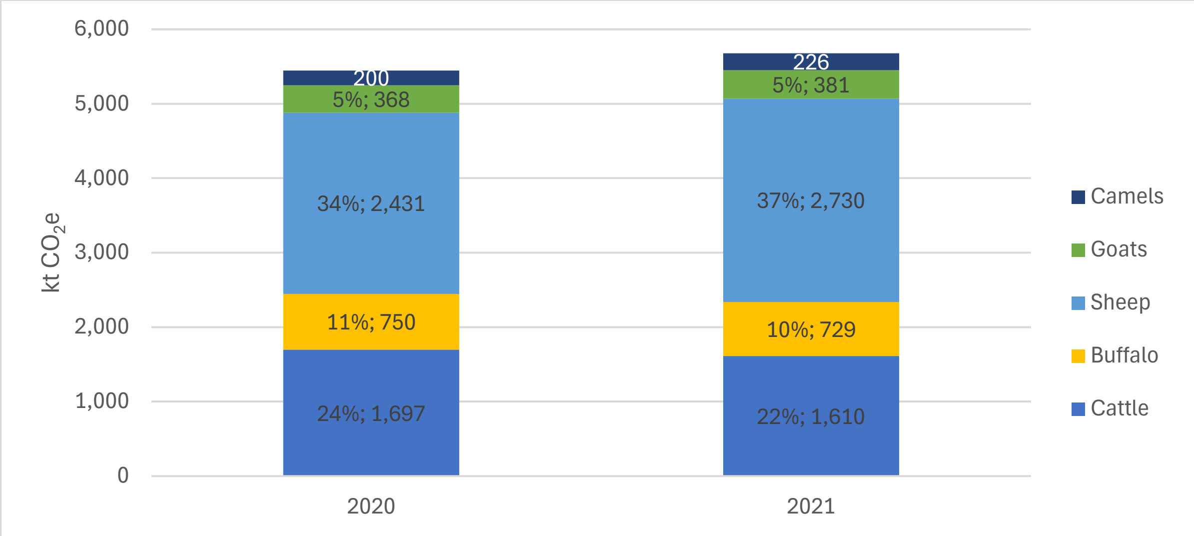


Figure 2-20 : CO_2e emissions from enteric fermentation (in $ktCO_2eq$)

Enteric fermentation (CRT 3A) has increased its contribution to the total and sectoral GHG emissions. This category contributes around 2.8% of the total national GHG emissions excluding LULUCF, in 2020 and 2021. Concerning its part in the agriculture sector (CRT 3), in Iraq, it is of 48% in 2021, and it was of 45% in 2020.

2.5.2.2 Methodological issues

Emissions of CH_4 from enteric fermentation are calculated with a Tier 1 approach which is in line with the 2006 IPCC Guidelines.

Activity data used are the annual livestock (average population in heads), for each subcategory. These activity data for the entire time series are provided by the Ministry of Agriculture (Figure 2-21)

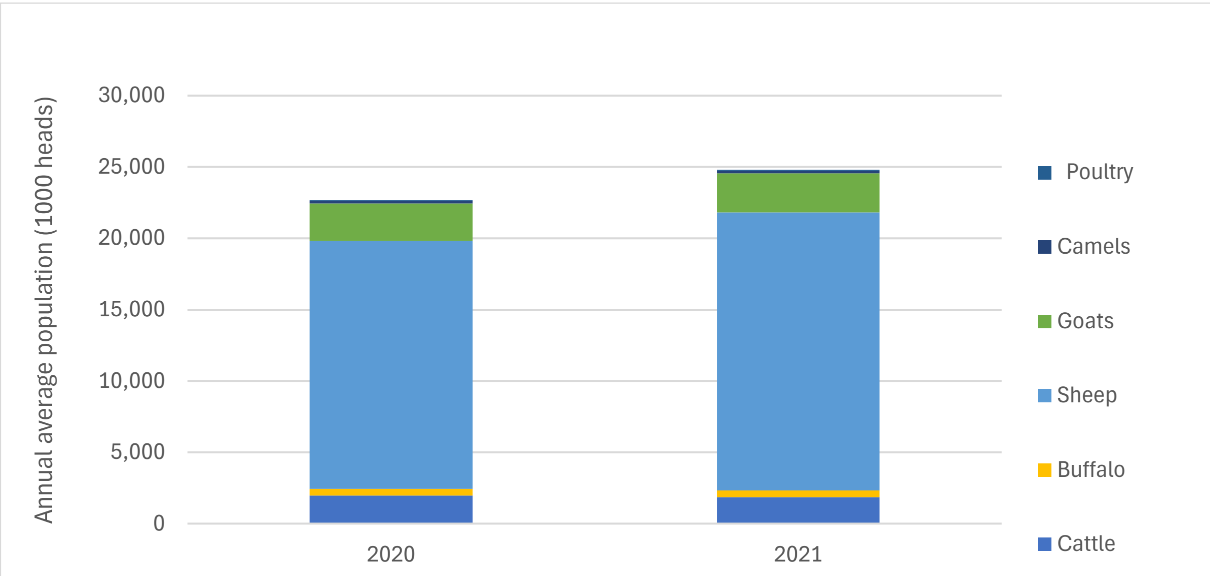


Figure 2-21 : Annual average population (1000 heads)

Emission factors used for calculating CH_4 emissions from enteric fermentation are taken from 2006 IPCC guidelines. They are of:

- 31 kg CH4/head/year for other cattle
- 55 kg CH4/head/year for buffalo
- 5 kg CH4/head/year for sheep and goats
- 46 kg CH4/head/year for camels.

2.5.2.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the agriculture sector was presented earlier.

2.5.2.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.5.2.5 Category-specific planned improvements

To improve the estimates from enteric fermentation, efforts could be made starting with the most emitting category in the current estimates (sheep). The improvement suggested consists in moving to an upper Tier method, which would be a Tier 2 method for sheep. The implementation of a Tier 2 method requires the collection of numerous data complementary to those necessary for the Tier 1 method (weight, feeding situation, milk production, wool growth, …).

2.5.3 Manure management (CRT 3B)

2.5.3.1 Category description

The manure management category covers the emissions of CH_4 (CRT 3B1) and N_2O (CRT 3B2) from the different livestock – cattle, sheep, buffalo, goats, camels and poultry. Cattle are considered as non-dairy cattle. For poultry, the only category considered is broilers.

Figure 2-22 describes the evolution of the emissions of GHG in equivalent CO_2, with details given by animal categories for all the emissions, except for indirect N_2O emissions that are reported with all the animal categories aggregated.

Buffalo were the largest contributors in both years, responsible for 35% in 2020 and decreasing slightly to 34% in 2021. Cattle emissions showed a slight decrease, contributing to 31% in 2020 and 29% in 2021. Sheep emissions increased over the period, accounting for 26% in 2020 and rising to 29% in 2021. Other categories (including goats and camels) remained relatively steady over the two years. Poultry emissions were the smallest among the categories: around 0.02%.

Manure management (CRT 3B) represents only 2.5% of the agriculture sector and remained steady between 2020 and 2021.

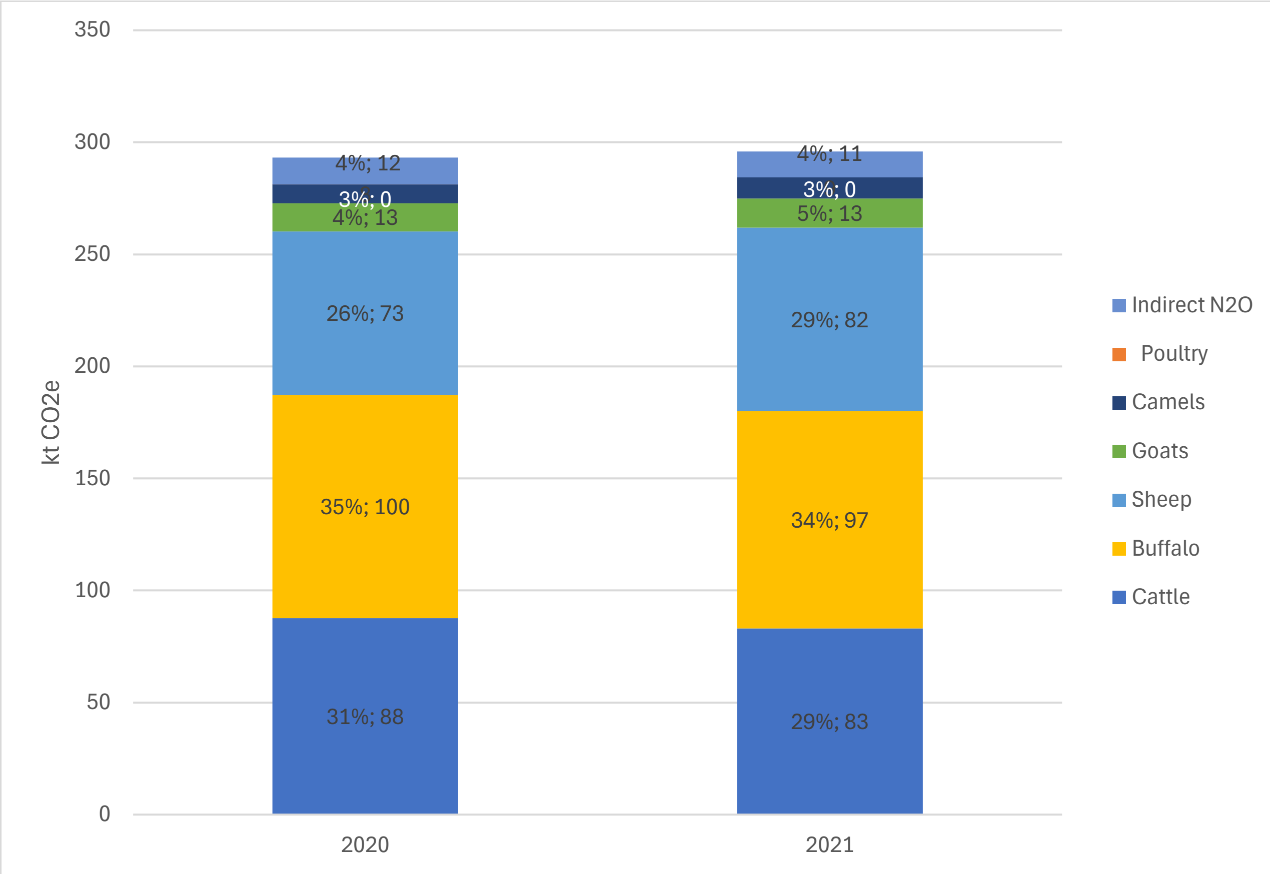


Figure 2-22: CO_2e emissions from manure management (in $ktCO_2eq$)

2.5.3.2 Methodological issues

CH_4 emissions:

Emissions of CH_4 from manure management are calculated with a Tier 1 approach which is in line with the 2006 IPCC Guidelines.

Activity data used are the annual livestock (average population in heads), for each subcategory. These activity data for the two years are provided by the Ministry of Agriculture, and are presented in the previous section (enteric fermentation).

The emission factors used are provided by the 2006 IPCC Guidelines. Depending on the category, the values retained are the ones for Middle East (temperate climate) or developing countries (temperate climate) (Table 2-19).

Table 2-19: Emission Factor (CH4/head)

Category	Emission factor (CH_4/head)	Regional characteristics
Other cattle	1	Middle East
Buffalo	5	Middle East
Sheep	0.15	Developing countries
Goats	0.17	Developing countries
Camels	1.92	Developing countries
Poultry	0.02	Developing countries

N_2O emissions:
Direct nitrous oxide emissions from manure management are subdivided by type of livestock (cattle, buffalo, sheep, and other livestock). There is an additional CRT category (3B2.5) in which indirect N_2O emissions from volatilization and leaching are reported, aggregating all the animal categories. In a Tier 1 methodology, as used in the Iraqi inventory for this category, indirect N_2O emissions from leaching and runoff from manure management are not estimated, in accordance with IPCC guidelines. Only indirect N_2O emissions from volatilization are accounted for.

To calculate N_2O emissions, the first step is to estimate the N excreted per animal category. To do so, the calculation suggested in the 2006 IPCC Guidelines is applied, based on a default N rate (provided in the 2006 IPCC Guidelines – values taken from Middle East) and the average weigh per animal.
The following weights have been considered:

- 350 kg/head for other cattle
- 350 kg/head for buffalo
- 39 kg/head for sheep
- 22.69 kg/head for goats
- 570 kg/head for camels
- 0.9 kg/head for poultry.

Direct N_2O emissions from manure management are estimated using a Tier 1 methodology, where the emission factors (EF) applied for each livestock category remain constant throughout the time series. Consequently, emissions for the different animal categories are directly proportional to livestock numbers and vary according to their trends.

N_2O emission factors from the 2006 IPCC Guidelines are provided by manure management system. The following hypothesis have been mode for Iraq, based on the default values from the IPCC Guidelines. Some adjustments have been suggested and indicated in Table 2-20.

Table 2-20 : Animal distribution per manure management system

Livestock	Dry lot	Pasture range	Daily spread	Poultry manure with litter	Comments
Other cattle	2.0%	96.0%	2.0%		“Other” attributed to dry lot “Burned for fuel” attributed to pasture
Buffalos	19.0%	62.0%	19.0%		“Other” attributed to dry lot “Burned for fuel” attributed to pasture
Sheep		100%			hypothesis 100% pasture
Goats		100%			hypothesis 100% pasture
Broilers				100%	hypothesis 100% poultry with litter
Camels		100%			hypothesis 100% pasture

The direct N_2O emissions factors provided by the 2006 IPCC are as follow:

- Dry lot: 0.02 kg N_2O/kg N
- Pasture range: accounted for in 3D
- Daily spread: 0 kg N_2O/kg N
- Poultry manure with litter: 0.001 kg N_2O/kg N.

Indirect N_2O emissions from manure management are estimated using a Tier 1 methodology. Values for the parameter Fracgas are taken from the 2006 IPCC Guidelines and are as follow:

- Dry lot: 30%
- Pasture range: accounted for in 3D
- Daily spread: 7%
- Poultry manure with litter: 40%

The emission factor used is taken from the 2006 IPCC Guidelines (EF4 = 0.01 kg N-N_2O/kg N volatilized).

2.5.3.3 Uncertainty assessment and time-series consistency

A general discussion on uncertainty in the agriculture sector were presented earlier.

2.5.3.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.5.3.5 Category-specific planned improvements

To improve the estimates from manure management, efforts could be made starting with the animal distribution per manure management system. The improvement would consist in collecting national data to be more representative of the Iraqi situation.

Another improvement that could be further explored consists in moving to an upper Tier method starting with the most emitting category (here, buffalo).

2.5.4 Rice cultivation (CRT 3C)

2.5.4.1 Category description (e.g. characteristics of sources)

Anaerobic decomposition of organic material in flooded rice fields produces CH_4.

This category (3C) contributes to 0.3% of the total GHG emissions excluding LULUCF, in 2020, as well as in 2021. Concerning its part in the Agriculture sector (CRT 3), in Iraq, it is stable at around 5.5% for the two inventory years.

2.5.4.2 Methodological issues

GHG emissions from rice cultivation are calculated with a Tier 1 approach which is in line with the 2006 IPCC Guidelines.

Activity data used are the developed area provided by the Ministry of Agriculture. The cultivation period is 135 days long.

Emission factor and associated scaling factor used for calculating GHG emissions comes from the 2006 IPCC guidelines, and are as follow:

- Baseline emission factor: 1.3 kg CH_4/ha/day
- Scaling factor for the water regime during the cultivation period: 0.78 (irrigated)
- Scaling factor for the water regime before the cultivation period: 1.22 (aggregated case)
- Scaling factor for organic amendment: 1 (no amendment considered)
- Scaling factor for rice cultivar, soil type, … : 1 (no adjustment).

2.5.4.3 Uncertainty assessment and time-series consistency

A general discussion of uncertainty in the Agriculture sector was presented earlier.

2.5.4.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.5.4.5 Category-specific planned improvements

Improvement could be made regarding the scaling factors currently applied, for example regarding the water regime before the cultivation period, or the organic amendment.

2.5.5 Agricultural soils (CRT 3D)

2.5.5.1 Category description

The agricultural soils category covers the direct (3D1) and indirect (3D2) emissions of N_2O. For direct emissions, the following emission sources are covered in the Iraqi inventory (Figure 2-23):

- Application of inorganic N fertilisers (3.D.1.1),
- Application of animal manure (3.D.1.2.a),
- Urine and dung deposited by grazing animals (3.D.1.3),
- Crop residues (3.D.1.4),

Emissions related to the application of sewage sludge (3.D.1.b.ii), other organic fertilisers (3.D.1.b.iii), mineralization/ immobilization associated with loss/gain of soil organic matter (3.D.1.e) and Cultivation of organic soils (3.D.1.6).are all considered as "not occurring" (NO).

For indirect emissions, the emissions are distinguished between the atmospheric deposition (3.D.2.1) and the nitrogen leaching and run-off (3.D.2.2).

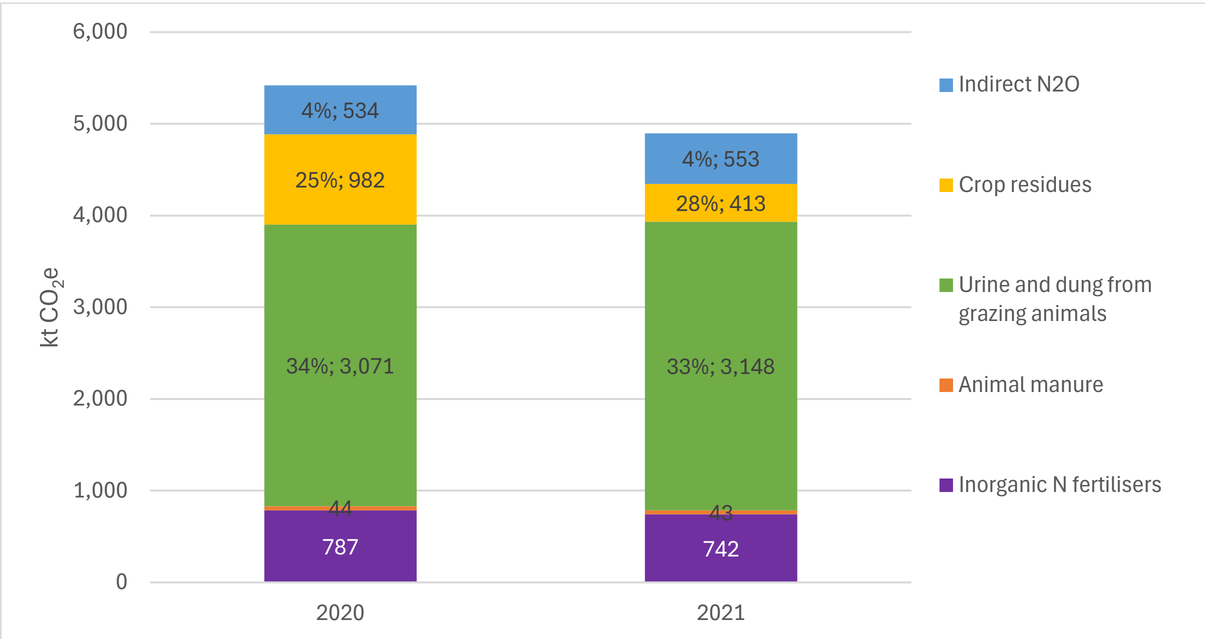


Figure 2-23 : CO_2e emissions from agricultural soils (in $ktCO_2eq$)

The agricultural soils (CRT 3D) contribute to 2.7% of the total GHG emissions excluding LULUCF, in 2020 and 2.4% in 2021. Concerning its part in the agriculture sector (CRT 3), in Iraq, it is of 41% in 2021, and it was of 45% in 2020.

2.5.5.2 Methodological issues

Direct N_2O emissions:

The estimation methodology is based on the 2006 IPCC Tier 1 approach, meaning that the emission factors (EF) applied to the activity data remain constant throughout the time series. Consequently, the direct N_2O emissions from agricultural soils are directly proportional to the activity data presented below.

Activity data used are the following:

- Amount of inorganic fertilizer: data are taken from national agricultural statistics
- Amount of animal manure applied to soils: estimated according to the 2006 IPCC Guidelines
- Urine and dung deposited by animals: estimated according to the 2006 IPCC Guidelines
- Amounts of N from crop residues: estimated according to the 2006 IPCC Guidelines.

Amount of animal manure applied to soils:

The amount of animal manure applied to soils is estimated based on the 2006 IPCC Guidelines method, using the values provided per manure management system for the parameter Fracloss:

- Dry lot: 40%
- Daily spread: 22%
- Poultry manure with litter: 50%

Urine and dung deposited by animals

The amount of nitrogen from urine and dung deposited by animals is estimated based on the nitrogen excreted per animal (see section 3B), multiplied by the share of animals in pasture (see section 3B).

Crop residues

The following crops have been considered for crop residue calculations: barley, maize, rice, sorghum, wheat, sunflower, peanut, potatoe, alfafa. To apply the 2006 IPCC Guidelines method, developed area and associated productions provided by the Ministry of Agriculture have been used. All the other parameters used for the calculation have been taken from the 2006 IPCC Guidelines. Notably, inputs from crop residue decreased between 2020 and 2021, while mineral fertilizer inputs declined slightly between 2021 and 2022.

Table 2-21: Activity data for direct N_2O emissions from agricultural soils (3D1), for 2020 and 2021

	2020	2021
Inorganic fertilisers (tons of N)	189	178
Animal manure applied to soils (tons of N)	11	10
Urine and dung deposited by grazing animals (tons of N)	536	564
Crop residues (tons of N)	236	99

Emissions factors used for calculating N_2O emissions come from the 2006 IPCC Guidelines and are as follow:

- For inorganic fertilizers, animal manure applied to soils and crop residues: 0.01 kg N-N_2O/kg N,
- For cattle, swine and poultry grazing: 0.02 kg N-N_2O/kg N,
- For other animals grazing: 0.01 kg N-N_2O/kg N.

Indirect N_2O emissions:
The indirect emissions of N_2O from managed soils are separated between two subcategories: atmospheric deposition and leaching and run-off. The emission estimation methodology used is based on Tier 1 from 2006 IPCC guidelines.
Activity data used are the same as the one for direct N_2O emissions, with some additional calculations to calculate the amounts of volatilized N and N lost through leaching and run-off, according to the 2006 IPCC guidelines.

Those parameters – taken from the 2006 IPCC Guidelines - are as follow:

- Fraction of synthetic fertilizer N that volatilizes as NH3 and NOx: FGASF = 0.1 kg N volatilized/kg N applied;
- Fraction of organic fertilizer N (including urine and dung deposited by grazing animals) that volatilizes as NH3 and NOx: FGASM = 0.2 kg N volatilized/kg N applied or deposited;

The emission factor for indirect N_2O from volatilization is taken from the 2006 IPCC Guidelines (0.01 kg N-N_2O/kg N volatilized).

No leaching is considered in Iraq as the 2019 IPCC Guidelines maps of climate shows that the whole area is considered as dry.

2.5.5.3 Uncertainty assessment and time-series consistency

See earlier sections for a general discussion on uncertainty in the agriculture sector.

2.5.5.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.5.5.5 Category-specific planned improvements

Further improvement could be made:

- by implementing the 2019 IPCC Guidelines that provides disaggregated values for emission factors, based on climate
- by completing the types of crops considered for crop residues
- by identifying the nitrogen brought to rice crops to use the dedicated emission factor.

2.5.6 Field burning of agricultural residues (CRT 3F)

2.5.6.1 Category description (e.g. characteristics of sources)

CH_4 and N_2O emissions from field burning of agricultural residues are estimated in this category. Field burning of residues is very small in Iraq. This category represents less than 0.001% of the Agriculture sector.

2.5.6.2 Methodological issues

GHG emissions from field burning of agricultural residues are calculated with a Tier 1 approach which is in line with the 2006 IPCC Guidelines.

Burning is considered only for rice and wheat, with very little area concerned (< 0.002% of the rice and wheat area).Emission factor used for calculating GHG emissions comes from 2006 IPCC guidelines.

2.5.6.3 Uncertainty assessment and time-series consistency

See earlier sections for a general discussion of uncertainty in the Agriculture sector.

2.5.6.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.5.6.5 Category-specific planned improvements

No specific improvement planned.

2.5.7 Urea application (CRT 3H)

2.5.7.1 Category description

For this category, the emissions of CO_2 related to the application of urea onto agricultural fields are estimated. This sector represents the only emissions of CO_2 from the Agriculture sector (which are considered in the emission inventory scope, hence different from CO_2 related to biomass).

Emissions are calculated using a Tier 1 methodology with a constant emission factor (EF) applied; therefore, emissions are directly proportional to changes in the activity data.

The urea application (CRT 3H) represents only 2% of the Agriculture sector and remained steady between 2020 and 2021.

Table 2-22:Activity data for urea application (3H), for 2020 and 2021

	2020	2021
Urea (tons)	355 852	368 975

2.5.7.2 Methodological issues

GHG emissions from urea application are calculated with a Tier 1 approach which is in line with the 2006 IPCC Guidelines.

Activity data used are the annual quantities of urea applied to agricultural soils, which are taken ffrom agricultural statistics.

Emission factor used for calculating GHG emissions comes from 2006 IPCC guidelines, and the value is of 0.2 t C/t urea.

2.5.7.3 Uncertainty assessment and time-series consistency

A general discussion of uncertainty in the agriculture sector was presented earlier.

2.5.7.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.5.7.5 Category-specific planned improvements

No specific improvement planned.

2.6 Land use, land-use change and forestry (CRT sector 4)

2.6.1 Overview of the sector and background information

This category includes all GHG emissions and absorptions (or “removals”, or “negative emissions”) due to land use, land use change and forestry (LULUCF). Since the sector present both emissions and absorptions, the term “flux” is used to mention all figures.

The CRF 4 category covers the following sectors:

- Forest land (4A), including Forest lands remaining forest lands (4A1), and Lands converted to forest lands (4A2) with croplands (4.A.2.1), grasslands (4.A.2.2), wetlands (4.A.2.3), settlements (4.A.2.4) and other lands (4.A.2.5),
- Cropland (4B), including Lands converted croplands (4B2) with forest lands (4.B.2.1), grasslands (4.B.2.2), wetlands (4.B.2.3) and settlements (4.B.2.4)
- Grassland (4C), including Grasslands remaining grasslands (4C1), and Lands converted to forest lands (4C2) with forest lands (4.C.2.1), croplands (4.C.2.2), wetlands (4.A.2.3), settlements (4.A.2.4) and other lands (4.A.2.5),
- Wetlands (4D), including Lands converted to another type of wetlands (4.D.2.3),
- Settlements (4E), including Lands converted to settlements (4E2), with forest lands (4.E.2.1), croplands (4.E.2.2) and grasslands (4.E.2.3),
- Other land (4F), including Lands converted to other lands (4F2), with forest lands (4.F.2.1), croplands (4.F.2.2) and grasslands (4.F.2.3),
- Harvested wood products (4G).

The subcategories Croplands remaining croplands (4B1), Grasslands remaining Grasslands (4C1), Wetlands remaining wetlands (4D1) and Settlements remaining settlements (4E1), are considered as not estimated (NE), applying the default tier 1 approach of equilibrium assumption.

Tier 1 methodologies were applied to all categories in the LULUCF sector, which does not include any key categories. This decision was driven by the limited availability of data and the short timeframe, which made it difficult to collect sufficient data for reporting at a higher tier level.

In Iraq, the LULUCF sector is a net sink in 2020 and 2021 mostly linked to forestland where carbon gains are estimated to be bigger than losses. Significant fluxes are also related to land use changes between the categories of cropland, grassland and other lands which are not giving a clear dynamic of changes (Figure 2-24 and Figure 2-25).

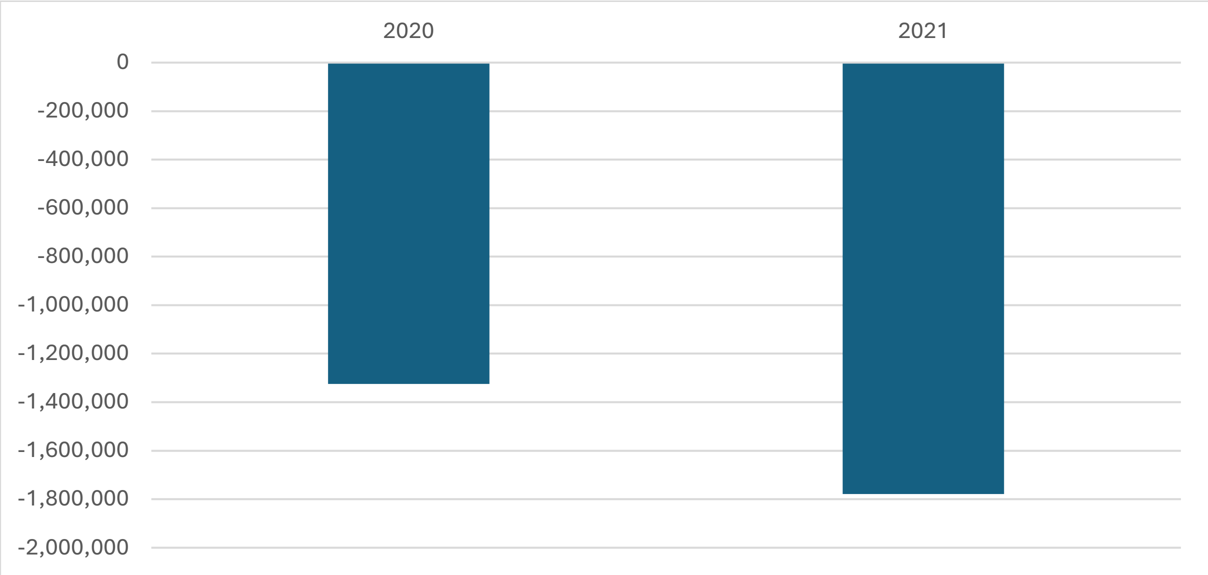


Figure 2-24: GHG emissions for LULUCF (CRT 4), for the years 2020 and 2021, (in kt CO_2e)

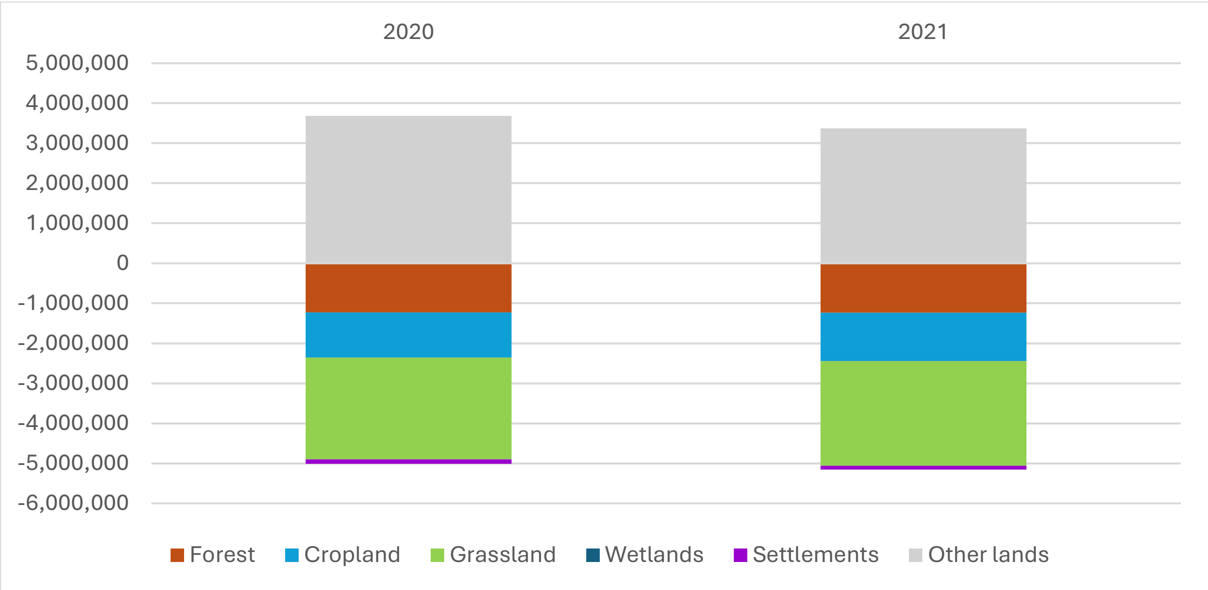


Figure 2-25: GHG emissions for LULUCF (CRT 4), stock variations for all pools for the years 2020 and 2021, per subcategory (in kt CO_2e)

2.6.2 Land-use definitions and the land representation approach(es) used and their correspondence to the land use, land-use change and forestry categories

The definition of forest is the one used by the FAO. The selected thresholds are:

- Minimum land area: 0.5 ha;
- Minimum canopy cover: 10% (in situ. i.e. potential of the standing stock to reach this threshold);
- Minimum height: 5 meters (in situ. i.e. potential of the standing stock to reach this threshold);

However, in the framework of the GHG inventory, all 6 land-use categories are directly connected with the definitions of a specific study used as a reference for the inventory: Remote Sensing and Machine Learning Based High resolution Land (Use Land Cover Classification Map for Iraq, A Step towards Improved Land and Water Management for Food Security).

Corine Land Cover which is the main source used to determine areas. The nomenclature of Corine Land Cover was associated to 6 IPCC categories following Table 2-23 and Table 2-24

Table 2-23: Areas of the land cover map and allocation in IPCC categories

Category	IPCC	Area in 2023 (ha)	%
Urban	SL	565 928	1.29
Water body	WL	549 576	1.25
Wetland	WL	115 151	0.26
Dense forest	FL	321 721	0.73
Open forest, shrubland	GL	755 048	1.72
Palm Tree	CL	166 560	0.38
Irrigated land	CL	2 529 890	5.78
Rainfed	CL	242 223	0.55
Arable land (5y)	CL	1 358 202	3.10
Arable land (10y)	CL	3 319 118	7.58
Grassland	GL	2 894 110	6.61
Sparse vegetation	GL	1 644 467	3.75
Marshland vegetation	WL	124 725	0.28
Herbaceous and mangrove	GL	620 037	1.42
Desert land	OL	10 549 307	24.09
Rocky desert	OL	7 796 902	17.80
Rock surface	OL	514 610	1.18
Uncultivated (abandoned farmland)	OL	9 727 706	22.21
TOTAL		**43 795 279**	**100.00**

Table 2-24: Areas of the land cover map and allocation by IPCC categories

Category	IPCC	Area in 2023 (ha)	%
Forest	FL	321 721	0.73
Cropland	CL	7 615 992	17.39
Grassland	GL	5 913 661	13.50
Wetlands	WL	789 451	1.80
Settlements	SL	565 928	1.29
Other lands	OL	28 588 525	65.28
TOTAL		**43 795 279**	**100.00**

2.6.3 Country-specific approaches

2.6.3.1 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The methodology to estimate land use matrixes corresponds to approach 2 because the gross land-use changes are estimated.

Land use change areas are based on data reported under UNCCD in 2022 (convention to combat desertification, PRAIS 2022). The land use changes have been estimated for the periods 2000-2010 (Table 2-25), and 2010-2015 (Table 2-26)

Table 2-25: Annual land use changes for the period 2000-2010 (ha/year)

	Forest	Cropland	Grassland	Wetland	Settlement	Other land
Forest		60	90	0	0	20
Cropland	130		10 020	0	150	36 470
Grassland	90	750		0	2 000	4 020
Wetland	0	0	0		0	100
Settlement	0	0	0	0		90
Other land	90	1 870	5 900	1 230	8 850	

Table 2-26: Annual land use changes for the period 2010-2015 (ha/year)

	Forest	Cropland	Grassland	Wetland	Settlement	Other land
Forest		20	20	0	0	0
Cropland	260		1 040	0	3 860	2 940
Grassland	200	660		0	80	460
Wetland	0	0	0		0	20
Settlement	0	0	0	0		0
Other land	80	12 760	14 580	20	4 100	

For the inventory 2020 it is necessary to estimate annual changes since 2000, so the following treatments are implemented:

- During each monitoring period the changes are supposed to be constant, annual changes are thus estimated by dividing the changes of the period by the number of years of the period.
- After 2015, that land use changes are assumed to be equivalent to the period 2010-2015.

The year 2023 was chosen as the only reference for land use changes to avoid potential small discrepancies between maps. All the areas are calculated on the basis of 2023 areas combined with annual changes. The calculation of "area of land remaining land" is done by subtracting all the changes that become that land in that year from the area at the end of the year.

This protocol allows building both annual and 20-year matrixes which are necessary for the calculation of carbon fluxes.

Table 2-27: Annual matrix for the year 2020 (ha)

	Forest	Cropland	Grassland	Wetland	Settlement	Other land	**Initial Area**
Forest	319 681	20	20	0	0	0	**319 721**
Cropland	260	7 586 532	1 040	0	3 860	2 940	**7 594 632**
Grassland	200	660	5 855 301	0	80	460	**5 856 701**
Wetland	0	0	0	789 431	0	20	**789 451**
Settlement	0	0	0	0	533 768	0	**533 768**
Other land	80	12 760	14 580	20	4 100	28 669 465	**28 701 005**
Final Area	**320 221**	**7 599 972**	**5 870 941**	**789 451**	**541 808**	**28 672 885**	**43 795 279**

Table 2-28: Annual matrix for the year 2021 (ha)

	Forest	Cropland	Grassland	Wetland	Settlement	Other land	**Initial Area**
Forest	320 181	20	20	0	0	0	**320 221**
Cropland	260	7 591 872	1 040	0	3 860	2 940	**7 599 972**
Grassland	200	660	5 869 541	0	80	460	**5 870 941**
Wetland	0	0	0	789 431	0	20	**789 451**
Settlement	0	0	0	0	541 808	0	**541 808**
Other land	80	12 760	14 580	20	4 100	28 641 345	**28 672 885**
Final Area	**320 721**	**7 605 312**	**5 885 181**	**789 451**	**549 848**	**28 644 765**	**43 795 279**

Table 2-29: 20-year matrix for the year 2020 (ha)

	Forest	Cropland	Grassland	Wetland	Settlement	Other land	**Initial Area**
Forest	311 721	800	1 100	0	0	200	**313 821**
Cropland	3 900	7 438 772	110 600	0	40 100	394 100	**7 987 472**
Grassland	2 900	14 100	5 554 441	0	20 800	44 800	**5 637 041**
Wetland	0	0	0	776 951	0	1 200	**778 151**
Settlement	0	0	0	0	351 408	900	**352 308**
Other land	1 700	146 300	204 800	12 500	129 500	28 231 685	**28 726 485**
Final Area	**320 221**	**7 599 972**	**5 870 941**	**789 451**	**541 808**	**28 672 885**	**43 795 279**

Table 2-30: 20-year matrix for the year 2021 (ha)

	Forest	Cropland	Grassland	Wetland	Settlement	Other land	**Initial Area**
Forest	311 991	760	1 030	0	0	180	**313 961**
Cropland	4 030	7 433 352	101 620	0	43 810	360 570	**7 943 382**
Grassland	3 010	14 010	5 569 051	0	18 880	41 240	**5 646 191**
Wetland	0	0	0	778 161	0	1 120	**779 281**
Settlement	0	0	0	0	362 408	810	**363 218**
Other land	1 690	157 190	213 480	11 290	124 750	28 240 845	**28 749 245**
Final Area	**320 721**	**7 605 312**	**5 885 181**	**789 451**	**549 848**	**28 644 765**	**43 795 279**

2.6.3.2 Information on approaches used for natural disturbances, if applicable

No specific treatment regarding natural disturbances was considered in the current inventory.

2.6.3.3 Information on approaches used for reporting harvested wood products

Emissions and removals from harvest wood products were not estimated in the current inventory.

2.6.4 Common elements to all land uses (CRF 4)

2.6.4.1 Carbon stock changes

- Living woody biomass :
  - It must be noted that woody and non-woody biomass are split to clarify the carbon pools (even if IPCC guidance does not always clearly separate woody and non-woody biomass).

- All fluxes related to living biomass are estimated by the stock-difference method on areas with land use changes (equation 2.5 of the IPCC 2006 guidelines) and by the gain-loss method on forest remaining forest (equation 2.4 of the IPCC 2006 guidelines). For all land uses but forest, on land remaining land, living biomass is assumed to be in equilibrium and gains and losses are reported as not estimated.
- Default carbon stocks from 2019 IPCC refinement (Table 4.7, subtropical dry forest in Asia) are used in the current inventory for living woody biomass (Table 2-31)

Table 2-31: Carbon stock in living woody biomass

	Aboveground Biomass (t d.m/ha)	Root to shoot ratio	Carbon content (tC/t d.m)	Above and below ground biomass (tC/ha)
Forest	70.9	0.44	0.47	48.0
Cropland	0	0	0.47	0
Grassland	0	0	0.47	0
Wetland	0	0	0.47	0
Settlement	0	0	0.47	0
Other land	0	0	0.47	0

- Living non woody biomass (grass, crops)
  - It must be noted that woody and non-woody biomass are split to clarify the carbon pools (even if IPCC guidance does not always clearly separate woody and non-woody biomass).
  - Default carbon stocks from 2006 IPCC guidelines (IPCC 2006: Table 5.9 annual cropland, IPCC 2006: Table 6.4 tropical dry grassland) are used in the current inventory for living non-woody biomass (Table 2-32)

Table 2-32: Carbon stock in living non-woody biomass

	Above and below ground biomass (tC/ha)
Forest	0
Cropland	5
Grassland	8.7
Wetland	0
Settlement	0
Other land	0

- Dead organic matter (dead wood, litter)
  - Data for deadwood carbon stocks are not available in the IPCC guidelines (Table 2.2).
  - The information regarding litter carbon stocks is extracted from the 2006 IPCC guidelines (Table 2.2), it is assumed that only forest areas have litter carbon stocks. This stock is assumed to be 2.0 tC/ha.
  - All fluxes related to litter are estimated by the stock-difference method on areas with land use changes.
- Soils (mineral and organic soils)
  - In Iraq, it is assumed that all soils are mineral soils. All fluxes related to organic soils are reported as not occurring.
  - For mineral soils, the stocks of carbon of soils are directly taken from data reported in 2022 under UNCCD (Convention to combat desertification, PRAIS 2022)(Table 2-33).

Table 2-33: Carbon stock in soil organic matter (SOC)

Land-Use Category	SOC (tC/ha)
Forest	100
Cropland	50
Grassland	62
Wetlands	47
Settlements	30
Other lands	11

All fluxes related to mineral soils are estimated by the stock-difference method on areas with land use changes, using equation 2.25 of the IPCC 2006 guidelines.

2.6.4.2 Direct N_2O Emissions from N Inputs to Managed Soils

It is assumed that no other land, but agricultural land, is fertilized in Iraq, thus direct N_2O emissions are reported as not occurring in LULUCF.

2.6.4.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.4.4 Direct N_2O Emissions from N Mineralization/Immobilization

Direct N2O Emissions from N Mineralization/Immobilization are currently not estimated in the Iraqi inventory for most categories.

2.6.4.5 Indirect N_2O Emissions from Managed Soils

Indirect N2O emissions from soils apart from those estimated in the Agriculture sector are currently not estimated.

2.6.4.6 Biomass Burning

Emissions from biomass burning are currently not estimated in the Iraqi inventory.

2.6.5 Forestlands (4A)

2.6.5.1 Description

This category comprises GHG emissions and removals arising from forestlands (Figure 2-26).

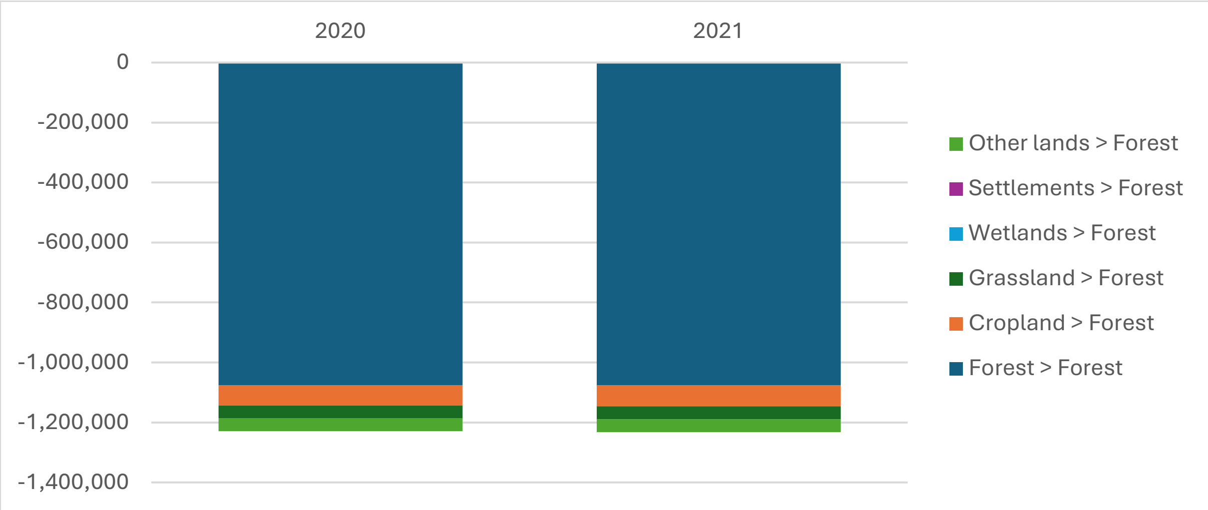


Figure 2-26: GHG emissions from Forest land by subcategory (CRF 4.A) (kt CO2e)

2.6.5.2 Methodological issues

2.6.5.3 Forestlands remaining forestlands (4A1)

2.6.5.3.1 Carbon stock changes

- Living biomass :
  - Carbon stock changes in living biomass in forest are estimated on the basis of the gains-losses method.
  - The increment of forest is calculated thanks to 2006 IPCC guidelines (equation 2.10, tier 1).

EQUATION 2.10
AVERAGE ANNUAL INCREMENT IN BIOMASS
Tier 1

$$G_{TOTAL} = \sum \{G_W \bullet (1 + R)\}$$ Biomass increment data (dry matter) are used directly

  - The above ground biomass growth comes from 2019 IPCC refinement (Table 4.9, subtropical dry forest in Asia) with 1.5 t d.m/ha/yr (parameter Gw of the equation)
  - The ratio of below ground comes from 2019 IPCC refinement (Table 4.4, subtropical dry forest in Asia) with 0.44 (parameter R of the equation).The losses of forest are calculated thanks to 2006 IPCC guidelines (equations 2.11 and 2.12).
  - The losses are based on harvested fuel wood provided by FAOSTAT only which gives 118 000 m3/yr for both years 2020 and 2021.

- Dead organic matter (dead wood, litter). On forest remaining forest equilibrium is assumed for dead organic matter, it is reported as not estimated in the Iraqi inventory.

- Soils (mineral and organic soils): It is assumed that in Iraq no organic soils exist in forestlands. On forest remaining forest, equilibrium is assumed for mineral soil, it is reported as not estimated in the Iraqi inventory.

2.6.5.3.2 Direct N_2O Emissions from N Inputs to Managed Soils

It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N_2O emissions are reported as not occurring.

2.6.5.3.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.5.3.4 Direct N_2O Emissions from N Mineralization/Immobilization

No carbon losses are estimated from soils, thus direct N_2O Emissions from N Mineralization are reported as not estimated for forest remaining forest.

2.6.5.3.5 Indirect N_2O Emissions from Managed Soils

No direct N_2O emissions are estimated on these areas, thus indirect N_2O emissions from soils are also assumed as not estimated.

2.6.5.3.6 Biomass Burning

It is likely that controlled burning is very limited in Iraq. Currently it is reported as not estimated. Wildfires are currently not estimated in the Iraqi inventory.

2.6.5.4 Land converted to forestlands (4A2)

2.6.5.4.1 Carbon stock changes

- Living woody biomass : Fluxes on living woody biomass are estimated thanks to a stock-difference method.
- Living non-woody biomass : Fluxes on living non-woody biomass are estimated thanks to a stock-difference method.
- Dead organic matter (deadwood, litter): Fluxes on living dead organic matter (deadwood, litter) are estimated thanks to a stock-difference method.
- Soils (mineral and organic soils): It is assumed that in Iraq no organic soils exist in forestlands. Fluxes on mineral soils are estimated thanks to a stock-difference method.

2.6.5.4.2 Direct N_2O Emissions from N Inputs to Managed Soils

It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N2O emissions are reported as not occurring.

2.6.5.4.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.5.4.4 Direct N_2O Emissions from N Mineralization/Immobilization

Direct N_2O Emissions from N Mineralization are currently reported as not estimated in the Iraqi inventory.

2.6.5.4.5 Indirect N_2O Emissions from Managed Soils

No direct N_2O emissions are estimated on these areas, thus indirect N_2O emissions from soils are also assumed as not estimated.

2.6.5.4.6 Biomass Burning

It is likely that controlled burning is negligible in Iraq. Currently it is reported as not estimated. Wildfires are currently not estimated.

2.6.5.5 Uncertainties and time-series consistency

A general discussion of uncertainty in the LULUCF sector was presented earlier.

2.6.5.6 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.5.7 Category-specific planned improvements

Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.6.6 Croplands (4B)

2.6.6.1 Description

This category includes GHG emissions and removals arising from croplands (Figure 2-27)

In this category, emissions and absorptions are only estimated for land conversions. No emission estimation is calculated for croplands remaining croplands and for biomass burning (4B1).

The evolution of emissions for lands converted to croplands (4B2) reflects the trend in land-use change areas.

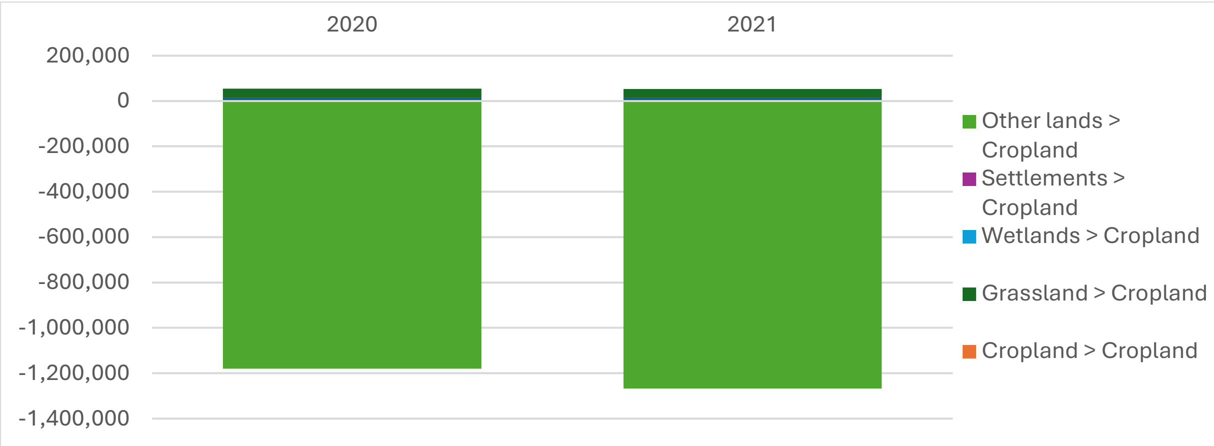


Figure 2-27: GHG emissions from cropland by subcategory (CRF 4.B) (kt CO_2e)

2.6.6.2 Methodological issues

2.6.6.2.1 Croplands remaining croplands (4B1)

2.6.6.2.1.1 Carbon stock changes

- Living woody biomass: On cropland remaining cropland equilibrium is assumed for living woody biomass, it is reported as not estimated in the Iraqi inventory.
- Living non-woody biomass: On cropland remaining cropland equilibrium is assumed for living non-woody biomass, it is reported as not estimated in the Iraqi inventory.

- Dead organic matter (dead wood, litter): On cropland remaining cropland equilibrium is assumed for dead organic matter, it is reported as not estimated in the Iraqi inventory.
- Soils (mineral and organic soils): On cropland remaining cropland equilibrium is assumed for mineral soils, it is reported as not estimated in the Iraqi inventory.

2.6.6.2.1.2 Direct N2O Emissions from N Inputs to Managed Soils

Direct N_2O emissions from agriculture are already reported under the sector agriculture.

2.6.6.2.1.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.6.2.1.4 Direct N_2O Emissions from N Mineralization/Immobilization

No carbon losses are estimated from soils, thus direct N_2O Emissions from N Mineralization are reported as not estimated for cropland remaining cropland.

2.6.6.2.1.5 Indirect N_2O Emissions from Managed Soils

Indirect N_2O emissions from agriculture are already reported under the sector agriculture.

2.6.6.2.1.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land (prescribed burning of residues are reported under the sector agriculture).

2.6.6.2.2 Land converted to croplands (4B2)

2.6.6.2.2.1 Carbon stock changes

- Living woody biomass : Fluxes on living biomass are estimated thanks to a stock-difference method.
- Living non-woody biomass : Fluxes on living biomass are estimated thanks to a stock-difference method.
- Dead organic matter (dead wood, litter): Fluxes on dead organic matter (dead wood, litter) are estimated thanks to a stock-difference method.
- Soils (mineral and organic soils): It is assumed that in Iraq no organic soils exist in croplands. Fluxes on mineral soils are estimated thanks to a stock-difference method.

2.6.6.2.2.2 Direct N_2O Emissions from N Inputs to Managed Soils

Direct N_2O emissions from agriculture are already reported under the sector agriculture.

2.6.6.2.2.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.6.2.2.4 Direct N_2O Emissions from N Mineralization/Immobilization

Direct N2O Emissions from N Mineralization/Immobilization are currently not estimated in the Iraqi inventory.

2.6.6.2.2.5 Indirect N_2O Emissions from Managed Soils

No other indirect N_2O emissions that those reported under agriculture are considered.

2.6.6.2.2.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land (prescribed burning of residues are reported under the agriculture sector.

2.6.6.3 Uncertainties and time-series consistency

See section 1.6 for a general discussion of uncertainty in the LULUCF sector.

2.6.6.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.6.5 Category-specific planned improvements

Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.6.7 Grasslands (4C)

2.6.7.1 Description

This category comprises GHG emissions and removals arising from grasslands (Figure 2-28).

In this category, emissions and absorptions are only estimated for land conversions and for biomass burning. No emission estimation is calculated for croplands remaining croplands (including in 4C1).

The evolution of emissions for lands converted to croplands (4C2) reflects the trend in land-use change areas.

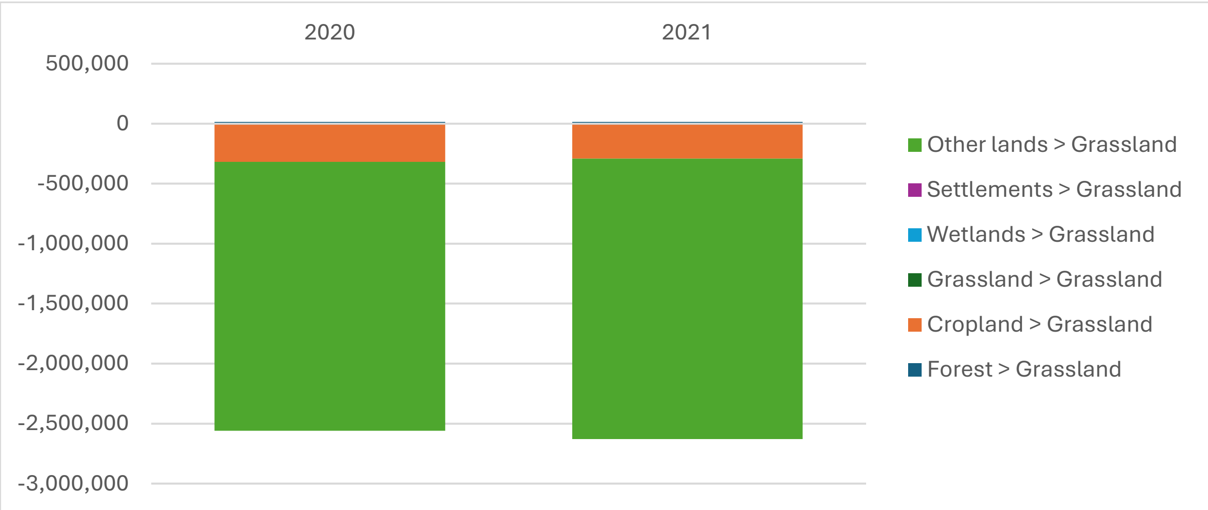


Figure 2-28: GHG emissions from grassland by subcategory (CRF 4.C) (kt CO2e)

2.6.7.2 Methodological issues

2.6.7.2.1 Grasslands remaining grasslands (4C1)

2.6.7.2.1.1 Carbon stock changes

- Living woody biomass : On grassland remaining grassland equilibrium is assumed for living biomass, it is reported as not estimated in the Iraqi inventory.
- Living non-woody biomass : On grassland remaining grassland equilibrium is assumed for living non-woody biomass, it is reported as not estimated in the Iraqi inventory.
- Dead organic matter (dead wood, litter): On grassland remaining grassland equilibrium is assumed for dead organic matter, it is reported as not estimated in the Iraqi inventory.
- Soils (mineral and organic soils): On grassland remaining grassland equilibrium is assumed for mineral soils, it is reported as not estimated in the Iraqi inventory.

2.6.7.2.1.2 Direct N_2O Emissions from N Inputs to Managed Soils

Direct N_2O emissions from agriculture are already reported under the sector agriculture.

2.6.7.2.1.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.7.2.1.4 Direct N_2O Emissions from N Mineralization/Immobilization

No carbon losses are estimated from soils, thus direct N_2O Emissions from N Mineralization are reported as not estimated for grasslands remaining grasslands.

2.6.7.2.1.5 Indirect N_2O Emissions from Managed Soils

Indirect N_2O emissions from agriculture are already reported under the agriculture sector.

2.6.7.2.1.6 Biomass Burning

It is likely that controlled burning exists in Iraq, but no data are available. Currently it is reported as not estimated. Wildfires are currently not estimated in the Iraqi inventory.

2.6.7.2.2 Land converted to grasslands (4C2)

2.6.7.2.2.1 Carbon stock changes

- Living woody biomass : Fluxes on living woody biomass are estimated thanks to a stock-difference method.
- Living non-woody biomass : Fluxes on living non-woody biomass are estimated thanks to a stock-difference method.
- Dead organic matter (dead wood, litter): Fluxes on living dead organic matter (dead wood, litter) are estimated thanks to a stock-difference method.
- Soils (mineral and organic soils): It is assumed that in Iraq no organic soils exist in grasslands. Fluxes on mineral soils are estimated thanks to a stock-difference method.

2.6.7.2.2.2 Direct N_2O Emissions from N Inputs to Managed Soils

Direct N_2O emissions from agriculture are already reported under the sector agriculture.

2.6.7.2.2.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils
Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.7.2.2.4 Direct N_2O Emissions from N Mineralization/Immobilization
Carbon losses are estimated from mineral soils, thus direct N_2O Emissions from N Mineralization are estimated in accordance with IPCC 2006 guidelines for land converted to grasslands.

2.6.7.2.2.5 Indirect N_2O Emissions from Managed Soils
Indirect N_2O emissions from agriculture are already reported under the sector agriculture.

2.6.7.2.2.6 Biomass Burning
It is likely that controlled burning is negligible in Iraq. Currently it is reported as not estimated. Wildfires are not estimated.

2.6.7.3 Uncertainties and time-series consistency
A general discussion of uncertainty in the LULUCF sector was presented earlier.

2.6.7.4 Category-specific recalculations
The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.7.5 Category-specific planned improvements
Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.6.8 Wetlands (4D)
2.6.8.1 Description
This category comprises GHG emissions and removals arising from wetlands.

In this category, emissions and absorptions are only estimated for land conversions but there was no conversion from lands to wetlands in the Iraqi inventory. No emission estimation is calculated for wetlands remaining wetlands and for biomass burning (4D1).
Hence, the emissions and removals for this category is 0 ktCO2 for all years.

2.6.8.2 Methodological issues
2.6.8.2.1 Wetlands remaining wetlands (4D1)
2.6.8.2.1.1 Carbon stock changes
- Living woody biomass : Equilibrium is assumed, no stock variations are occurring in this category. Also no information on changes is available.
- Living non-woody biomass : Equilibrium is assumed, no stock variations are occurring in this category. Also no information on changes is available.
- Dead organic matter (dead wood, litter): Equilibrium is assumed, no stock variations are occurring in this category. Also no information on changes is available.

- Soils (mineral and organic soils): Equilibrium is assumed, no stock variations are occurring in this category. Also no information on changes is available.

2.6.8.2.1.2 Direct N_2O Emissions from N Inputs to Managed Soils

It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N_2O emissions are reported as not occurring.

2.6.8.2.1.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.8.2.1.4 Direct N_2O Emissions from N Mineralization/Immobilization

No carbon losses are estimated from soils, thus direct N_2O Emissions from N Mineralization are reported as not occurring for wetlands remaining wetlands.

2.6.8.2.1.5 Indirect N2O Emissions from Managed Soils

No direct N_2O emissions are estimated on these areas, thus indirect N_2O emissions from soils are also assumed as not occurring.

2.6.8.2.1.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land.

2.6.8.2.2 Land converted to wetlands (4D2)

2.6.8.2.2.1 Carbon stock changes

No land use change to wetlands were identified in Iraq. No conversion implies no emission nor removal in Iraqi inventory.

2.6.8.2.2.2 Direct N_2O Emissions from N Inputs to Managed Soils

It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N2O emissions are reported as not occurring.

2.6.8.2.2.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.8.2.2.4 Direct N_2O Emissions from N Mineralization/Immobilization

Direct N2O Emissions from N Mineralization/Immobilization are currently not estimated in the Iraqi inventory.

2.6.8.2.2.5 Indirect N_2O Emissions from Managed Soils

Indirect N_2O emissions from soils are currently not estimated in the Irak inventory.

2.6.8.2.2.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land.

2.6.8.2.3 Uncertainties and time-series consistency
See section 1.6 for a general discussion of uncertainty in the LULUCF sector.

2.6.8.2.4 Category-specific recalculations
The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.8.2.5 Category-specific planned improvements
Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.6.9 Settlements (4E)
2.6.9.1 Description
This category comprises GHG emissions and removals arising from settlements (Figure 2-29).

In this category, emissions and absorptions are only estimated for land conversions. No emission estimation is calculated for croplands remaining croplands and for biomass burning (4E1). The emission evolution for lands converted to croplands (4E2) reflects the trend in land-use change areas.

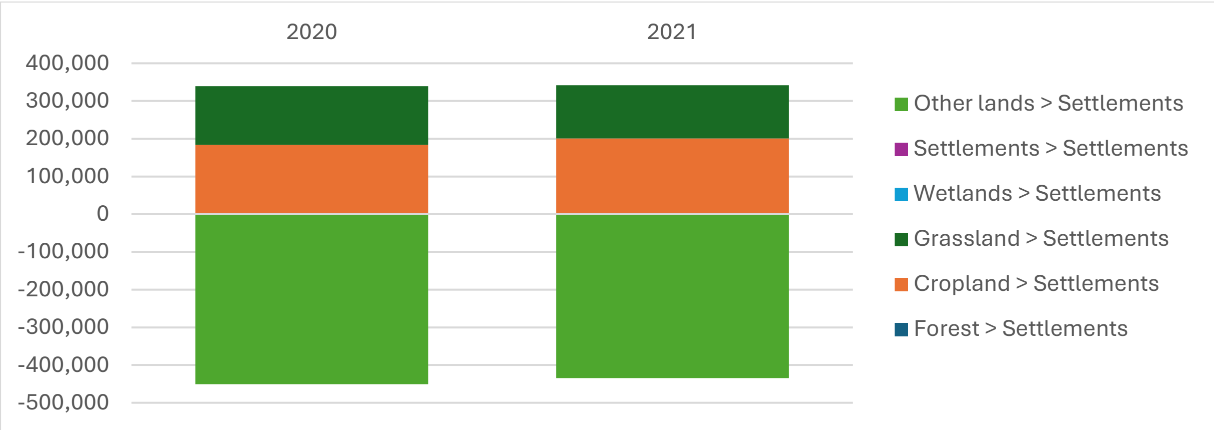


Figure 2-29: GHG emissions from settlements (CRF 4.E) (kt CO2e)

2.6.9.2 Methodological issues
2.6.9.2.1 Settlements remaining settlements (4E1)
2.6.9.2.1.1 Carbon stock changes
- Living woody biomass: On settlement remaining settlement equilibrium is assumed for living woody biomass, it is reported as not estimated in the Iraqi inventory.
- Living non-woody biomass: On settlement remaining settlement equilibrium is assumed for living non-woody biomass, it is reported as not estimated in the Iraqi inventory.
- Dead organic matter (dead wood, litter): On settlement remaining settlement equilibrium is assumed for dead organic matter, it is reported as not estimated in the Iraqi inventory.
- Soils (mineral and organic soils): On settlement remaining settlement equilibrium is assumed for mineral soils, it is reported as not estimated in the Iraqi inventory.

2.6.9.2.1.2 Direct N_2O Emissions from N Inputs to Managed Soils

It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N_2O emissions are reported as not occurring.

2.6.9.2.1.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.9.2.1.4 Direct N_2O Emissions from N Mineralization/Immobilization

No carbon losses are estimated from soils, thus direct N_2O Emissions from N Mineralization are reported as not occurring for settlements remaining settlements.

2.6.9.2.1.5 Indirect N_2O Emissions from Managed Soils

No direct N_2O emissions are estimated on these areas, thus indirect N_2O emissions from soils are also assumed as not occurring.

2.6.9.2.1.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land.

2.6.9.2.2 Land converted to settlements (4E2)

2.6.9.2.2.1 Carbon stock changes

- Living woody biomass: Fluxes on living woody biomass are estimated thanks to a stock-difference method.
- Living non-woody biomass: Fluxes on living non-woody biomass are estimated thanks to a stock-difference method.
- Dead organic matter (dead wood, litter): Fluxes on living ad organic matter (dead wood, litter) are estimated thanks to a stock-difference method.
- Soils (mineral and organic soils): It is assumed that in Iraq no organic soils exist in settlements. Fluxes on mineral soils are estimated thanks to a stock-difference method.

2.6.9.2.2.2 Direct N2O Emissions from N Inputs to Managed Soils

It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N2O emissions are reported as not occurring.

2.6.9.2.2.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils

Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.9.2.2.4 Direct N2O Emissions from N Mineralization/Immobilization

Direct N2O Emissions from N Mineralization/Immobilization are currently not estimated in the Iraqi inventory.

2.6.9.2.2.5 Indirect N2O Emissions from Managed Soils

Indirect N2O emissions from soils are currently not estimated in the Iraqi inventory.

2.6.9.2.2.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land.

2.6.9.3 Uncertainties and time-series consistency

A general discussion of uncertainty in the LULUCF sector was presented earlier.

2.6.9.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.9.5 Category-specific planned improvements

Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.6.10 Other lands (4F)

2.6.10.1 Description

This category comprises GHG emissions and removals arising from other lands (Figure 2-30)

In this category, emissions and absorptions are only estimated for land conversions. No emission estimation is calculated for other lands remaining other lands and for biomass burning (4F1). The emissions evolution for lands converted to croplands (4F2) reflects the trend in land-use change areas.

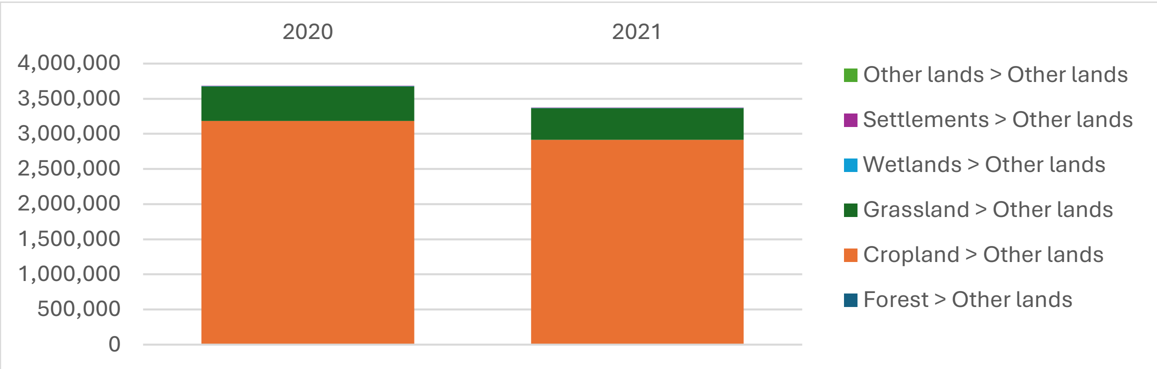


Figure 2-30: GHG emissions from other land (CRF 4.F) (kt CO2e)

2.6.10.2 Methodological issues

2.6.10.2.1 the lands remaining other lands (4F1)

2.6.10.2.1.1 Carbon stock changes

- Living woody biomass: On other lands remaining other lands equilibrium is assumed for living biomass, it is reported as not estimated in the Iraqi inventory.
- Living non-woody biomass: On other lands remaining other lands equilibrium is assumed for living biomass, it is reported as not estimated in the Iraqi inventory.
- Dead organic matter (dead wood, litter): On other lands remaining other lands equilibrium is assumed for dead organic matter, it is reported as not estimated in the Iraqi inventory.
- Soils (mineral and organic soils): On other lands remaining other lands equilibrium is assumed for mineral soils, it is reported as not estimated in the Iraqi inventory.

2.6.10.2.1.2 Direct N2O Emissions from N Inputs to Managed Soils
It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N2O emissions are reported as not occurring.

2.6.10.2.1.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils
Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.10.2.1.4 Direct N2O Emissions from N Mineralization / Immobilization
No carbon losses are estimated from soils, thus direct N2O Emissions from N Mineralization are reported as not occurring for other lands remaining other lands.

2.6.10.2.1.5 Indirect N2O Emissions from Managed Soils
No direct N2O emissions are estimated on these areas, thus indirect N2O emissions from soils are also assumed as not occurring.

2.6.10.2.1.6 Biomass Burning
It is assumed that no biomass burning is occurring on this type of land.

2.6.10.2.2 Land converted to other lands (4F2)

2.6.10.2.2.1 Carbon stock changes
- Living woody biomass : Fluxes on living woody biomass are estimated thanks to a stock-difference method.
- Living non-woody biomass : Fluxes on living non-woody biomass are estimated thanks to a stock-difference method.
- Dead organic matter (dead wood, litter): Fluxes on living dead organic matter (dead wood, litter) are estimated thanks to a stock-difference method.
- Soils (mineral and organic soils): It is assumed that in Iraq no organic soils exist in other lands. Fluxes on mineral soils are estimated thanks to a stock-difference method.

2.6.10.2.2.2 Direct N2O Emissions from N Inputs to Managed Soils
It is assumed that no other land but agricultural land is fertilized in Iraq, thus direct N2O emissions are reported as not occurring.

2.6.10.2.2.3 Emissions and removals from drainage and rewetting and other management of organic and mineral soils
Drainage and rewetting of organic and mineral soils are assumed to be not occurring in Iraq, thus related emissions and removals are reported as not occurring.

2.6.10.2.2.4 Direct N2O Emissions from N Mineralization / Immobilization
Direct N2O Emissions from N Mineralization/Immobilization are currently not estimated in the Iraqi inventory.

2.6.10.2.2.5 Indirect N2O Emissions from Managed Soils

Indirect N2O emissions from soils are currently not estimated in the Iraqi inventory.

2.6.10.2.2.6 Biomass Burning

It is assumed that no biomass burning is occurring on this type of land.

2.6.10.3 Uncertainties and time-series consistency

A general discussion of uncertainty in the LULUCF sector was presented earlier.

2.6.10.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.10.5 Category-specific planned improvements

Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.6.11 Harvested wood products (4G)

2.6.11.1 Description

This category includes GHG emissions and removals arising from biomass which is harvested in order to produce wood products, and hence sequester the CO_2, until its end-of use where it is released. Only CO_2 fluxes are applicable to this category.

Currently only fuelwood consumption is considered in harvest, and no commercial wood is estimated. Consequently, the emissions and removals from harvested wood products are currently not estimated in the Iraqi inventory.

2.6.11.2 Methodological issues

Thus, the emissions and removals from harvested wood products are currently not estimated in the Iraqi inventory.

2.6.11.3 Uncertainties and time-series consistency

A general discussion of uncertainty in the LULUCF sector was presented earlier.

2.6.11.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.6.11.5 Category-specific planned improvements

Future improvements will need to focus on enhancing the reliability of data and quantifying categories that are currently not estimated.

2.7 Waste (CRT sector 5)

2.7.1 Overview of the sector and background information

In Iraq, the Waste sector (CRT 5) includes the emissions from the following activities:

- Solid waste disposal (5A) – managed SWDS (5A1) and unmanaged SWDS (5A2).

- Incineration (5C1) and open-burning (5C2).
- Wastewater treatment and discharge (5D), including only domestic wastewater (5D1).

It is considered that there is no composting (5B1) or biogas production (5B2) in Iraq for the studied period.

Among the different GHGs, CH_4, N_2O and CO_2 emissions are estimated for the Waste sector.
Tier 1 methodologies were applied to all categories in the Waste sector, even for key categories. This decision was driven by the limited availability of data and the short timeframe, which made it difficult to collect sufficient data for reporting at a higher tier level.

The waste sector is the one with the most complete and available data, enabling the estimation of emissions over an extended period (from 1990 to 2021). Furthermore, to estimate emissions from Solid Waste Disposal Sites (SWDS), it is necessary to look back at least 50 years, as recommended by the IPCC guidelines. However, for the present NID, the focus will be on the years 2020 and 2021 when presenting results.

Many of the data and assumptions are derived from the following Japan International Cooperation Agency report (JICA report).[32]

Data collection study on solid waste management in Iraq, Final Report - January 2022, Japan international cooperation agency, Ministry of Construction and Housing and Municipalities and Public Works, Regional Ministry of Municipalities and Tourism in Kurdistan, Mayoralty of Baghdad, Basrah City and Erbil City.

In 2020 and 2021, the CRT 5 contributed to around 41% of the national CH_4 emissions and 6% of the national totals of N_2O, excluding LULUCF contribution. The waste sector is particularly preponderant in the Iraqi methane emissions. In terms of GHG contribution, the waste sector accounts between 7.3% and 8.3% of the national emissions in 2020 and in 2021. Within this sector, the methane emissions are predominant and represent around 90% of the emissions, while CO_2 emissions represent around 6% and N_2O emissions around 3%.

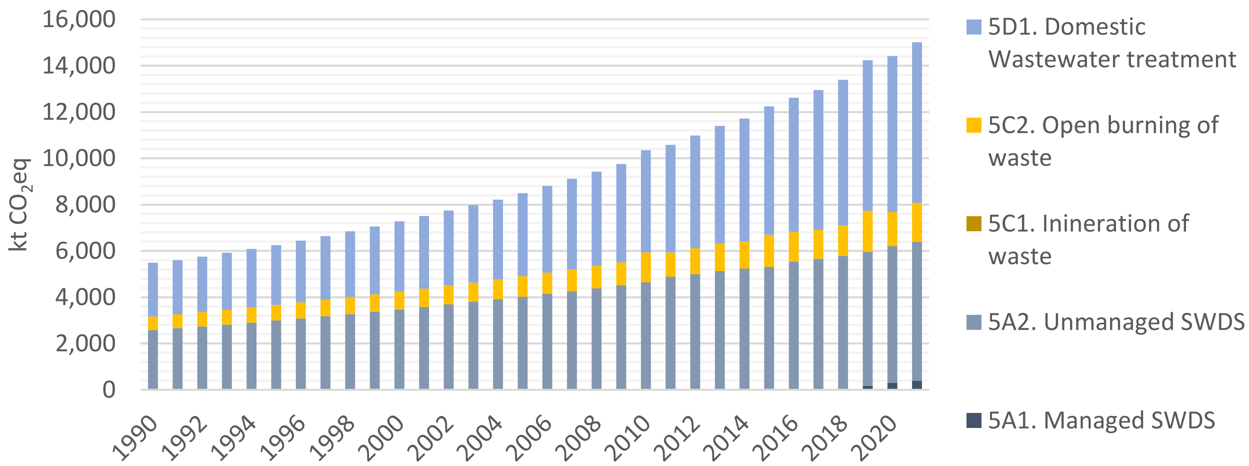


Figure 2-31: Waste sector emissions by sub-sector (in kt CO_2eq)

32 This report can be found at: openjicareport.jica.go.jp/pdf/12367264.pdf

GHG emissions from Waste amounted to 14.4 Mt CO_2e in 2020 and increased to 15 Mt CO_2e in 2021 (Figure 2-31)

2.7.2 Solid waste disposal sites (CRT 5A)

2.7.2.1 Category description

The category of the disposal of solid waste (5A1) is responsible of emissions of methane (CH_4), and of biogenic CO_2, which is not reported in the national totals.

Estimated emissions pertain only to municipal solid waste, as no information was available on industrial solid waste.

GHG emissions from SWDS have increased over the years, rising from 2.6 Mt in 1990 to 6.2 Mt in 2020 and 6.4 Mt in 2021—an increase of 147% between 1990 and 2021. However, its contribution to the waste sector has slightly decreased: from 46% of total sector emissions in 1990 to 42% in 2021 (Figure 2-32)

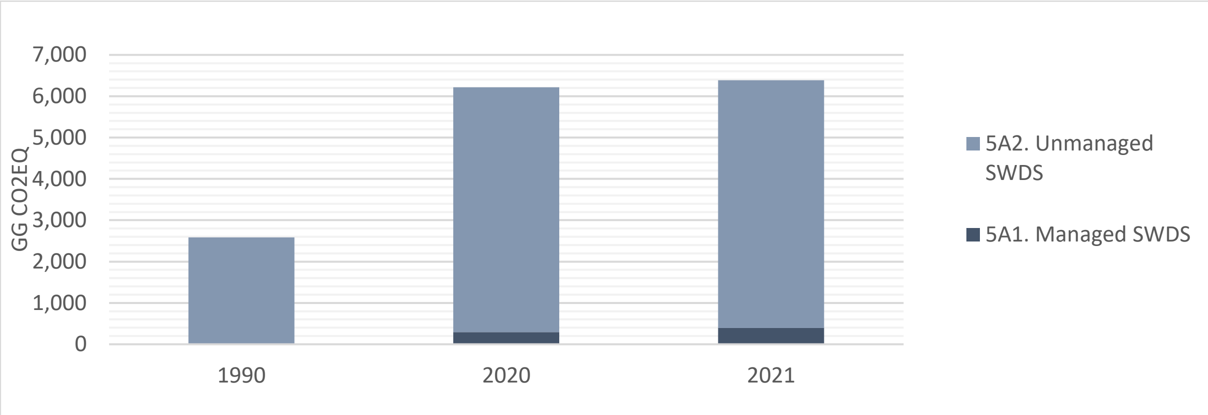


Figure 2-32: Solid waste disposal sites emissions (in kt CO2eq)

2.7.2.2 Methodological issues

The Tier 1 methodology recommended by the 2006 IPCC Guidelines was applied. The IPCC Waste Software proposed by the IPCC is implemented, more especially the "waste by composition" approach.

As far as possible country-specific parameters have been used as input data:

Amount of municipal solid waste generated:
Total amount of waste generated in Iraq for the 2010 – 2021 period was based on the collection rate for the whole country and the amount of waste collected from the JICA report.
The total amount of waste generated between 1950 and 2009 have been estimated based on the population of Iraq and an estimated generation rate of solid waste per inhabitant.

- Population

National data on population used in the Iraqi inventory are from UN World Urbanization Prospects[33] while the population of Kurdistan (excluding Iraq) is estimated based on the global population of the territory (Iraq including Kurdistan) and the average proportion of the population living in Kurdistan.

- Municipal Solid Waste (MSW) generation rate:

33 Percentage of Population at Mid-Year Residing in Urban Areas by region, subregion and country, 1950-2050, United Nations - World Urbanization Prospects
https://population.un.org/wup/Download/

The generation rate of solid waste per inhabitant has been estimated based on the average rate between 2010 and 2022 and has been considered constant over time (Table 2-34)

Table 2-34: MSW generation rate used in the inventory (in kg/inhabitant/year)

Year	Generation rate of MSW per inhabitant [kg/cap/year]
1950 - 2009	484,18
2010	613,62
2011	483,34
2012	496,32
2013	463,11
2014	442,32
2015	567,37
2016	472,26
2017	447,18
2018	453,77
2019	518,26
2020	427,11
2021	468,42

Fraction of generated MSW going to landfills (% to SWDS)

The amount of MSW disposed in landfills is estimated mainly based on the JICA report and on the following assumptions (Table 2-35):

- For the period 2010 – 2019, supposed to decrease with the development of the recycling practices.
- For the period 1950 – 2009: supposed to be constant and equal to the 2010 value
- For the period 2020 – 2021: supposed to be constant and equal to the 2019 value.

Table 2-35: Fraction of generated MSW going to landfills used in the inventory (in %)

Year	Solid Waste Disposal Sites (5.A) [%]
1950 - 2009	75,2
2010	75,2
2011	74,7
2012	74,1
2013	73,6
2014	73,0
2015	72,5
2016	71,9
2017	71,3
2018	70,8
2019	70,2
2020	70,2
2021	70,2

Repartition between management practices

For the period from 1950 to 2016, it is assumed that 100% of SWDS are unmanaged, with this proportion decreasing to 95% in 2017 and 90% from 2018 to 2021 due to the implementation of managed SWDS.

This assumption is based on the situation in Baghdad, which is considered representative of the entire country (Table 2-36).

Table 2-36: Repartition between management practices

Year	Unmanaged, shallow (%)	Unmanaged, deep (%)	Managed(%)	Managed, semi-aerobics(%)	Uncategorized (%)
1950 - 2016	100	0	0	0	0
2017	95	0	5	0	0
2018 - 2021	90	0	10	0	0

Waste composition

The composition of waste from Baghdad is assumed to be representative for the entire country for the period from 2010 to 2021 (Table 2-37 and Figure 2-33). The composition for 2010 is assumed to be relevant for the period from 1950 to 2009.

Table 2-37: Municipal solid waste composition used, per waste category (in %)

Year	Plastics	Paper/ Cardboard	Textiles	Food	Wood	Garden	Glass	Minerals	Nappies	Rubber and Leather	Other, inert waste
1950 – 2009	13.2	14.0	4.3	48.1	0.4	0.7	6.3	4.6	4.8	2.9	0.6
2010	13.2	14.0	4.3	48.1	0.4	0.7	6.3	4.6	4.8	2.9	0.6
2011	13.1	13.2	5.3	46.6	0.4	0.7	6.2	7.2	3.9	2.9	0.6
2012	13.5	15.9	4.4	47.8	0.4	0.7	6.5	5.2	2.0	2.9	0.6
2013	15.7	18.2	3.2	43.3	0.4	0.7	5.5	5.7	3.7	2.9	0.6
2014	16.1	13.3	2.5	43.7	0.4	0.7	7.1	7.8	4.9	2.9	0.6
2015	13.1	15.3	4.8	44.0	0.4	0.7	4.8	6.7	6.8	2.9	0.6
2016	15.2	16.3	3.9	43.3	0.4	0.7	5.1	5.6	5.9	3.0	0.6
2017	15.2	16.0	2.6	43.0	0.4	0.7	6.4	6.7	5.4	3.0	0.6
2018	15.7	16.3	3.6	42.1	0.4	0.7	6.4	5.6	5.6	3.0	0.6
2019	19.6	18.9	1.8	40.1	0.5	1.0	4.2	4.7	4.4	4.0	0.8
2020	19.0	23.2	1.7	40.6	0.4	0.7	2.8	4.0	4.0	3.0	0.6
2021	19.9	23.3	1.6	39.5	0.4	0.7	3.8	3.8	3.6	2.9	0.6

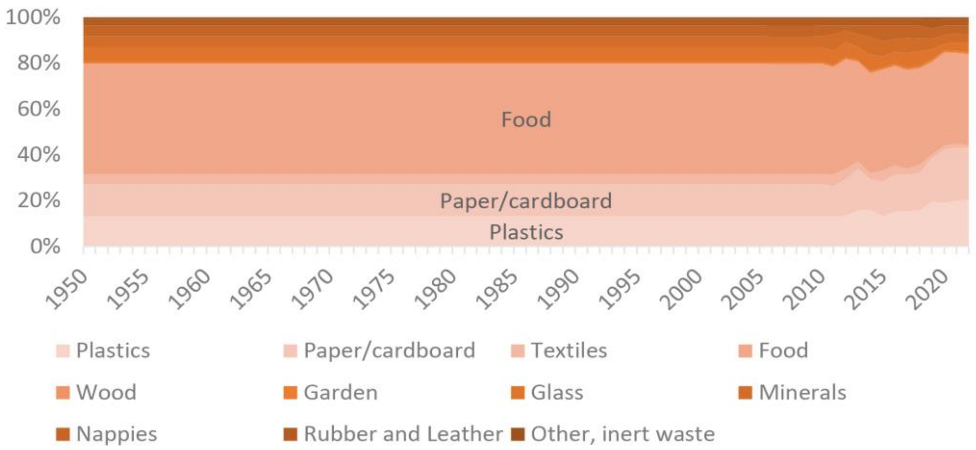


Figure 2 33: Composition of MSW treated (%)

Other parameters

Default values recommended by the 2006 IPCC Tool have been applied for the other parameters:

- Degradable organic carbon (DOC) content of each category of waste
- Fraction of the degradable organic carbon that decomposes under anaerobic conditions (DOC_f)
- Methane generation rate constant (k)
- Methane Correction Factor (MCF)
- An oxidation factor of 0 was assumed

2.7.2.3 Uncertainty assessment and time-series consistency

See earlier sections for a general discussion of uncertainty in the Waste sector.

2.7.2.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.7.2.5 Category-specific planned improvements

The following improvements are proposed to enhance the accuracy and relevance of data used in this category.

- Many of the data and assumptions are derived from the Japan International Cooperation Agency report. Working with data from national sources, if possible, would be beneficial.
- If characterization studies are available to determine the composition of landfilled waste, including moisture content, organic fraction, etc., it would be helpful to incorporate them.
- Due to a lack of information, industrial waste landfilling has not been included. Including it would be advantageous.

2.7.3 Open burning and incineration (CRT 5C1 and 5C2)

2.7.3.1 Category description

The categories of open-burning and incineration (5C1 and 5C2) are responsible of emissions of CO_2, CH_4 and to a lesser extent of N_2O.

Open burning is the second most common treatment for municipal solid waste, after landfilling. As for incineration, it is used exclusively to treat medical waste and was only recently implemented (since 2010). All the emi ssions from open-burning and incineration are reported under the CRT 5.C.1.b. "Non-biogenic".

Emissions from open burning increased by 15.8% between 2020 and 2021, rising from 1.5 Mt CO_{2eq} to 1.7 Mt CO_{2eq}. Its share of the waste sector also grew, from 10.1% in 2020 to 11.3% in 2021. Emissions from incineration have been steadily increasing since 2010, as more medical waste is being treated this way. However, emissions remain minimal compared to those from open burning, totalling just 0.00201 Mt CO_{2eq} (2.01 kt CO_{2eq}) in 2020 and 0.00206 Mt CO_{2eq} (2.06 kt CO_{2eq}) in 2021 (Figure 2 -34)

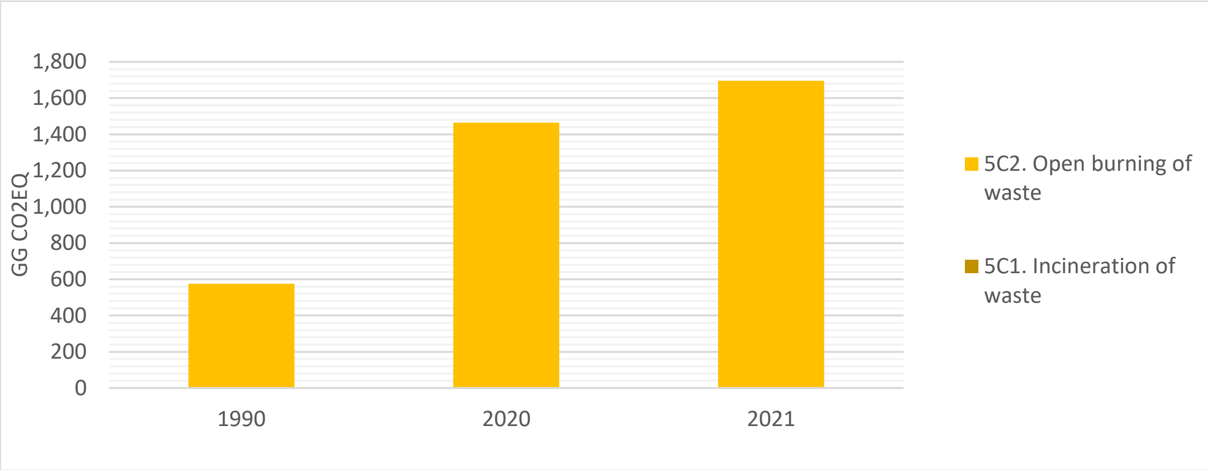


Figure 2 -34 : Incineration and open-burning emissions (in kt CO2eq)

2.7.3.2 Methodological issues

The Tier 1 methodology recommended by the 2006 IPCC Guidelines was applied.
As far as possible country-specific parameters have been used as input data:
For open burning of MSW:

- Amount of municipal solid waste generated: the same quantity of waste as described in the previous section on SWDS was used.
- Fraction of generated MSW going to open-burning (%):

The amount of MSW burnt is primarily based on estimates regarding the uncollected portion, which is assumed to be treated as follows (JICA report)

- Open burning: 40.0%
- Open dumping: 40.0%
- Reuse: 20.0%

- MSW composition: the same composition as described in the previous section on SWDS was used.
- CO_2 emission factor: default values of dry matter content, Total carbon content, Fossil carbon fraction, and Oxydation Factor from the 2006 IPCC guidelines were used to calculate the CO_2 emission factor.
- CH_4 and N_2O emissions factors: default values from the 2006 IPCC guidelines were used: 6,500 g/Mg (wet weight) for CH_4 and 150 g/Mg (wet weight) for N_2O.

For incineration of medical waste:

- Amount of medical waste:

The quantity of medical waste was sourced from the JICA report (Table 2-38). Compared to international data, it appears that the amount of medical waste in Iraq is extremely small, suggesting that insufficient data may have been collected.

Table 2-38: Medical solid waste generation rate

Year	Medical Solid Waste generation rate [kg/cap/day]	Medical Solid Waste disposed [kg/yr]
2020	0,0005	7 574,28
2021	0,0005	7 782,21

- Fraction of generated medical waste going to incineration (%): It is assumed that all medical solid waste is incinerated
- CO_2 emission factor: default values of dry matter content, Total carbon content, Fossil carbon fraction, and Oxydation Factor of medical waste from the 2006 IPCC guidelines were used to calculate the CO_2 emission factor.
- N_2O emissions factors: the same default value of the emissions factor for industrial waste was used: 100 g/Mg (wet weight) for N_2O (table 5.6, chap. 5 of IPCC guidelines)

2.7.3.3 Uncertainty assessment and time-series consistency

A general discussion of uncertainty in the Waste sector was presented earlier.

2.7.3.4 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.7.3.5 Category-specific planned improvements

To improve the accuracy of the data and assumptions, the following improvements are proposed:

- Collect national data on the quantity of treated medical waste
- Collect national data on the quantity of industrial waste sent to incineration
- The same applies to hazardous waste.

2.7.4 Wastewater treatment (CRT 5D)

2.7.4.5 Category description

Under this category, the following sources must be considered:

- Wastewater treatment: only domestic wastewater is considered as data was not available to estimate industrial wastewater.
- Water discharge in water bodies.

CH_4 emissions primarily occur during the wastewater treatment phase, while N_2O emissions occur during water discharge. However, GHG emissions from wastewater treatment are almost entirely methane, which accounts for 94%.

On-site biogas production in WWTP does not occur over the territory.
Emissions from wastewater treatment increased from 6.7 Mt in 2020 to 6.93 Mt in 2021—a 2.7% increase. However, its contribution to the waste sector has remained relatively stable in recent years, at around 46% of the total sector emissions (Figure 2-35)

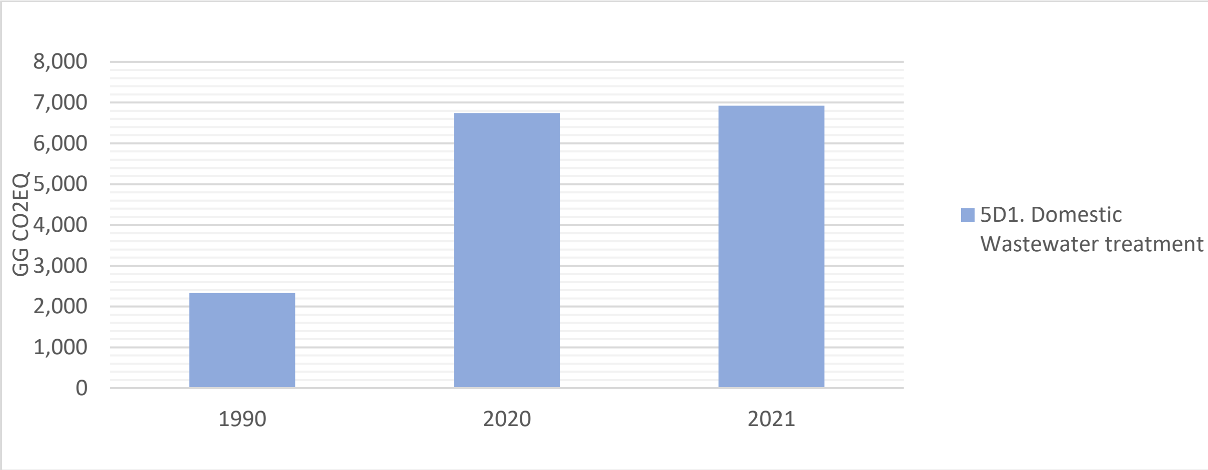


Figure 2-35: Wastewater treatment emissions (in kt CO2eq)

2.7.4.6 Methodological issues

Tier 1 methodology of the 2006 IPCC Guidel ines is applied to estimate CH_4 and N_2O emissions from domestic wastewater treatment and discharge.

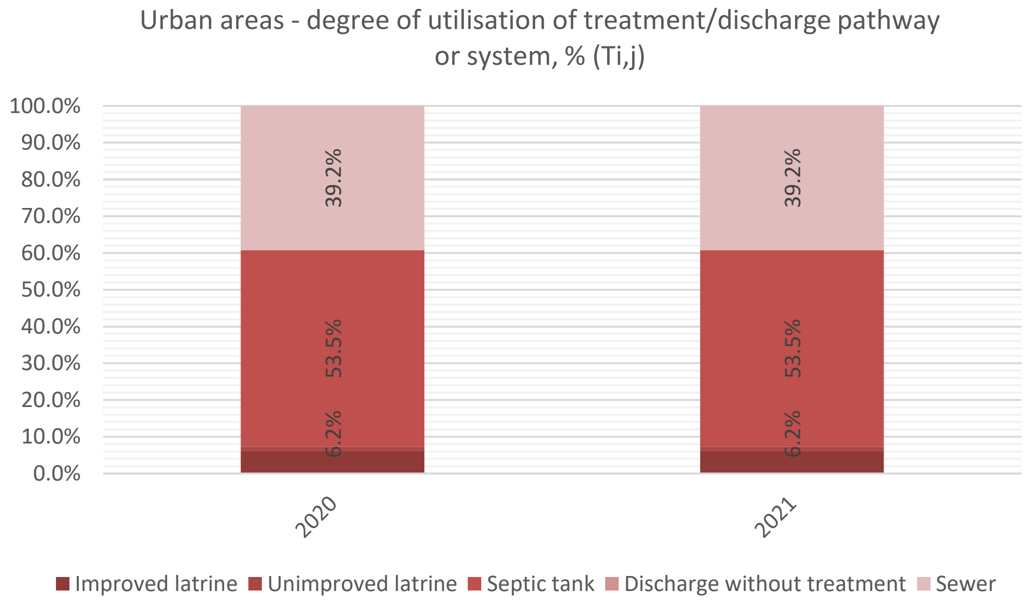
CH_4 emissions:

a) TOW in domestic wastewater is estimated using the equation 6.3 of the 2006 IPCC Guidelines.

As far as possible, country-specific parameters have been used as input data in the calculation:

- Population and Fraction of urban/rural population (U_i) comes from UN database
- Degree of utilisation of treatment/discharge pathway or system ($T_{i,j}$)

The treatment systems and discharge pathways repartition used is from UN water database[34] and depends on whether the area is urban or rural. The repartition is similar from 2020 to 2021 (Figure2-36) It should be noted that the term "sewer" here refers to anaerobic digester for sludge (conservative assumption).



34 Degree of use of the treatment system or discharge pathway for each income class (Ti,j) - Iraq
United Nation - Water treatment - countries.xlsx
United Nation – Water

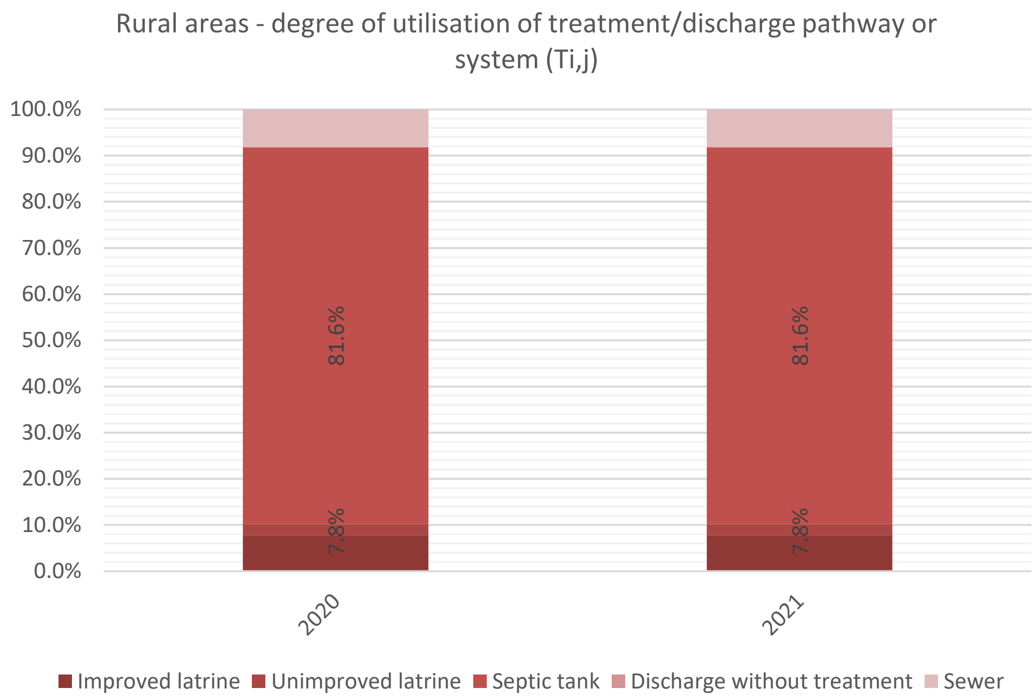


Figure 2-36 : Degree of utilization of treatment/discharge pathway or system (Ti,j) in urban and rural areas (2020 and 2021)

- Correction factor for additional Industrial BOD (I): The default I values proposed in the 2006 IPCC Guidelines were used for the relevant treatment and discharge system, i.e. 1 for Improved and unimproved latrine, septic tank and discharge without treatment and 1.25 for sewer.
- Organic component removed as sludge (S): In the absence of specific data, the default value recommended in the 2006 IPCC Guidelines—0—is applied to the Iraqi inventory.

b) Emission factors for each discharge or treatment system of domestic wastewater are estimated using Equation 6.2 of the 2006 IPCC Guidelines.

- Methane Correction factor (MCF)

In the Iraqi inventory, default values recommended by the 2006 IPCC Guidelines are applied to each treatment system and discharge pathway (Table 2-39)

Table 2-39: Methane correction factor per treatment systems and discharge pathways (MCF)

Type of treatment and discharge pathway or system considered	MCF applied
Improved latrine – Dry climate, ground water table lower than latrine, small family (3-5 persons)	0.1
Unimproved latrine – Dry climate, ground water table lower than latrine, communal (many users)	0.5
Septic tank	0.5
Discharge without treatment – by default it is considered to be discharged on ground)	0
Sewer – anaerobic digester for sludge	0.8

- Maximum CH_4 producing capacity (B_0): the default value recommended in the 2006 IPCC Guidelines (0.6 kg CH_4/kg BOD) is applied.

c) Amount of CH_4 recovered (R).

In absence of national data, the default value recommended in the 2006 IPCC Guidelines – 0 – is applied.

N_2O emissions:
To estimate N_2O emissions from domestic wastewater discharged, the equation 6.7 of the 2006 IPCC Guidelines is applied.

a) Total nitrogen in effluent (N-effluent) - estimated using the equation 6.8 of the 2006 IPCC Guidelines.

- Population (P): The population data used for the category 5D are consistent with the data used for the category 5A and population data used for CH_4 emissions from 5D.

Annual per capita protein consumption (Protein): National data on the annual amount of protein consumed per capita used are from FAO Statistics (Dietary Protein Consumption: g/person/day); average data in kg/year are considered in calculations (Table 2-40)

Table 2-40: Annual per capita protein consumption

Year	Per capita protein availability [kg/person/year]
2020	25,94
2021	25,55

- Fraction of Nitrogen in protein (Fnpr), Factor for non-consumed protein (Fnon-con) and factor for industrial and commercial co-discharged (Find-com). In the absence of country-specific information, the default values recommended in the 2006 IPCC Guidelines are applied for the fraction of nitrogen in protein, the factor for non-consumed protein added to wastewater, and the factor for industrial and commercial co-discharged protein into the sewer system (Table 2-41)

Table 2-41: Fraction of Nitrogen in protein (Fnpr), Factor for non-consumed protein (Fnon-con) and factor for industrial and commercial co-discharged (Find-com)

Parameters	Applied
Fraction of Nitrogen in protein (kg N/kg protein)	0.16
Factor for non-consumed protein ($F_{non-com}$)	1.1
Factor for industrial and commercial co-discharged ($F_{ind-com}$)	1.25 for sewer ; 1 for the remaining treatments

- Nitrogen removed with sludge (N-sludge): In absence of country specific information, the default value recommended in the 2006 IPCC Guidelines – 0 – is applied.

b) Emission factor (EF)

The default EF recommended i n the 2006 IPCC Guidelines (0.005 kg N_2O-N/kg N) is applied.

Note: N_2O emissions from advanced WWTP > there is no advanced WWTP with controlled nitrification and denitrification steps in Iraq. Consequently, emissions are not occurring.

2.7.4.7 Uncertainty assessment and time-series consistency

A general discussion of uncertainty in the Waste sector was presented in earlier sections.

2.7.4.8 Category-specific recalculations

The present report is Iraq's first BTR, consequently no recalculations are included. Recalculations will be performed and evaluated in the next reporting cycle.

2.7.4.9 Category-specific planned improvements

Future improvements include:

- Estimating industrial wastewater emissions.
- Using more country-specific data, especially regarding treatment types where possible.

CHAPTER 3

INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS UNDER ARTICLE 4 OF THE PARIS AGREEMENT

3 Information Necessary to Track Progress Made in Implementing and Achieving Nationally Determined Contributions Under Article 4 of the Paris Agreement

3.1 Description of Iraq's NDC under Article 4 of the Paris Agreement, including updates (para. 64 of the MPGs)

3.1.1 Background

On 1 January 2021, Iraq formally submitted its Update Nationally Determined Contribution (NDC) update to the UNFCCC Secretariat, marking a renewed commitment to address the climate crisis and outlining a pathway towards sustainable development. This update emphasizes Iraq's ambitious plan to reduce greenhouse gas emissions by 2030, reflecting a balance between economic growth and environmental responsibility.

The updated NDC includes a focus on decarbonizing key sectors of Iraq's economy, including energy, transportation, and industry. Iraq is prioritizing efforts to eliminate gas flaring, transition from high-carbon liquid fuels to cleaner alternatives, and increase the role of renewable energy. These sectoral strategies underscore Iraq's intent to make a meaningful impact on emissions reduction, aligning with global climate goals.

In addition, Iraq's NDC update provides a comprehensive overview of historical, ongoing, and planned actions in both adaptation and mitigation. With a primary focus on water scarcity, sustainable agriculture, and climate-smart infrastructure, Iraq's adaptation strategy emphasizes the importance of enhancing water resource management and expanding climate-resilient agricultural practices. Furthermore, the document highlights Iraq's dedication to sustainable development through increased irrigation efficiency, water harvesting, and renewable energy-powered desalination initiatives.

This updated NDC not only showcases Iraq's commitment to environmental protection and climate resilience but also integrates these efforts with national economic development plans, promoting sectoral diversification and poverty reduction. Iraq's active engagement in global climate governance is reflected in its holistic approach, positioning the country as a proactive participant in regional and international climate action.

3.1.2 Description of the latest NDC

(a) Target and description

Iraq's updated NDC sets an unconditional emissions reduction target of 1-2% by 2030, alongside a conditional target of a 15% reduction by 2030. Achieving the full 15% reduction is dependent on Iraq securing $100 billion in international financial support and technical assistance over the 2021-2030 period.

Key revisions in the 2021 NDC compared to Iraq's 2015 submission include (i) advancing the target year from 2035 to 2030, and (ii) focusing efforts on eliminating gas flaring and transitioning from high-carbon liquid fuels to natural gas, especially within power generation.

The baseline year for Iraq's business-as-usual (BAU) scenario is set as 2020, although the specific baseline emissions value is not provided within the NDC. This base year was determined as part of Iraq's BTR, using the latest national GHG inventory data, thereby providing a solid basis for accurately measuring emissions reductions.

(b) Target year
The NDC target of Iraq is a single-year target. The target year is 2030.

(c) Base Year and Baseline
The baseline year for Iraq's BAU scenario is 2020, with BAU emissions outlined in the BTR report. This scenario projects GHG emissions from 2020 through 2030 and extends to 2050, establishing benchmarks for emissions reduction. The BAU baseline provides a robust foundation for evaluating Iraq's progress in meeting its reduction targets.

(d) Time Frame for Implementation
The implementation period for Iraq's NDC spans from 2021 to 2030, with the emissions reduction target focused on the end of this timeframe.

(e) Scope and Coverage
Iraq's NDC covers all domestic sectors, with a particular focus on high-emissions areas such as:

- Oil & Gas
- Electricity
- Transport
- Additionally, non-oil industries, agriculture, solid waste management, and the residential sector, where energy efficiency measures are central, have been identified as key areas for reducing GHG emissions. Iraq has already initiated steps to support these efforts, including implementing green and smart building codes, enacting a solar energy law, and commissioning power plants that utilize natural gas instead of heavy fuel oil. The NDC further highlights the adoption of waste-to-energy applications in industrial processes, aligning with Iraq's broader goal of sustainable energy transition.

(f) Intention to use cooperative approaches that involve the use of internationally transferred mitigation outcomes under Article 6 towards NDCs under Article 4 of the Paris Agreement
Iraq's conditional target for a 15% reduction in greenhouse gas emissions by 2030 hinges on securing $100 billion in climate finance. Iraq intends to engage in cooperative approaches under Article 6 of the Paris Agreement, which facilitate international collaboration and financial support necessary for achieving its climate objectives. Through these approaches, Iraq seeks access to international funding and mitigation resources essential to meeting its conditional reduction target.

The required $100 billion in climate finance would support critical projects across high-emission sectors, including oil and gas, electricity, and transport. This funding is crucial for expanding renewable energy capacity, enhancing energy efficiency, and transitioning from high-carbon fuels to cleaner options such as natural gas in power generation. These projects form the backbone of Iraq's strategy to meet its NDC targets while advancing sustainable development and economic resilience.

Engagement in Article 6 cooperative approaches positions Iraq to attract international investments, leverage advanced technologies, and collaborate with global partners in its climate actions. This collaborative strategy aims to achieve Iraq's 15% conditional reduction target, strengthening the nation's climate resilience and advancing its progress toward a low-carbon economy.

(g) Any updates or clarifications of previously reported information (e.g. recalculation of previously reported inventory data, or greater detail on methodologies or use of cooperative approaches)
The base year of the BAU scenario was calculated within the framework of Iraq's first BTR, utilizing the most recent data from the national GHG emissions inventory. In the event of recalculations to the

base year of the BAU scenario—whether due to the inclusion of new emission sources or improvements in the methodologies for estimating emissions—updates to the BAU scenario will be incorporated into subsequent BTRs. This approach ensures that Iraq's reporting remains accurate and aligned with the latest data and techniques, maintaining transparency and reliability in tracking progress towards its climate targets.

3.2 Information necessary to track progress made in implementing and achieving NDCs under Article 4 of the Paris Agreement (paras. 65–79 of the MPGs)

To track progress towards the implementation and achievement of its NDC under Article 4, Iraq will use "National total net GHG emissions and removals" as reported in its National GHG Inventory Report section (Table 3-1). As noted in the previous section, if recalculations of the GHG emissions inventory occur due to the inclusion of new emission sources or improvements in the methodologies for estimating emissions in the national inventory, an update of the BAU scenario will be incorporated into the relevant BTR.

Table 3-1: Indicators for tracking progress

Information	Description
Selected indicator	National total net GHG emissions and removals.
Reference level	The reference level is total net GHG emissions as reported in the BaU scenario of BTR.
Updates	This is the first time the reference level is reported, hence there are no updates. The value of the reference level may be updated in the future due to methodological improvements and / or inclusion new sources and gases in the GHG inventory and BaU scenario.
Relation to the NDC	The indicator is defined in the same unit and metric as the target of the NDC. Hence it can be used directly for tracking progress in implementing and achieving the NDC target.
Definition	Total net GHG emissions correspond to the annual total of emissions and removals reported in CO2 equivalents in the latest GHG inventory of Iraq. The totals comprise all sectors and gases included in the latest NIR.

A key objective of the BTR is to showcase Iraq' progress in implementing their NDC and advancing toward its achievement. The latest data on GHG emissions and removals within the NDC's scope serves as the primary metric for tracking this progress. Table 3-2 provides a summary of the status.

Table 3-2: Summary of progress towards implementing and achieving the NDC

	Unit	Base year value	Values in the implementation period			Target level	Target year
			2021	2022	2030		
Indicator: National total net GHG emissions and removals	kt CO_2eq	197,115	200,068	NE (flexibility applied)	NA	1-2% below baseline, conditional 15%	2030
Baseline emissions	kt CO_2eq	19,457	201,979	202,289	268,596		

An annual emissions balance, aligned with Chapter III.B (Application of Corresponding Adjustments), will be included in a subsequent BTR following the finalization of additional guidance by the CMA, based on annual reporting under Article 6.2.
For more detailed information, please refer to CTF Table 4 ("Structured Summary: Tracking Progress Made in Implementing and Achieving the NDC under Article 4 of the Paris Agreement"), which has been submitted electronically alongside this BTR.

3.3 Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement (paras. 80–90 of the MPGs)

3.3.1 Mitigation pathways

Four mitigation pathways for GHG mitigation were identified and analyzed. The mitigation actions and projects focus on the following areas: primary energy, renewable energy, and energy efficiency.

- **Mitigation Pathway 1: Reducing Losses in Electricity Transmission and Distribution and Improving Power Generation Efficiency**: This pathway focuses on enhancing the efficiency of electricity generation stations and reducing losses in the transmission and distribution networks. The goal is to lower electricity losses from 22% in 2020 to 15% by 2030 and further to 10% by 2050. Implementation will be gradual, with the project's key components including optimization of distribution and generation, improvement of system capacity factors, and upgrading or replacing existing conductors and insulators with low-resistance equipment. Additionally, the project aims to reduce the carbon footprint in the oil and gas sector by modernizing oil wells and refineries.
- **Mitigation Pathway 2: Gradual and secure transition of energy sources, and diversify the energy mix (by Combined Cycle Natural Gas Plants)**: Under this pathway, 21 projects are planned to expand capacities of existing plants and convert certain plants from simple gas units to combined cycle units, with a total projected capacity increase of 8,789 MW between 2021 and 2030. Iraq intends to reduce all diesel-operated plants by 2026, followed by all simple fossil-fuel units by 2035, replacing them with natural gas combined cycle (NGCC) units in line with the National Integrated Energy Strategy. The implementation of this plan depends on Iraq's ability to ensure a 24-hour uninterrupted electricity supply.
- **Mitigation Pathway 3: Investment in Associated Gas Capture and Utilization**: This pathway includes four projects aimed at reducing flared gas by 50% by 2030, calculated as methane emissions burned per ton of equivalent oil produced. The project also focuses on capturing associated gas and redirecting it for use in the energy, industrial, or export sectors. This approach offers dual benefits by reducing combustion emissions while enhancing the supply of natural gas for productive use.
- **Mitigation Pathway 4: Increasing the Share of Renewable Energy in the Energy Mix**: This pathway proposes nine projects to generate electricity from solar power across various regions in Iraq, targeting a total capacity of 7,755 MW between 2021 and 2030, in line with the target in NDC in renewable energy investments totaling 12 GW, based on 2021 Cabinet decisions. The projects aim to diversify the energy mix, incorporating renewable sources such as solar, hydro, and wind energy. By 2030, the renewable share is expected to reach 8.5% of the total energy mix (3% hydro, 2.5% wind, and 3% solar), with a target of 12% by 2050 (5% hydro, 3% wind, and 4% solar).

3.3.2 Estimation of the mitigation impact

Estimating the impact of mitigation actions is essential for developing consistent projection scenarios that align with the outlined policies and measures. This estimation process not only helps ensure alignment with strategic goals but also plays a key role in assessing the effectiveness of these mitigation policies and measures. By quantifying the potential impact, we can evaluate whether the implemented actions are adequate to achieve targeted emission reductions and other sustainability objectives.

Additionally, these estimations provide a foundation for ongoing monitoring and evaluation, enabling adjustments as needed to stay on course toward long-term targets. The insights gained from these assessments help policymakers determine if further actions are required to meet emission reduction goals and contribute to an evidence-based approach to policy adaptation and improvement.

In this context, the mitigation achieved in 2021 and 2022 was not reported in Iraq's first BTR but will be included in subsequent BTR submissions, in accordance with the flexibility provisions outlined in paragraph 85 of the MPGs.

3.3.2.1 Mitigation pathway 1

Under this pathway, one project will be implemented to improve the efficiency of electricity generation stations and reduce losses in electricity transmission and distribution by a percentage from 22% in 2020 to 15% to 10% by 2030 and 2050, respectively. It will be implemented gradually, and the key components of the project include optimizing distribution and generation, improving system capacity factor, and upgrading or replacing existing conductors and insulators with equipment of lower resistance. The project also aims to reduce the carbon footprint in the oil and gas sector by developing oil wells and refineries. Table 3-3 presents the quantification of the mitigation effect.

Table 3-3: Quantification of the mitigation impact of pathway 1

	2025	2030	2035	2040	2045	2050
Total electricity incl distribution losses (BaU scenario) in GWh	129,684	179,044	243,031	310,868	384,279	464,696
Losses in electricity transmission and distribution (before mitigation actions)	22.00%	22.00%	22.00%	22.00%	22.00%	22.00%
Losses in electricity transmission and distribution (after mitigation actions)	20.00%	15.00%	13.75%	12.50%	11.25%	10.00%
Losses in electricity avoided in GWh	3,242	14,745	23,246	33,751	46,546	61,960
EF of power system in ktCO2eq/GWh[35]	0.472	0.552	0.470	0.431	0.419	0.366
Mitigation effect in kt CO2eq	1,530	8,141	10,919	14,540	19,519	22,681

3.3.2.2 Mitigation pathway 2

Under this pathway, 21 projects were included with a view to increasing the capacities of some installed plants and convert some plants from simple gas units to combined units for electricity generation with a total capacity of 8,789 MW in the period between 2021-2030. Iraq aimed to shut down all diesel-operating plants by 2026 and then shut down all simple unit plants operating on other types of fossil fuels by 2035 and convert them all to combined gas units (NG-Combined Cycle). The implementation of this plan depends on Iraq's ability to ensure a 24-hour uninterrupted electricity supply. Table 3-4 illustrates the quantification of the mitigation effect.

35 The emission factor (EF) of the power system varies annually to capture the ongoing changes in the power system as projected under the Business-as-Usual (BaU) scenario.

Table 3-4: Quantification of the mitigation impact of pathway 2

	2025	2030	2035	2040	2045	2050
Percentage of electricity produced from simple fired plants (BaU scenario)	69%	65%	50%	30%	25%	15%
Percentage of simple fired plants after mitigation actions	60%	10%	0%	0%	0%	0%
Percentage of combined fired after mitigation actions	40%	90%	100%	100%	100%	100%
Mitigation effect associated with the conversion of simple to combined gas fired in kt CO2eq	3,184	33,962	33,184	30,400	33,175	23,538
Mitigation effect associated with the decommission of diesel units in Residential and Tertiary sectors in kt CO2eq		2,680	2,891	3,111	3,317	3,528
Total mitigation effect of Pathway 2 in kt CO2eq	3,184	36,642	36,075	33,511	36,492	27,065

3.3.2.3 Mitigation pathway 3

Under this pathway, 4 projects will be implemented aiming to reduce the amount of flared gas by 50% by 2030 (expressed as methane emissions burned per ton of equivalent oil produced). The project also considers capturing associated gas and making it available for other uses. Therefore, this measure has a dual benefit of reducing combustion emissions and providing higher supplies of natural gas. Table 3-5 presents the quantified impact of the mitigation effect.

Table 3-5: Quantification of the mitigation impact of pathway 3

	2030	2035	2040	2045	2050
CH4 that was flared, kt CO2eq	163,376	171,545	180,122	189,128	198,585
Mitigation effect in ktCO2eq	68,902	89,783	95,583	101,936	108,201

3.3.2.4 Mitigation pathway 4

Under this pathway, 9 proposed projects have been included for generating electricity from solar energy in multiple regions of Iraq, with a total capacity of 7,755 megawatts between 2021 and 2030, in line with the target in NDC in renewable energy investments totaling 12 GW, based on 2021 Cabinet decisions. These projects aim to introduce additional capacities of solar, hydro, and wind energy reaching up to 8.5% (3% hydro, 2.5% wind, and solar 3%) by 2030 and 12% by 2050 (5% hydro, 3% wind, and solar 4%). Table 3-6 presents the quantified impact of the mitigation effect.

Table 3-6: Quantification of the mitigation impact of pathway 4

	2030	2035	2040	2045	2050
Capacity factor wind (2.6-3.5 TWh/GW/year)	3.05	3.05	3.05	3.05	3.05
Capacity factor solar PV (1.3-2.2 TWh/GW/year)	1.75	1.75	1.75	1.75	1.75
Capacity factor hydro (2.6-5.3 TWh/GW/year)	3.95	3.95	3.95	3.95	3.95
Total new capacity in GW	7.755	-	-	-	11.633
Wind	29%	-	-	-	25%
Solar PV	35%	-	-	-	33%
Hydro	35%	-	-	-	42%
Additional electricity from RES (GWh)	6,957	7,435	7,913	8,392	8,870
Mitigation effect in ktCO2eq	6,474	6,919	7,364	7,809	8,254

3.3.3 Detailed description of mitigation actions

3.3.3.1 Mitigation pathway 1

The project aims to enhance the efficiency of electricity generation stations and reduce transmission and distribution losses from 20% in 2020 to 15% by 2030 and further to 10% by 2050. Implementation is progressing gradually. Key components include optimizing both distribution and generation processes, improving the system's capacity factor, and upgrading or replacing existing conductors and insulators with lower-resistance equipment. Additionally, the project seeks to reduce the carbon footprint of the oil and gas sector by advancing the development of petroleum wells and refineries. Below is a detailed description of a proposed initiative to improve electricity production efficiency across energy stations in Iraq from 2021 to 2050 (Table 3-7).

Table 3-7: Outline of the project proposed to improve electricity efficiency production in power plants for the period 2021-2050.

Project 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 GHG): Energy / Primary Energy and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity / Ministry of Oil In collaboration with the German company SIEMENS
The Status (planned, implemented, under execution, canceled/invalid)	Under implementation
Key Assumptions Used in 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)	(2021-2025)
The goal 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.	

3.3.3.2 Mitigation pathway 2

This pathway envisions a transition from fossil fuel power plants in Iraq by 2035. As part of this transition, Iraq aims to decommission all diesel-operated power plants by 2026 and to convert all simple cycle plants powered by other fossil fuels into Natural Gas Combined Cycle (NGCC) plants by 2035, in alignment with the Integrated National Energy Strategy.

Outlined below are 21 projects aimed at increasing the capacity of existing combined cycle plants and converting several simple cycle gas plants to combined cycle plants, thereby boosting electricity generation. Together, these projects target a cumulative additional capacity of 8,789 megawatts between 2021 and 2030.

Table 3-8: Outline of the first project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle gas plants to produce more electricity

Project 1 – Path 2 Name and Brief Description of Mitigation Measures	Installation of additional capacity of 250 megawatts at Samawah Station to reach a total capacity of 750 megawatts. Installation of additional capacity of 250 megawatts at Dhi Qar power plant to reach a total capacity of 750 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity in contract with GE (General Electric)
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under implementation / Phase 1 completed, Phase 2 halted due to funding unavailability
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated power plants by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas power plants with units operating on the principle of combined-cycle (2021-2030). • Replacement of diesel-operated power plants with others operating on the principle of combined-cycle (2026).	

Table 3-9: Outline of the second project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 2 – Path 2 Name and Brief Description of Mitigation Measures	Basmayah Investment Project - Phases 1 and 2 with an additional capacity of 1000 megawatts to reach a total capacity of 3000 megawatts. Basmayah Investment Project - Phase 3 with an additional capacity of 500 megawatts to reach a total capacity of 1500 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity through a private sector contract - funded domestically
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Phase 1 completed; Phase 2 halted due to funding unavailability (source: BUR of Iraq)
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated power plants by 2026 and then cease all simple-cycle stations running on other fossil fuels by 2035, converting them all to combined-cycle power stations (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with stations operating on the principle of combined-cycle (2021-2030). • Replacement of diesel-operated stations with others operating on the principle of combined-cycle (2026).	

Table 3-10: Outline of the third project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 3 – Path 2 Name and Brief Description of Mitigation Measures	Rumaila Investment Station Project - Phase 1 with an additional capacity of 500 megawatts to reach a total capacity of 1000 megawatts. Rumaila Investment Station Project - Phase 2 with an additional capacity of 500 megawatts to reach a total capacity of 1500 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity through domestic financing - private sector
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The pathway aims with all its projects to completely stop fossil fuel power plants by 2035. Iraq aims to stop all diesel-operated stations by 2026, and then cease all simple-cycle units running on other fossil fuels by 2035, converting them to combined-cycle power units (NG-Combined Cycle)	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel plants by 2035 • Replacement of simple gas cycle plants with capacities operating on the combined cycle principle (2021-2030) • Replacement of diesel-powered plants with plants operating on the combined cycle principle (2026)	

Table 3-11: Outline of the fourth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 4 – Path 2 Name and Brief Description of Mitigation Measures	Rumaila Station Gas Units Conversion Project - Phase 1 with an additional capacity of 500 megawatts to reach a total capacity of 1500 megawatts. Rumaila Station Gas Units Conversion Project - Phase 2 with an additional capacity of 500 megawatts to reach a total capacity of 1500 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity through domestic financing
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-12: Outline of the fifth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 5 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Maysan Simple Station to Combined Cycle with an additional capacity of 250 megawatts to reach a total capacity of 750 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity through domestic financing
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Implemented
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-13: Outline of the sixth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 6 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Al-Amara Simple Station to Combined Cycle with an additional capacity of 250 megawatts to reach a total capacity of 750 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity through domestic financing
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Implemented
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-14: Outline of the seventh project within the scope of the second pathway proposed with a view to increasing, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 7 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Kirkuk Gas Station to Combined Cycle with an additional capacity of 278 megawatts to reach a total capacity of 557 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity - Contract signed with Stiller Energy on 2021/12/2 - Loan from BANK EXIM with a 36-month period after financial closure
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-15: Outline of the eighth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 8 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of the Diwaniyah gas power plant into a combined cycle with an additional capacity of 250 megawatts to reach a total capacity of 500 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Underway
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path, with all its projects, aims to completely halt fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated plants by 2026, followed by halting all units operating on other types of fossil fuels by 2035 and converting them all to combined cycle power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel 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 3-16: Outline of the ninth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 9 – Path 2 Name and Brief Description of Mitigation Measures	Project to convert Mansuriyah Gas Station into a compound cycle with an added capacity of 364 megawatts to reach a total capacity of 728 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The pathway aims to completely stop fossil fuel power stations by 2035. Iraq aims to stop all diesel-powered stations by 2026 and thereafter cease all stations with simple units operating on other fossil fuels by 2035, converting them all to NG-Combined Cycle units.	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power stations by 2035 • Replacement of simple cycle gas stations with capacities operating on the principle of combined cycle (2021-2030) • Replacement of diesel-powered stations with stations operating on the principle of combined cycle (2026)	

Table 3-17: Outline of the tenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and convert several other power plants from simple gas units to combined units to produce more electricity.

Project 10 – Path 2 Name and Brief Description of Mitigation Measures	Project to convert Al-Hilla gas power station into a combined cycle with an added capacity of 125 megawatts to reach a total capacity of 250 megawatts
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The track aims, with all its projects, to completely stop fossil fuel power stations by 2035. Iraq seeks to stop all diesel-powered stations by 2026, followed by the cessation of all units operating on other types of fossil fuels by 2035 and converting them all to combined cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• 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-powered stations with stations operating on the principle of combined cycle (2026)	

Table 3-18: Outline of the eleventh project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 11 – Path 2 Name and Brief Description of Mitigation Measures	Project to convert Khour Al Zubair gas station to a combined cycle with an added capacity of 125 megawatts to reach a total capacity of 250 megawatts
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Underway
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The pathway aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq aims to cease all diesel-operated stations by 2026 and subsequently halt all single-unit stations operating on other fossil fuels by 2035, converting them all to combined-cycle power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel 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 3-19: Outline of the twelfth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and convert several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 12 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Karbala Gas Station to Combined Cycle with an additional capacity of 125 megawatts to reach a total capacity of 250 megawatts
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity – Chinese Shanghai Company
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-20: Outline of the thirteenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and convert several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 13 – Path 2 Name and Brief Description of Mitigation Measures	Conversion of Najaf Gas Power Station into a 125 MW additional capacity combined cycle project to reach a total capacity of 250 MW.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity - Chinese Shanghai Company
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The pathway aims to completely halt fossil fuel power stations by 2035. Iraq seeks to cease all diesel-operated stations by 2026, followed by the cessation of all simple cycle units operating on other fossil fuels by 2035, converting them all into combined cycle units. (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel 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 3-21: Outline of the fourteenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and convert several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 14 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Shadra 1 gas station to Combined Cycle with an additional capacity of 160 megawatts, reaching a total capacity of 320 megawatts. Conversion project of Shadra 2 gas station to Combined Cycle with an additional capacity of 169 megawatts, reaching a total capacity of 338 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement CO_2 Reduction	The Executing Entity: Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-22: Outline of the fifteenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 15 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Haditha 1 gas station to Combined Cycle with an additional capacity of 250 megawatts, reaching a total capacity of 500 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units 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 3-23: Outline of the sixteenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and convert several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 16 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Gas Station Al-Quds 3 into a combined cycle with an additional capacity of 250 megawatts to reach a total capacity of 500 megawatts. Conversion project of Gas Station Al-Quds 3 into a combined cycle with an additional capacity of 250 megawatts to reach a total capacity of 500 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The aim of each project is to completely phase out diesel and simple cycle plants (with replacement by combined cycle natural gas plants) by 2035. Iraq seeks to halt all diesel-operated stations by 2026, followed by the cessation of all stations with simple units operating on other types of fossil fuels by 2035, converting them all to combined power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel stations by 2035. • Replacement of simple gas cycle stations with capacities operating on the principle of the combined cycle (2021-2030). • Replacement of diesel-operated stations with stations operating on the principle of the combined cycle (2026).	

Table 3-24: Outline of the seventeenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 17 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Al-Khairat gas station into a compound cycle with an additional capacity of 625 megawatts to reach a total capacity of 1250 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The objective of each path is to completely stop fossil fuel stations by 2035. Iraq aims to stop all diesel-operated stations by 2026, followed by ceasing all simple cycle stations operating on other types of fossil fuels by 2035, and converting them all to combined power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel stations by 2035. • Replacement of simple gas cycle stations with capacities operating on the combined cycle principle (2021-2030) • Replacement of diesel-operated stations with stations operating on the combined cycle principle (2026)	

Table 3-25: Outline of the eighteenth project within the scope of the second pathway proposed to increase, in the period between 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 18 – Path 2 Name and Brief Description of Mitigation Measures	Project to convert the Qayara gas station into a combined cycle with an additional capacity of 375 megawatts to reach a total capacity of 750 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, for a complete cessation of fossil fuel stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and subsequently cease all stations with simple units operating on other fossil fuels by 2035, converting them all to combined power units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel stations by 2035. • Replacement of simple gas cycle stations with capacities operating on the combined cycle principle (2021-2030) • Replacement of diesel-operated stations with stations operating on the combined cycle principle (2026)	

Table 3-26: Outline of the nineteenth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity

Project 19 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of Akkas gas station to Combined Cycle with an additional capacity of 125 megawatts, reaching a total capacity of 250 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel stations by 2035. • Replacement of simple gas cycle stations with capacities operating on the combined cycle principle (2021-2030) • Replacement of diesel-operated stations with stations operating on the combined cycle principle (2026)	

Table 3-27: Outline of the twentieth project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and convert several other simple cycle gas plants to combined cycle gas plants to produce more electricity.

Project 5 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of the Debis gas station into a compound cycle with an additional capacity of 169 megawatts to make the total capacity 338 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power stations by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then stop all stations with simple units operating on other types of fossil fuels by 2035, converting them all to compound gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power stations by 2035 • Replacement of simple gas cycle stations with capacities operating on the principle of the compound cycle (2021-2030) • Replacement of diesel-operated stations with stations operating on the principle of the compound cycle (2026)	

Table 3-28: Outline of the twenty-first project within the scope of the second pathway proposed to increase, in the period 2021-2030, the capacities of some existing combined cycle power plants and converting several other simple cycle gas plants to combined cycle power plants to produce more electricity.

Project 21 – Path 2 Name and Brief Description of Mitigation Measures	Conversion project of South Baghdad 1 gas station to Combined Cycle with an additional capacity of 125 megawatts, reaching a total capacity of 250 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Fuel Switching and Efficiency Improvement Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase generation efficiency and capacity
Time Period (Years)	(2026-2030)
Objective of Mitigation Measures	
The path aims, with all its projects, to completely stop fossil fuel power plants by 2035. Iraq seeks to stop all diesel-operated stations by 2026 and then cease all simple-cycle units running on other fossil fuels by 2035, converting them all to combined-cycle gas units (NG-Combined Cycle).	
Planned Activities within the Mitigation Measure	
• Complete cessation of fossil fuel power plants by 2035. • Replacement of simple-cycle gas stations with units operating on the principle of combined-cycle (2021-2030). • Replacement of diesel-operated stations with stations operating on the principle of combined-cycle (2026).	

3.3.3.3 Mitigation pathway 3

This pathway targets a 50% reduction in flared gas volumes by 2030, measured in terms of methane emissions burned per ton of oil equivalent. Pathway 3 also involves capturing associated gas to make it available for other productive uses. This approach offers dual benefits: it reduces emissions from gas flaring while increasing the supply of natural gas. Outlined below are the four proposed projects supporting this initiative.

Table 3-29: Outline of the first project within the scope of the third pathway proposed to use, by 2030, associated gas for fuel purposes.

Project 1 – Path 3 Name and Brief Description of Mitigation Measures	New Basra Gas Complex - Investment in Flared Associated Gas from Rumaila, Zubair, and West Qurna 1 Fields - 200 MMSCFD for Phase 1 and 200 MMSCFD for Phase 2.
Sector and Subsector (and Reduced GHG): Energy / Primary Energy Reducing CO_2	The Executing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	The project assumes a 50% reduction in flared gas quantities by 2030 (expressed as methane emissions burned per ton of oil equivalent produced). The project also considers that associated gas is captured and made available for other uses. Thus, this action has a dual benefit of reducing combustion emissions and providing higher supplies of natural gas.
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
To reduce emissions from combustion and to provide higher quantities of natural gas.	
Planned Activities within the Mitigation Measure	
• Capturing associated gas and making it available for other uses.	

Table 3-30: Outline of the second project within the scope of the third pathway proposed to use, by 2030, associated gas for fuel purposes.

Project 2 – Path 3 Name and Brief Description of Mitigation Measures	The Nasiriya and Gharraf Complex for Utilizing Associated Gas Burned from Nasiriya and Gharraf Fields with a Capacity of 200 MMSCFD
Sector and Subsector (and Reduced GHG): Energy / Primary Energy Reducing CO_2	The Executing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	The project assumes a 50% reduction in flared gas quantities by 2030 (expressed as methane emissions burned per ton of equivalent oil fuel produced). The project also considers that associated gas is captured and made available for other uses. Therefore, this measure has a dual benefit of reducing combustion emissions and providing higher supplies of natural gas.
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
To reduce emissions from combustion, and to provide higher quantities of natural gas.	
Planned Activities within the Mitigation Measure	
• Capturing associated gas and making it available for other uses.	

Table 3-31: Outline of the third project within the scope of the third pathway proposed to use, by 2030, associated gas for fuel purposes.

Project 3 – Path 3 Name and Brief Description of Mitigation Measures	Artaoui Complex for Associated Gas Investment Burned from the Western Qurna Fields - Mad - Sabah - Al-Luhais Capacity of 300 MMSCFD for the first phase and 300 MMSCFD for the second phase.
Sector and Subsector (and Reduced GHG): Energy / Primary Energy Reducing CO_2	The Executing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	The project assumes a 50% reduction in flared gas quantities by 2030 (expressed as methane emissions burned per ton of equivalent oil fuel produced). The project also considers that associated gas is captured and made available for other uses. Therefore, this measure has a dual benefit of reducing combustion emissions and providing higher supplies of natural gas.
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
To reduce emissions from combustion, and to provide higher quantities of natural gas.	
Planned Activities within the Mitigation Measure	
• Capturing associated gas and making it available for other uses.	

Table 3-32: Outline of the fourth project within the scope of the third pathway to start exploiting associated gas by 2030.

Project 4 – Path 3 Name and Brief Description of Mitigation Measures	Al Fayhaa Complex for Associated Gas Investment from Al Fayhaa Field with a capacity of 120 MMSCFD.
Sector and Subsector (and Reduced GHG): Energy / Primary Energy Reducing CO_2 and CH_4	The Executing Entity Ministry of Oil and Gas
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	The project assumes a 50% reduction in flared gas quantities by 2030 (expressed as methane emissions burned per ton of equivalent oil fuel produced). The project also considers that associated gas is captured and made available for other uses. Therefore, this measure has a dual benefit of reducing combustion emissions and providing higher supplies of natural gas.
Time Period (Years)	(2021-2025)
Objective of Mitigation Measures	
To reduce emissions from combustion, and to provide higher quantities of natural gas.	
Planned Activities within the Mitigation Measure	
• Capturing associated gas and making it available for other uses.	

3.3.3.4 Mitigation pathway 4

The project aims to expand renewable energy capacity in Iraq by increasing the shares of solar, hydro, and wind energy to reach a combined 8.5% of the total energy mix by 2030 (3% hydro, 2.5% wind, and 3% solar) and 12% by 2050 (5% hydro, 3% wind, and 4% solar). To support this goal, nine solar energy projects have been proposed across various regions in Iraq, with a cumulative target capacity of 7,755 megawatts between 2021 and 2030, in line with the target in NDC in renewable energy investments totaling 12 GW, based on 2021 Cabinet decisions.

Table 3-33: Outline of the first project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 1 – Path 4 Name and Brief Description of Mitigation Measures	Solar Power Generation Project in Basra - Artawi by Southern Production Company with a total capacity of 1000 Megawatts.
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity / Southern Production Company Investing Company: TOTAL
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key 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 Measures	
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 the Mitigation Measure	
• Installation of solar panels and supplying generated power to the national electricity distribution network • Electricity generation from solar energy in Basra – Artawi by the Southern Production Company with a total capacity of 1000 Megawatts.	

Table 3-34: Outline of the second project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 2 – Path 4 Name and Brief Description of Mitigation Measures	Solar Power Generation Project in Amarah, Ur, and Ramadi (1 and 2) and Mosul-Ayn Tamr, with a total capacity of 2000 Megawatts.
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Abu Dhabi Future Energy Company (Masdar)
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase 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 Measures	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions	
Planned Activities within the Mitigation Measure	
• Installation of solar panels and supply of generated power to the national electricity grid • Electricity generation from solar energy in Amarah, Ur, Ramadi (1 and 2), and Mosul-Ain Tamur, with a total capacity of 2000 Megawatts.	

Table 3-35: Outline of the third project proposed within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 3 – Path 4 Name and Brief Description of Mitigation Measures	Project to equip the Ministry of Electricity headquarters in Baghdad with 1 megawatt of solar power, connected to the national electricity grid (on-grid).
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase 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 Measures	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions.	
Planned Activities within the Mitigation Measure	
• Project to equip the Ministry of Electricity headquarters in Baghdad with 1 megawatt • Installation of solar panels and supply of generated power to the national electricity grid.	

Table 3-36: Outline of the fourth project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 4 – Path 4 Name and Brief Description of Mitigation Measures	Solar power generation project in Karbala and Alexandria by Middle Euphrates Production Company with a total capacity of 525 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Norwegian company Scatec
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase 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 Measures	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions.	
Planned Activities within the Mitigation Measure	
• Installation of solar panels and supply of generated power to the national electricity grid. • Generating electricity from solar energy in Karbala and Alexandria by Middle Euphrates Production Company with a total capacity of 525 megawatts.	

Table 3-37: Outline of the fifth project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 5 – Path 4 Name and Brief Description of Mitigation Measures	Solar power generation project in Samawah by South Production Company with a total capacity of 2000 megawatts, noting that the added capacity during the first phase is 750 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Power China
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key 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 Measures	
Increase the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions.	
Planned Activities within the Mitigation Measure	
• Installation of solar panels and supply of generated power to the national electricity grid • Electricity generation from solar energy in Samawah by South Production Company with a total capacity of 2000 megawatts, noting that the added capacity during the first phase is 750 megawatts.	

Table 3-38: Outline of the sixth project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity

Project 6 – Path 4 Name and Brief Description of Mitigation Measures	Project for generating electricity from solar energy in Najaf by the Middle Euphrates Production Company with a total capacity of 1000 Megawatts
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Acwa Power
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key 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 Measures	
Increasing the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions.	
Planned Activities within the Mitigation Measure	
• Installation of solar panels and supplying generated power to the national electricity grid • Generating electricity from solar energy in Najaf by the Middle Euphrates Production Company with a total capacity of 1000 Megawatts.	

Table 3-39: Outline of the seventh project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 7 – Path 4 Name and Brief Description of Mitigation Measures	Solar Power Generation Project in Abu Al-Khasib, Al-Bathaa, and Rehabilitation by South Production Company with a total capacity of 1000 megawatts, noting that the additional capacity during the first phase is 550 megawatts.
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Gulf Power
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase 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 Measures	
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 the Mitigation Measure	
• Installation of solar panels and supply of generated power to the national electricity grid • Electricity generation from solar energy in Abu Al-Khasib, Al-Bathaa, and Rehabilitation by South Production Company with a total capacity of 1000 megawatts, noting that the additional capacity during the first phase is 550 megawatts.	

Table 3-40: Outline of the eighth project within the scope of the fourth pathway proposed to introduce, by 2030, additional solar, hydro and wind capacity.

Project 8 – Path 4 Name and Brief Description of Mitigation Measures	Solar Power Generation Project in Al-Khadir, Al-Ramla, and Jassan by South Production Company, Middle Euphrates Production Company, and Central Region Production Company with a total capacity of 150 Megawatts, and with a capacity of 50 Megawatts for each site.
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Phanse
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key 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 Measures	
Increasing the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions.	
Planned Activities within the Mitigation Measure	
• Installation of solar panels and supplying generated power to the national electricity grid. • Electricity generation from solar energy in Al-Khadir, Al-Ramla, and Jassan by South Production Company, Middle Euphrates Production Company, and Central Region Production Company with a total capacity of 150 Megawatts, and with a capacity of 50 Megawatts for each site.	

Table 3-41: Outline of a ninth project proposed within the scope of the fourth pathway to introduce, by 2030, additional solar, hydro and wind capacity.

Project 9 – Path 4 Name and Brief Description of Mitigation Measures	The South Production Company is undertaking a solar power generation project at Sawa 1 and Sawa 2, with a combined total capacity of 80 megawatts (MW).
Sector and Subsector (and Reduced GHG): Energy / Renewable Energy Reducing CO_2	The Executing Entity Ministry of Electricity Investing Company: Gulf Power
Status (Planned, Implemented, Under Implementation, Cancelled/Invalid)	Under Implementation
Key Assumptions Used in Mitigation Analysis	Increase 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 Measures	
Increasing the share of clean energy from renewable sources at the expense of fossil fuels and diesel, thereby achieving sustainability in electricity generation and reducing emissions	
Planned Activities within the Mitigation Measure	
• Installation of solar panels and supplying generated power to the national electricity grid. • Electricity generation from solar energy in Saawa 1 and Saawa 2 by South Production Company with a total capacity of 80 Megawatts.	

3.4 Projections of greenhouse gas emissions and removals, as applicable (paras. 92–102 of the MPGs)

3.4.1 Definition of projection scenarios

The analysis of greenhouse gas emission mitigation has been conducted by sector at the national level, focusing on opportunities to reduce emissions within the energy sector (including primary energy, renewable energy, and energy efficiency). For this analysis, two scenarios were established: a baseline scenario, known as Business as Usual (BaU), and two mitigation scenarios—'With Measures' (WM) and 'With Additional Measures' (WAM).

- BaU Scenario: This scenario assumes that no new policies or programs will be introduced to actively reduce greenhouse gas emissions or enhance carbon removal. Establishing this baseline is essential for evaluating mitigation efforts, as the effectiveness and costs of different mitigation options are directly compared to this benchmark. The baseline was developed based on existing trends, national policies, and plans, using 2021 as the reference year. It integrates the policies, programs, and projects outlined in the National Integrated Energy Strategy for 2013-2030, which form the foundation of the baseline scenario projected through to 2050. Developing the BaU scenario involved forecasting future levels of various activities for 2022-2050, with assumptions based on official data regarding population growth, gross domestic product, and other key variables sourced from national institutions, the United Nations, the World Bank, and the International Energy Agency.

- Mitigation Scenarios: The WM and WAM mitigation scenarios were developed according to criteria specific to Iraq's context, such as the potential for substantial greenhouse gas reduction, economic impacts, alignment with national development objectives, policy feasibility, sustainability, data availability for assessment, and other sector-relevant factors. The WM scenario assumes partial implementation of mitigation policies, achieving a 15% reduction in GHG emissions by 2030 relative to BaU levels, with this reduction sustained through 2050. The WAM scenario assumes full implementation of the mitigation policies and measures outlined in the preceding chapter, maximizing emissions reduction potential.

These scenarios offer a structured approach to analyzing emission reduction strategies and understanding the economic and environmental impacts of potential policy pathways in Iraq.

3.4.2 Methodology used to develop emission projections

A 5-step methodology was applied to develop the BaU scenario of the GHG emissions, as illustrated in Figure 3-1.

- **Step 1: Socio-economic indicators**: The first step in developing the BaU scenario involves collecting socio-economic indicators, such as data about population, GDP, oil and gas production, and industrial production, and analyzing their historical values, as well as official projections for the years up to 2050.
- **Step 2: Identifying primary parameters for GHG emission projections in each sector**: In the second step, the primary parameter that has the most significant impact on each sector's activity data and, therefore, on its GHG emissions is identified. These parameters are selected based on their potential to predict future GHG emissions in each sector. The parameters identified for each sector are then correlated with the socio-economic indicators in the next step of the methodology.
- **Step 3: Correlation analysis between primary parameters and socio-economic indicators**: The purpose of the third step is to identify the relationship strength between each primary parameter identified in Step 2 and the relevant socio-economic indicators. The indicator with the strongest correlation is selected to project the parameter, activity data, and subsequently, the GHG emissions. The relationship strength between the primary parameters and socio-economic indicators is evaluated using two measures: the correlation coefficient and the coefficient of determination. These measures provide a quantitative assessment of the relationship between the primary parameters and the socio-economic indicators, helping to identify the most relevant indicator for each sector. A brief definition of correlation coefficient and coefficient of determination follows:
  - Correlation coefficient: A correlation coefficient is a statistical measure that quantifies the strength and direction of the relationship between two variables. It ranges from -1 to 1, where values close to -1 indicate a strong negative correlation, values close to 1 indicate a strong positive correlation, and values close to 0 indicate no correlation.
  - Coefficient of determination: The coefficient of determination, also known as R-squared, is a statistical measure that indicates how well a regression model fits the observed data. It represents the proportion of the total variation in the dependent variable that is explained by the independent variables. It ranges from 0 to 1, with higher values indicating a better fit of the model to the data.
- **Step 4: Projecting primary parameters for each sector**: In the fourth step of the methodology, the primary parameters for each sector are projected. The projections are based on the relationship identified with the socio-economic indicator that has the highest correlation and coefficient factors. By projecting the primary parameters, it is possible to estimate the future activity levels and GHG emissions for each sector in the following step.

- **Step 5: Projecting future activity levels and GHG emissions for each sector**: In the fifth and final step of the methodology, the future activity levels and GHG emissions for each sector are projected. This is done by using the detailed model developed for the estimation of the GHG inventory. The model takes into account the projected activity levels for each sector, along with the primary parameters and their relationship with the socio-economic indicators. Based on these inputs, the model can compute the future GHG emissions for each subsector. The results of this step provide the final GHG emissions projections for the BaU scenario.

The mitigation scenarios, WM and WAM, were developed by calculating the reduction in emissions relative to the BaU emission projections, reflecting the impact of mitigation efforts.

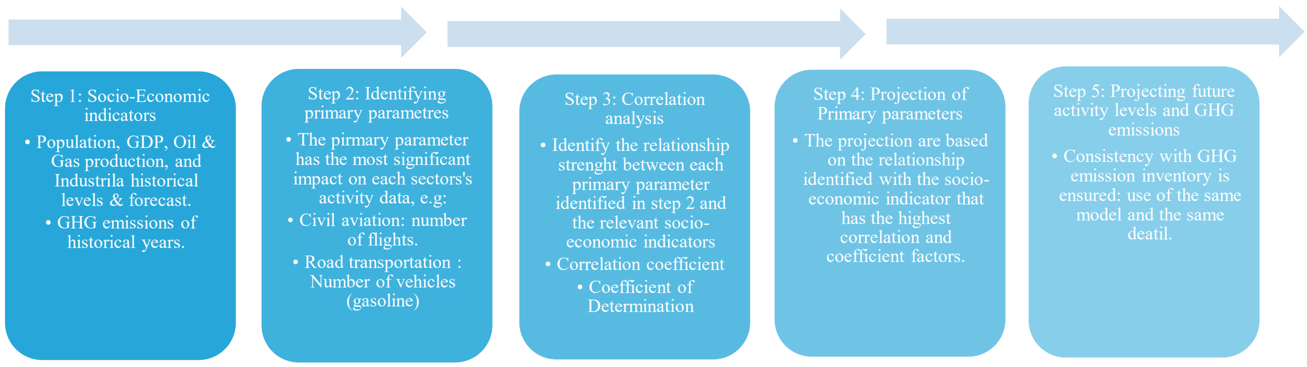


Figure 3-1: Methodology applied for the construction of the baseline (BaU scenario)

3.4.3 Data sources and key socio-economic parameters

Key aggregate economic data for constructing the baseline scenario were sourced as follows:

- Gross Domestic Product (GDP): Historical GDP values were obtained from the World Bank, with short-term projections (2024-2029) from the International Monetary Fund (IMF) and long-term forecasts (2030-2050) from the International Institute for Applied Systems Analysis (IIASA) SSIP database (Figure 3-2).
- Value-Added in Economic Sectors: Data on sectoral value-added were sourced from figures provided by the World Bank.
- Population and Household Data: Population data, household size, and projected population growth rates for the period 2000-2050 were derived from the UN World Population Prospects 2024 and IMF databases (Figure 3-3).
- Energy Demand: Historical energy demand data for 2000-2022 (Energy Balances) were obtained from the International Energy Agency (IEA), while projections for 2023-2050 were calculated based on the methodology described in the previous section, incorporating local and global trends, population growth, and economic expansion.
- Electricity Generation: Data on electricity generation were sourced from the IEA.
- Electricity Transmission and Distribution Losses: Information on electricity losses during transmission and distribution was obtained from the IEA.
- Oil Refining: Oil refining data for 2013-2030 were sourced from the Integrated National Energy Strategy, supplemented by IEA data.
- Oil and Natural Gas Production: Date on oil and natural gas production were sourced from the IEA.

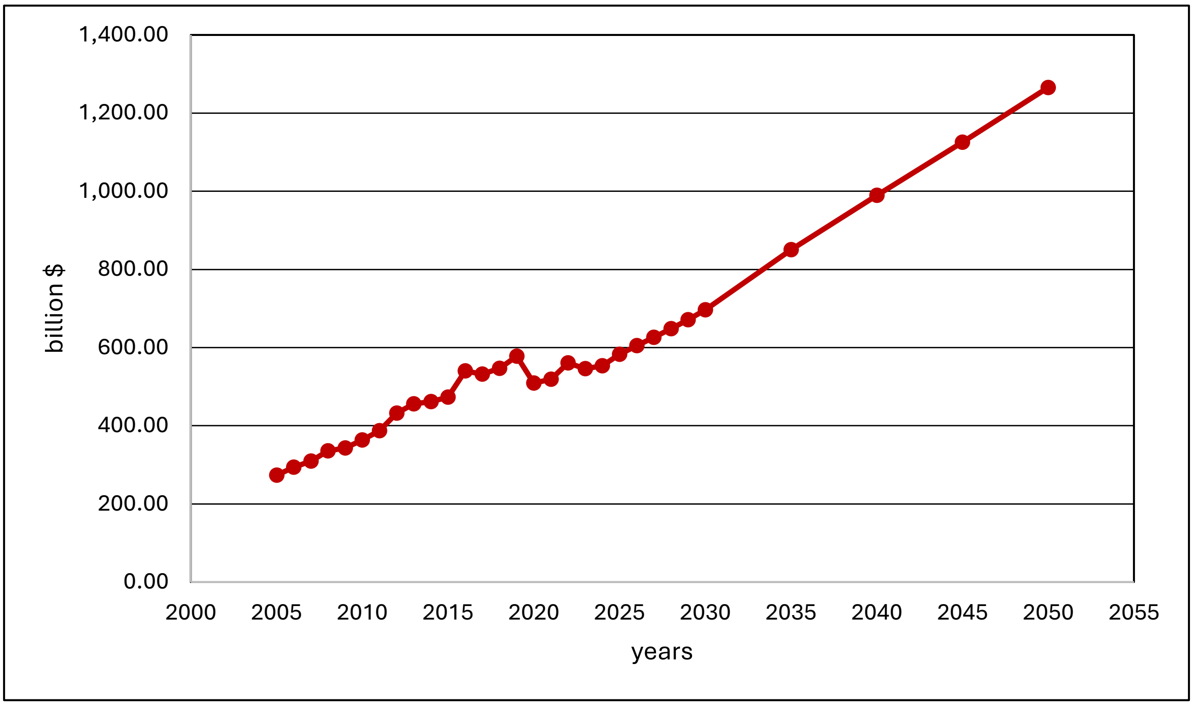


Figure 3-2: GDP, PPP (constant 2021 international $) and projection till year 2050 (source: IMF and IIASA)

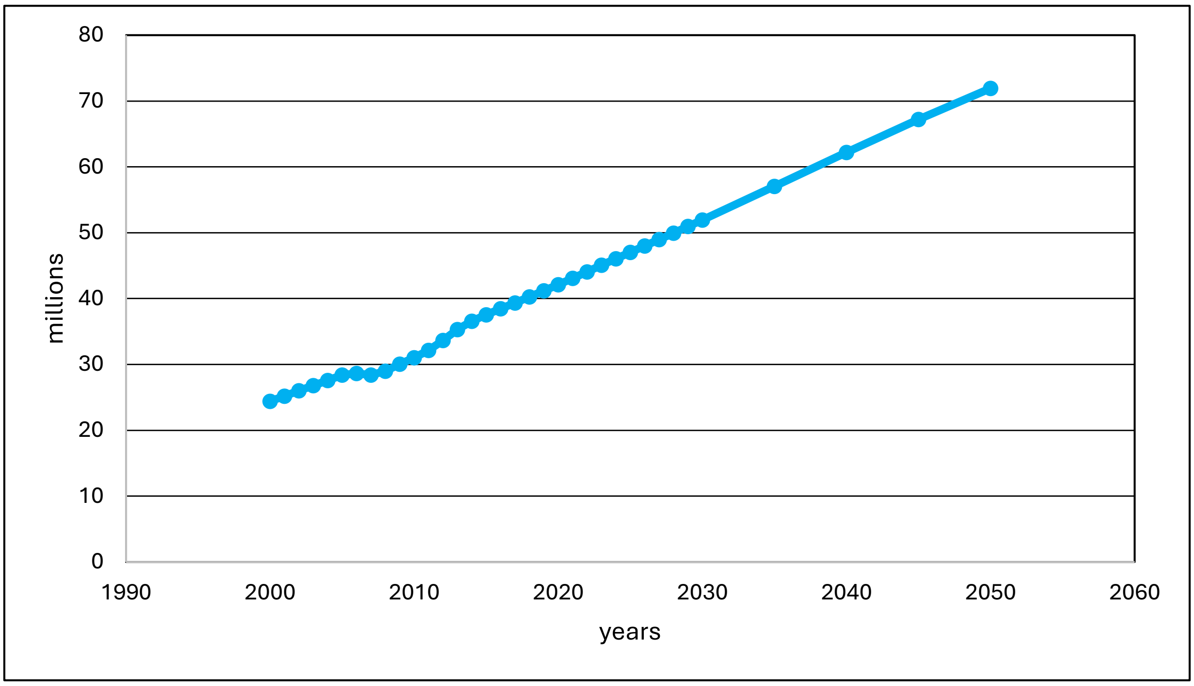


Figure 3-3: Population and projection till year 2050 (source: UN World Population Prospects 2024)

3.4.4 Reference scenario (BaU scenario)

3.4.4.1 Energy sector

The energy sector encompasses a broad array of industries crucial for economic growth and energy security, including power generation, oil and gas production, oil refining, manufacturing and construction, transportation, and residential sectors, along with other sectors such as commercial and agriculture. To develop reliable projections for future energy trends, several assumptions were integrated, alongside consi derations of socio-economic factors such as population growth, urbanization, industrial expansion, and technological advancements:

- Power Sector: Historical data from the International Energy Agency (IEA) was utilized for the period 2000–2022, encompassing metrics such as electricity generation from oil, natural gas, and renewable energy sources (RES) like solar PV and hydro. Electricity imports and distribution losses, estimated at 22%, were also included in the analysis. Future projections of fuel and technology shares through 2030 are aligned with the Integrated National Energy Strategy (Figure 3-4). In addition, a target of natural gas (NG) to supply 80% of electricity production by 2030 was considered. Combined cycle NG-fired plants are projected to make up 35% of NG-fired capacity by 2030, reaching 85% by 2050. Electricity generation from RES is anticipated to reach 5% by 2030 and 10% by 2050. Additionally, electricity imports are expected to phase out entirely by 2030 and remain at zero thereafter.

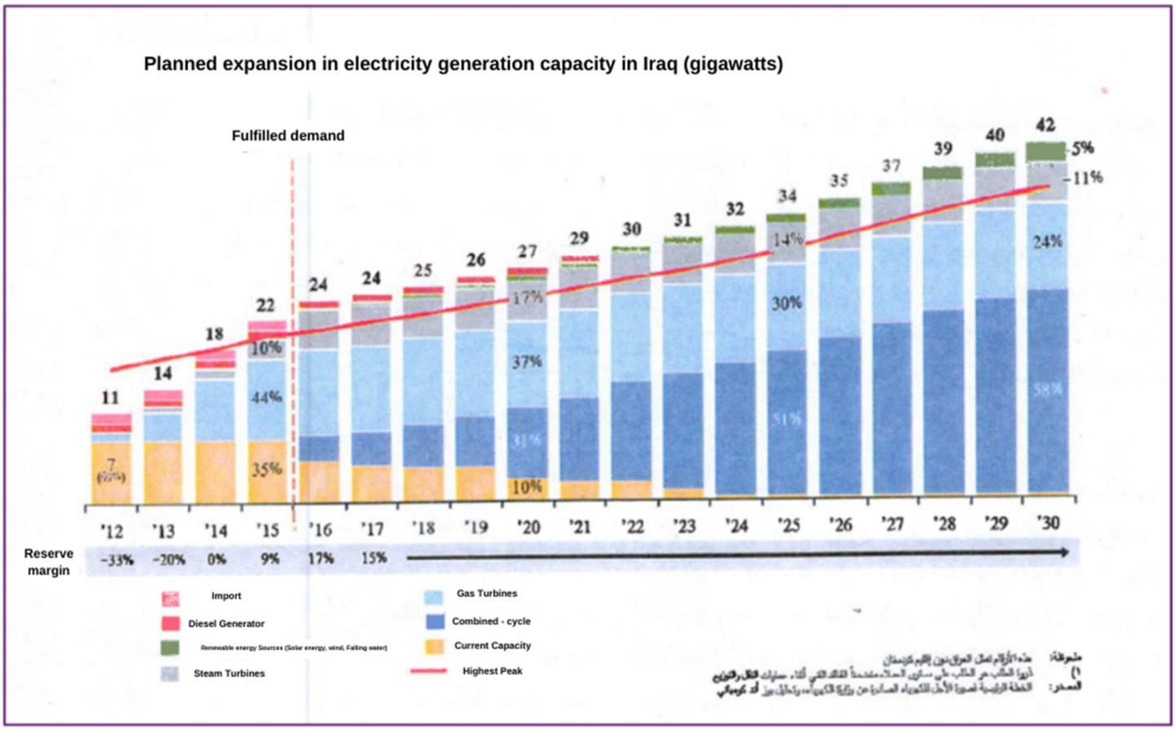


Figure 3-4: Power Generation Stations and Their Participation Rates in Energy Supply and Planned Expansion According to the Integrated National Energy Strategy 2021-2030

- Oil and gas sector: Historical data from the International Energy Agency (IEA) for the years 2000–2022 was utilized, covering key metrics such as oil and gas production. Projections were based on emission estimates that were derived from GHG inventories for 2020 and 2021, encompassing both fugitive emissions—such as those from venting and flaring of associated gas—and emissions from combustion activities.
- Oil refining: Historical data from the International Energy Agency (IEA) for 2000–2022 served as the foundation for analysis, with projections informed by greenhouse gas (GHG) emission estimates based on 2020 and 2021 inventories. For the refining sector, it was assumed that by 2030, the designed refining capacity of 900,000 barrels per day would be fully operational. Currently, this capacity is underutilized, with an effective output of only 600,000 barrels per day, primarily due to aging refining infrastructure and periodic disruptions caused by sabotage attacks. After 2030, projections for refining output were aligned with trends in demand for transportation fuels, assuming that the sector's output would track closely with anticipated growth in fuel requirements for transportation.
- Manufacturing and construction industries: Historical data from the International Energy Agency (IEA) for 2000–2022 served as the foundation for analysis. Future projections were primarily

guided by anticipated GDP growth, which serves as a key indicator of energy demand and sectoral expansion.

- Transport sector: Historical data from the International Energy Agency (IEA) for 2000–2022 served as the foundation for analysis. Future projections were primarily guided by anticipated GDP and population growth, which serve as a key indicators of energy demand and sectoral expansion.
- Residential and other sectors: Historical data from the International Energy Agency (IEA) for 2000–2022 served as the foundation for analysis, with projections informed by greenhouse gas (GHG) emission estimates based on 2020 and 2021 inventories. Future projections were primarily guided by anticipated GDP and population growth, which serve as a key indicators of energy demand and sectoral expansion.

Table 3-42 and Figure 3-5 below provide a detailed overview of GHG emissions across various categories within the energy sector for selected historical and projected years.

Table 3-42: GHG emission projections (in ktCO2eq) of energy sector according to BaU scenario (baseline)

Category	2020	2025	2030	2035	2040	2045	2050
Power sector	58,242	61,201	98,852	114,152	133,925	161,142	170,110
Oil refining	8,006	8,661	11,967	13,267	14,441	15,595	16,781
Oil and gas production	28,118	33,183	40,588	42,618	44,749	46,986	49,335
Manufacturing industries and construction	24,023	25,817	27,622	31,774	35,524	39,209	42,997
Transport sector	29,437	34,778	37,703	41,799	45,499	49,135	52,872
Residential	9,494	8,977	9,365	9,975	10,378	10,725	11,071
Other sectors (Energy)	2,396	3,875	4,035	4,479	5,177	5,862	6,567
Total Energy	**159,716**	**176,492**	**230,132**	**258,064**	**289,693**	**328,654**	**349,733**

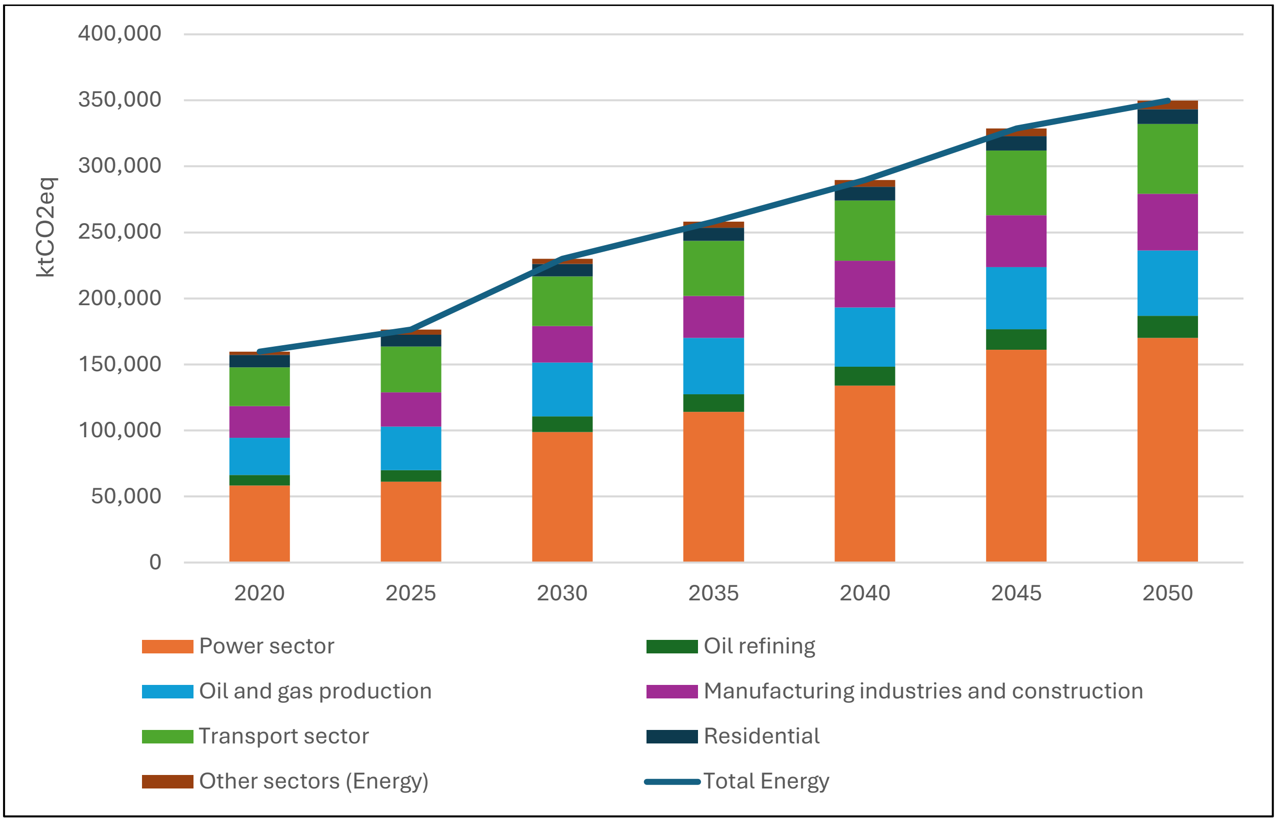


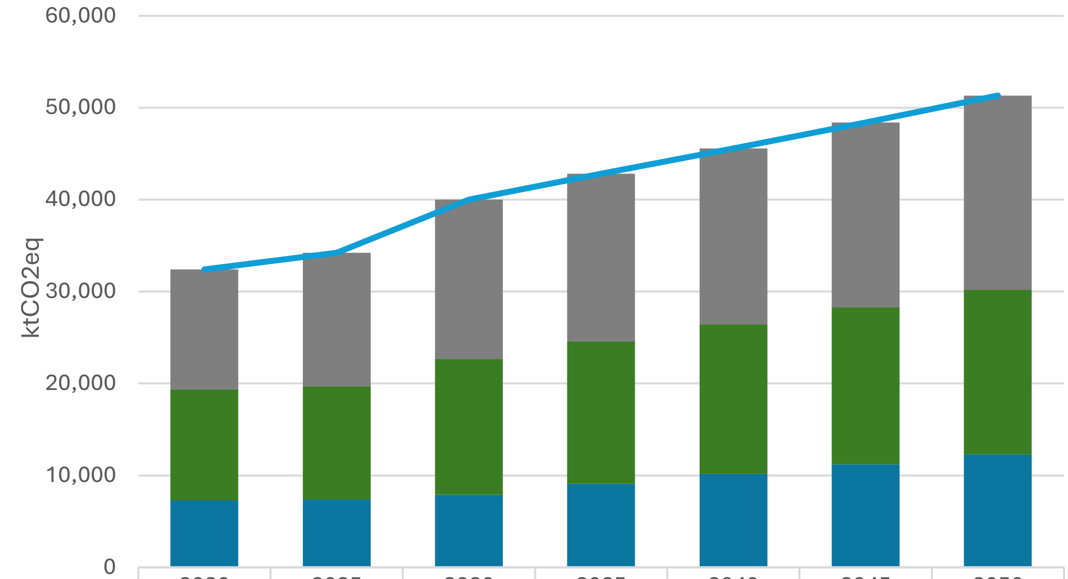
Figure 3-5: Projected GHG emissions (in ktCO_2eq) for the energy sector under the BaU baseline scenario

3.4.4.2 Non-energy sectors

The non-energy sector encompasses emissions and removals from Industrial Processes and Product Use (IPPU), Agriculture, Waste, and LULUCF:

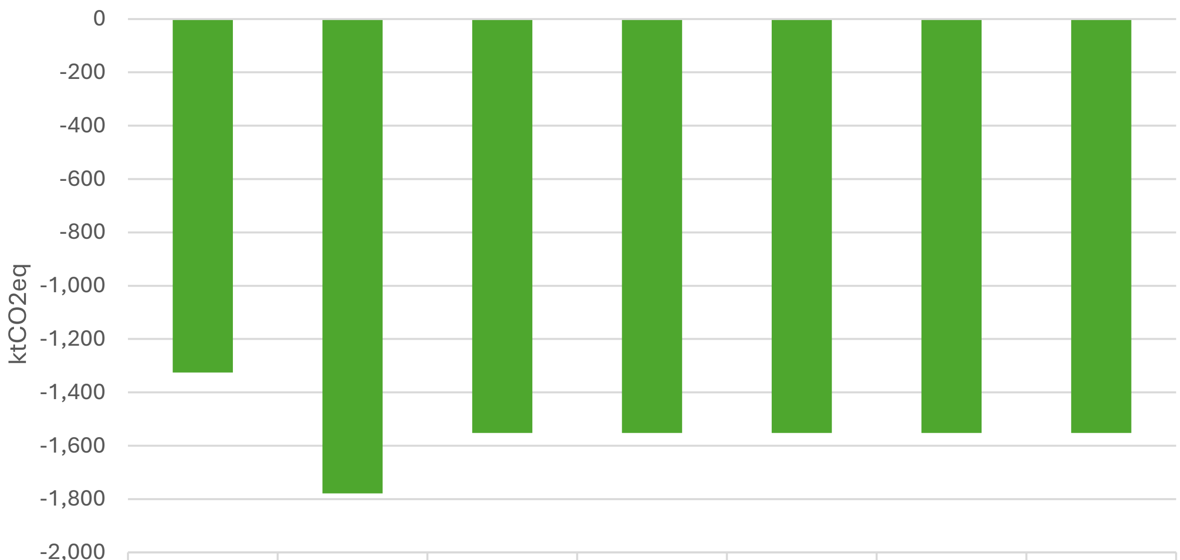
- Industrial Processes and Product Use (IPPU): Projections were informed by greenhouse gas (GHG) emission estimates derived from 2020 and 2021 inventories. Emissions related to ammonia production were categorized under the energy sector, as historical data from the International Energy Agency (IEA) accounted for fuel use in ammonia production. This approach helped to avoid double counting of emissions. Projected growth in emissions was aligned with anticipated trends in the manufacturing and construction industries, ensuring consistency between the two datasets.
- Agriculture and waste sectors: Projections were informed by greenhouse gas (GHG) emission estimates derived from 2020 and 2021 inventories. Future projections were primarily guided by anticipated GDP and population growth.
- Land Use, Land-Use Change and Forestry (LULUCF) : In the absence of detailed data on the sector's evolution, a conservative approach was adopted by averaging the emissions from 2020 and 2021 to project emissions for future years. Figure 7 illustrates the projected GHG removal from the LULUCF sector from 2020 to 2050 in ktCO_2eq, based on the BaU scenario (baseline).

- Figure 3-6 and Figure 3-7 depict GHG emissions and removals for historical and projected years, highlighting sectoral contributions under the BaU scenario.



	2020	2025	2030	2035	2040	2045	2050
Waste	13,063	14,523	17,370	18,239	19,151	20,108	21,114
Agriculture	12,081	12,339	14,758	15,496	16,270	17,084	17,938
IPPU	7,267	7,374	7,889	9,075	10,146	11,199	12,281
Total non Energy	32,411	34,236	40,017	42,810	45,568	48,391	51,333

Figure 3-6: GHG emission projections (in ktCO2eq) of non-energy sectors according to BaU scenario (baseline)



	2020	2025	2030	2035	2040	2045	2050
LULUCF	-1,325	-1,779	-1,552	-1,552	-1,552	-1,552	-1,552

Figure 3-7: Projected GHG Removal from LULUCF Sector (in $ktCO_2eq$) according to BaU Scenario (Baseline)

3.5 Mitigation scenarios

3.5.1 Mitigation pathways

The chapter on mitigation policies and measures outlines a comprehensive analysis of four distinct pathways for reducing GHG emissions. These pathways focus on strategic areas: optimizing primary energy use, expanding renewable energy sources, and enhancing energy efficiency.

- **Mitigation Pathway 1: Reducing Losses in Electricity Transmission and Distribution and Improving Power Generation Efficiency**: This pathway focuses on enhancing the efficiency of electricity generation stations and reducing losses in the transmission and distribution networks. The goal is to lower electricity losses from 22% in 2020 to 15% by 2030 and further to 10% by 2050. Implementation will be gradual, with the project's key components including optimization of distribution and generation, improvement of system capacity factors, and upgrading or replacing existing conductors and insulators with low-resistance equipment. Additionally, the project aims to reduce the carbon footprint in the oil and gas sector by modernizing oil wells and refineries.

- **Mitigation Pathway 2: Gradual and secure transition of energy sources, and diversify the energy mix (with Replacement by Combined Cycle Natural Gas Plants)**: Under this pathway, 21 projects are planned to expand capacities of existing plants and convert certain plants from simple gas units to combined cycle units, with a total projected capacity increase of 8,789 MW between 2021 and 2030. Iraq intends to phase out all diesel-operated plants by 2026, followed by all simple fossil-fuel units by 2035, replacing them with natural gas combined cycle (NGCC) units in line with the National Integrated Energy Strategy.

- **Mitigation Pathway 3: Investment in Associated Gas Capture and Utilization**: This pathway includes four projects aimed at reducing flared gas by 50% by 2030, calculated as methane emissions burned per ton of equivalent oil produced. The project also focuses on capturing associated gas and redirecting it for use in the energy, industrial, or export sectors. This approach offers dual benefits by reducing combustion emissions while enhancing the supply of natural gas for productive use.

- **Mitigation Pathway 4: Increasing the Share of Renewable Energy in the Energy Mix**: This pathway proposes nine projects to generate electricity from solar power across various regions in Iraq, targeting a total capacity of 7,755 MW between 2021 and 2030, in line with the target in NDC in renewable energy investments totaling 12 GW, based on 2021 Cabinet decisions. The projects aim to diversify the energy mix, incorporating renewable sources such as solar, hydro, and wind energy. By 2030, the renewable share is expected to reach 8.5% of the total energy mix (3% hydro, 2.5% wind, and 3% solar), with a target of 12% by 2050 (5% hydro, 3% wind, and 4% solar).

3.5.2 Mitigation impact

Estimating the impact of mitigation actions is essential for developing consistent projection scenarios that align with the outlined policies and measures. The assumptions and methodologies underlying these estimations are detailed in the "Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement (paras. 80–90 of the MPGs) " chapter. Figure 3-8, provides a summary of the projected mitigation impacts for each pathway.

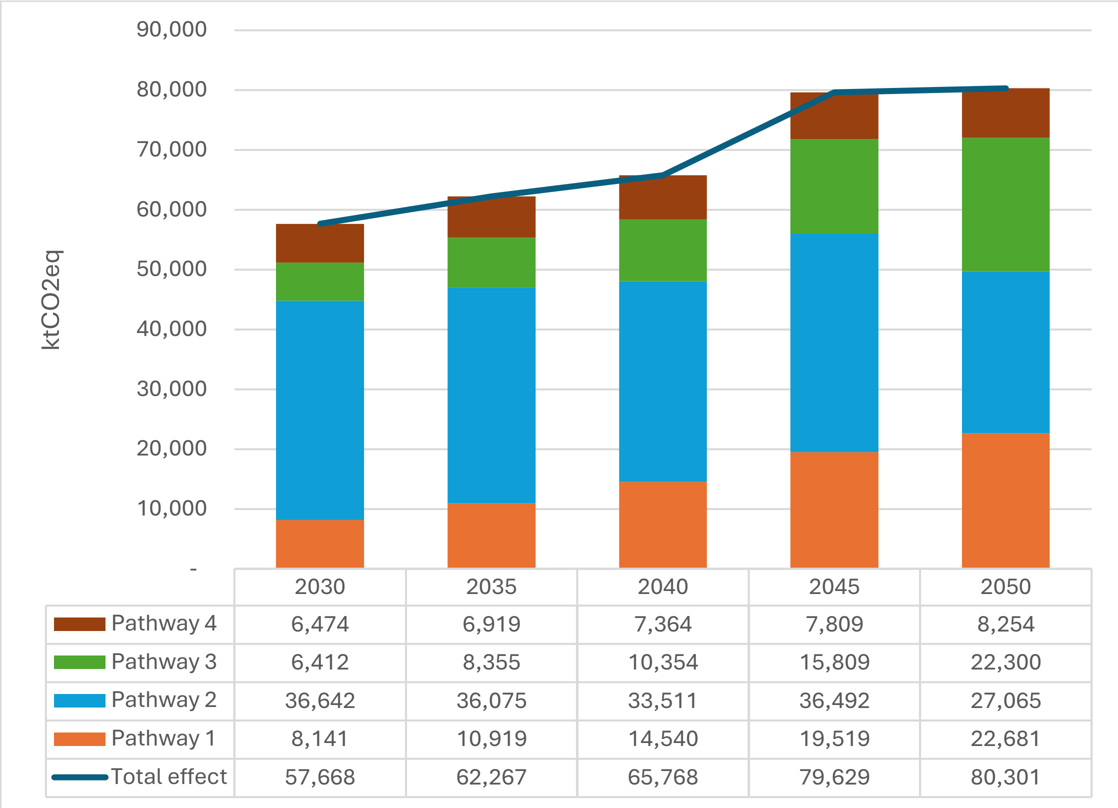


Figure 3-8: Mitigation impact in ktCO2eq of the four proposed pathways

3.5.3 'With measures' and with additional measures' scenarios

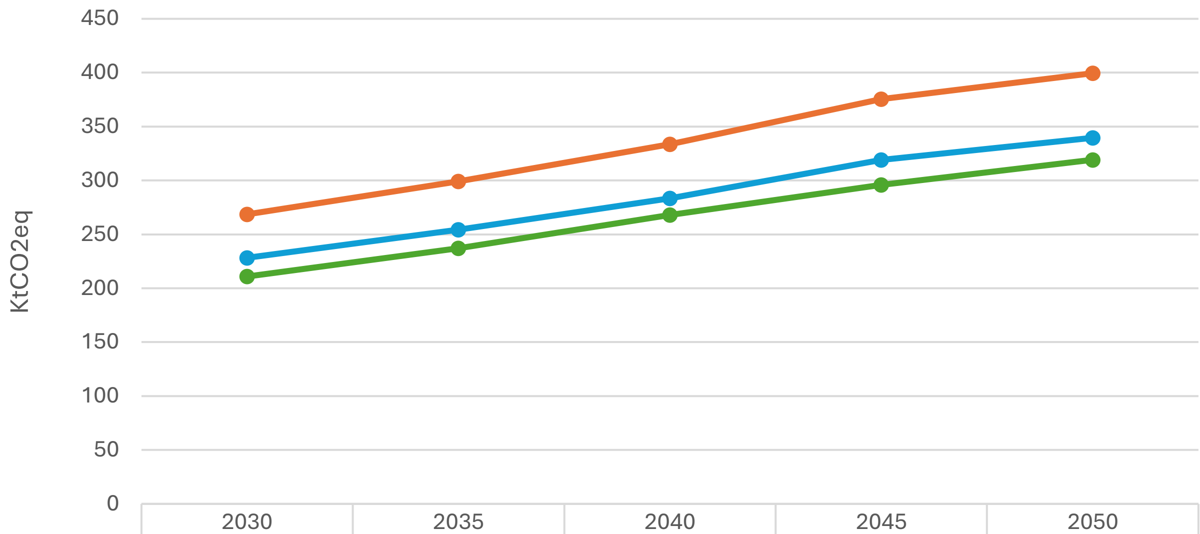
The WM scenario assumes partial implementation of mitigation policies, achieving a 15% reduction in GHG emissions by 2030 relative to BaU levels, with this reduction sustained through 2050 (Table 3-43: Comparison of BaU and WM scenarios). The WAM scenario assumes full implementation of the mitigation policies and measures outlined in the preceding chapter, maximizing emissions reduction potential (Table 3-44). Figure 3-9, shows projected GHG emissions (ktCO_2eq) for selected years under BaU, WM, and WAM scenarios, highlighting mitigation impacts through 2050.

Table 3-43: Comparison of BaU and WM scenarios

Year	BaU (MtCO2eq)	WM (MtCO2eq)	Mitigation effect (MtCO2eq)	% reduction compared to BaU
2030	268.60	228.31	40.29	15
2035	299.32	254.42	44.90	15
2040	333.71	283.65	50.06	15
2045	375.49	319.17	56.32	15
2050	399.52	339.59	59.93	15

Table 3-44: Comparison of BaU and WAM scenarios (data in MtCO2eq)

Year	BaU (MtCO2eq)	WAM (MtCO2eq)	Mitigation effect (MtCO2eq)	% reduction compared to BaU
2030	268.60	210.932	57.668	21
2035	299.32	237.053	62.267	21
2040	333.71	267.942	65.768	20
2045	375.49	295.861	79.629	21
2050	399.52	319.219	80.301	20



	2030	2035	2040	2045	2050
BaU	268.6	299.32	333.71	375.49	399.52
WM	228.31	254.42	283.55	319.17	339.59
WAM	210.932	237.053	267.942	295.861	319.219

Figure 3-9: Projected GHG Emissions (ktCO_2eq) Under BaU, WM, and WAM Scenarios (2020–2050)

3.6 Flexibility applied in reporting of mitigation policies and measures, actions and plans (i.e. by developing country Parties that need it in the light of their capacities as per paras. 4–6 of the MPGs)

Due to capacity and time constraints encountered during the preparation of its first BTR, in alignment with Article 13, paragraph 2, of the Paris Agreement, Iraq is leveraging the flexibility provisions outlined in paragraphs 92 and 102 of the MPGs, as annexed to Decision 18/CMA.1, which are associated with the reporting of projections of GHG emissions and removals. More specifically:

- Flexibility provision associated with in paragraph 98 of MPGs, which is related with the requirement to report projections on a sectoral basis and by gas.
- Flexibility provision associated with in paragraph 100 of MPGs, which is related with the requirement to report projections with and without LULUCF.

Iraq is in the process to develop its National MRV system that will play a crucial role in tracking various aspects related to climate action. It will monitor GHG emissions across all sectors of the economy, encompassing energy, transport, industry, agriculture, and waste. Furthermore, the system will also track the progress of mitigation actions, such as the installation of renewable energy projects and advancements in energy efficiency. By capitalizing on its upcoming MRV system, the projections for the update of the NDC will be developed in a more detailed basis fulfilling the requirements of paragraphs 92-102 of MPGs. Iraq plans to include these projections in the subsequent BTRs (2nd or 3rd BTR), depending on the progress in the development of the national MRV system.

CHAPTER 4

INFORMATION RELATED TO THE IMPACTS OF CLIMATE CHANGE AND ADAPTATION UNDER ARTICLE 7 OF THE PARIS AGREEMENT

4 Information Related to the Impacts of Climate Change and Adaptation Under Article 7 of the Paris Agreement

4.1 National circumstances, institutional arrangements, and legal frameworks

Iraq faces significant vulnerabilities to climate change, primarily due to its location in an arid and semi-arid region where rising temperatures, declining precipitation, and frequent extreme weather events - such as droughts and floods - are increasingly common. These environmental pressures are exacerbated by socio-economic challenges, including ongoing conflicts, rapid population growth, and heavy dependence on the Tigris and Euphrates rivers for water resources. These rivers are considered as Iraq's primary water sources but their supply is affected by hydraulic works in neighboring countries and the rising demand from the Iraq's growing population and expanding economic activities in the country.

The national economy relies predominantly on oil production, making the country into the most oil-dependent country globally, as per UNDP.[36] Therefore, fluctuations in demand and global oil prices driven by climate change or other factors such as the reduction of the use of fossil fuels or the COVID-19 pandemic, directly affect public revenues and the country's capacity to invest in infrastructure to enhance climate resilience.

Combined with recent geopolitical conflicts, these factors significantly affect the country's vulnerability to climate change. According to the University of Notre Dame's Global Adaptation Initiative (ND-GAIN) Index, Iraq ranks 105th out of 193 countries in climate change vulnerability. This index evaluates countries based on their exposure to climate risks and adaptive capacity, with metrics such as food security, water resources, and health infrastructure, contributing to an overall assessment of resilience. The section below delves into specific details of climate change in Iraq, particularly focusing on key sectors of high relevance to the country's resilience and development. These sectors include water resources management, agriculture, health and infrastructure.

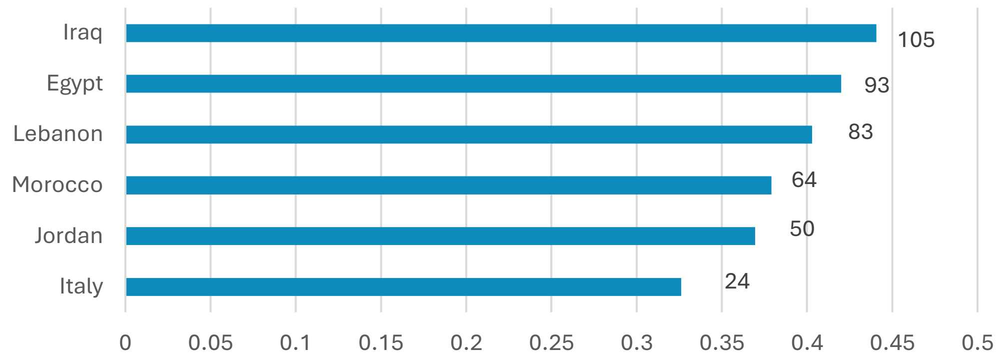


Figure 4-1 Vulnerability index – Relative position of Iraq against the globe (position in text labels)
Source: University of Notre Dame

4.1.1 Sectoral national circumstances and strategic climate adaptation priorities

This section outlines Iraq's strategic approach to climate adaptation through its national policies and legal framework. The analysis below, which addresses key sectoral adaptation priorities, is based on existing and currently developed adaptation plans providing a comprehensive overview of Iraq's efforts to incorporate climate resilience in the Iraqi economy.

36 https://www.undp.org/iraq/economic-diversification

The national legal framework in Iraq is structured around key policies aimed at enhancing resilience and incorporating climate risk into national economic operations. It comprises two main components: one directly integrates adaptation and resource management through broader legal instruments, while another set of law and policies explicitly addresses adaptation.

In the first component, Law No27 of 2009 on the Protection and Improvement of the Environment forms the backbone of Iraq's environmental policy. Even though climate change adaptation is not explicitly mentioned, the Law supports climate resilience indirectly by providing a legal basis for the sustainable use of water and other resources, and emphasizing the protection of biodiversity. Similarly, Iraq Vision 2030 links climate change adaptation with poverty reduction, water management, improved health services and sustainable development. This strategic document identifies the need to further diversify the economy, with an emphasis on developing strategic sectors such as agriculture, investing in renewable energy and implementing ecoefficiency policies to mitigate climate change impacts. Additionally, the National Drought and Desertification Strategy focuses on water resource management and land rehabilitation to combat desertification and mitigate the effects of climate change on agriculture and water availability. At the sectoral level, the Agriculture Development Strategy promotes climate-smart practices, by integrating climate adaptation into agricultural planning. The Protected Areas Network and Biodiversity Monitoring Plan also contribute to climate adaptation by preserving ecosystems and biodiversity, essential for natural resilience to climate impacts.

Furthermore, the Water and Land Resources Strategy provides a comprehensive plan for the development and improvement of Iraq's water and land resources until 2035 through the optimal and integrated management of these resources to ensure the requirements for water, food, and energy security, while protecting the environment in light of the challenges faced. Additionally, it prioritizes the development of infrastructure for major projects related to water use to meet sustainable development needs. The strategy outlines two parallel pillars:

Pillar one: Implementing broad reforms that include rehabilitating infrastructure for all water-use sectors, improving efficiency, and adopting a smart water demand management policy in light of limited water resources and climate change impacts.

Pillar two: Continuing efforts to establish permanent national water quotas through agreements with neighboring countries. Additionally, negotiations with riparian states are being pursued based on principles of cooperation and in alignment with the international law. The Water and Land Resources strategy is currently under revision, with an emphasis on assessing the impacts of climate change on water resources.

Among the key documents explicitly addressing climate change adaptation, Iraq's NDC, prepared and submitted in 2021, mark significant progress in integrating climate risk into national policies. The NDC highlights the need for new legislation and revisions to existing laws to ensure alignment with efforts to combat climate change. It also identifies the most vulnerable sectors and establishes strategic adaptation priorities for the upcoming period. The National Adaptation Plan (NAP), currently being developed with the support of the GEF and the UNEP Climate Change Adaptation Unit[37], aims in continuing the integration of adaptation in the existing policies and in identifying the needs for further design of new policies that will increase resilience. In parallel to the development of the NAP, Iraq has also developed a protocol for integrating climate change adaptation into development plans, building on expertise from the NAP process. Policy reforms are viewed also as opportunities for economic growth and welfare by transforming climate adaptation challenges into avenues for public infrastructure projects and private investments.

37 https://www.undp.org/arab-states/press-releases/iraq-takes-center-stage-and-makes-its-mark-un-climate-change-conference

Following the examination of Iraq's climate adaptation policies, it is essential to focus on the four priority sectors identified for adaptation efforts: health, water, agriculture, and biodiversity. As also mentioned also in other parts of this chapter, these sectors are particularly vulnerable to the impacts of climate change and are crucial for Iraq's long-term resilience and economic growth. Adaptation actions in these areas are vital for safeguarding public health, ensuring water security, sustaining agricultural productivity and food supply, and preserving biodiversity. Each sector has been prioritized due to its role in mitigating the adverse effects of climate change, its potential economic significance and its contribution to Iraq's adaptive capacity.

4.1.2 Agriculture

The agricultural sector is the second contributor to the Iraqi economy contributing approximately 5% in the GDP.[38] Approximately 22% of the Iraqi territory is classified as suitable for agricultural production, however, almost half is currently being used. Almost 75% of the farmers income derives from crop production.[39] It is noted that approximately 25% of the households were supported by agriculture in 2017.[40] The agricultural sector in Iraq is highly vulnerable to the impacts of climate change and especially to rising temperatures, water scarcity and soil salinity. The increased frequence of extreme climate events, such as droughts and desert dust storms (DDS) affect crop yields and livestock and the livelihoods of rural populations. As per recently conducted studies, in the business-as-usual climate scenario the yield of wheat varieties (the second most produced food commodity in Iraq) may be reduced up to 71.1% compared to the RCP4.5. This is expected to affect food security, farmers' income and the viability of the agriculture supply chain in the Iraqi economy[41], further exacerbating the vulnerability of the approximately 1.77 million people already at risk of food insecurity.[42] Furthermore, the above and climate change factors affecting the food supply have already been accelerating rural to urban migration.

Agricultural is a key pillar for diversifying the Iraqi economy. The NDC and NAP emphasize the need for climate-responsive agricultural policies and strategies. The ongoing update of Iraq's Drought Management Framework aims to align drought risk management across the agricultural sector, ensuring collaborative mechanisms among institutional stakeholders. Current policies advocate for basin-level water budgets, soil degradation prevention, climate-smart agriculture, efficient water use, and climate-resilient crop varieties. A priority in the coming years is fostering collaboration between Ministries for effective data collection and promoting a participatory approach involving local communities and international partners.

4.1.3 Water-resources management

Water resources management in Iraq is highly vulnerable to climate change, particularly in terms of declining water availability, rising temperatures, and shifting precipitation patterns. Approximately 98% of Iraq's water demand is served by the Tigris and Euphrates rivers making the country heavily dependent on these transboundary resources.

Precipitation has decreased during the 1971-2020 period, with most of this trend being noted in the southern and western parts of the country. Drastic reductions in water flow are noted due to both climate change, upstream dam constructions and other hydraulic projects in the last century, leading to the

38 Climate risk assessment for Iraq, Walker Institute, 2022
39 FAO. 2021. Agricultural value chain study in Iraq – Dates, grapes, tomatoes and wheat. Bagdad. https://doi.org/10.4060/cb2132en
40 IOM, Migration, Environment, and Climate Change in Iraq, Baghdad, 2022.
41 ICARDA, Support to the Implementation of the Second National Communication and Biennial Update Report for Iraq (2022)
42 Health and Climate change – country profile 2021, World Health Organization

reduction of water that the country receives in 2023 by 50.3% compared to 1933.[43] Similar reductions are also noted in the water flow. Climate projections suggest a 9% decrease in precipitation by 2050, with an expected increase in the intensity of rainfalls. The Water and Land Resources Strategy has divided the country into eight agro-climatic zones based on climate and crop suitability. Each agro-climatic zone has a specific cropping pattern, consisting of 34 strategic crops. These conditions create a new framework for water management, with an estimated 20% reduction in average runoff (country average) intensifying pressure for water users.

The decline in water availability has caused significant stress on agriculture, drinking water supplies, and nature ecosystems like the southern marshlands. In recent decades, prolonged droughts have become the norm, intensifying water scarcity across the country. The reduction in water availability, besides affecting a significant part of the population and linked sectors, increases the salinity in the existing water bodies, while the ecological equilibrium close to the marshlands is significantly disrupted.

The NDC and NAP identify the need for integrating climate change adaptation in the existing water management policies. Furthermore, the policy documents strengthen the implementation of cost-effective measures in the water management sector to affect both the supply (water resources) and the demand (water efficiency). The expected subnational/regional adaptation plans, being described in the currently developed NAP, are considered effective policy means to address water management issues considering regional characteristics and differences. Furthermore, these plans prioritize stakeholder engagement and inclusiveness to ensure comprehensive and localized solutions.

On this aspect, the sustainable use of ground water and the development of modern monitoring technologies to track groundwater quality and quantity are among the highest priorities of the existing elements of climate adaptation policies in the water sector. The construction of small dams for water harvesting in the eastern and desert regions of the country are considered as viable alternatives for increasing resilience to extreme climate events, affecting water supply positively. The development of desalination plants with the use of renewable energy sources is another focus area that is considered beneficial for the country and can increase the supply of fresh water, especially during droughts. Finally, due to the country's geographical characteristics, the NDC stresses the need for continuous regional cooperation with its riparian states (Turkey and Iran) to equitable and sustainable allocation of water resources (Tigris and Euphrates) through enhanced climate and water diplomacy framed also through the assessment of regional risks and jointly crisis management.

On the demand side, the NDC and NAP foresee the enhancement of irrigation efficiency by implementing specialized methods tailored to crop types, soil, and climate characteristics. Rehabilitation of key irrigation infrastructure, development of drainage systems to direct water to discharge areas or evaporation basins, and the utilization of non-conventional water sources for various sectors (e.g., oil well injection, green belt irrigation) are also included. The use of alternative water resources could significantly reduce the demand for fresh water, especially given the size of the oil sector in Iraq. Furthermore, the existing policies foresee the development of climate change adaptation strategies and plans for the water-dependent sectors of the Iraqi economy, and the development of sectoral water budgets.

4.1.4 Health sector

Climate change has substantially impacted Iraq's healthcare sector, in two dimensions. High temperatures frequently exceeding 50°C increase heat strokes, cardiovascular strains and affect

43 "Water security provides opportunity to achieve peace and development in Iraq", article from UNDP, available online: https://www.undp.org/arab-states/blog/water-security-provides-opportunity-achieve-peace-and-development-iraq and the Ministry of Water Resources of Iraq.

vulnerable populations such as the elderly and the outdoor workers. The increased temperature and the prolonged droughts deteriorate air quality leading to higher frequency of respiratory diseases, while water scarcity affects sanitation raising the risk of gastrointestinal illnesses and waterborne diseases. Under a high emissions scenario (RCP8.5), heat-related deaths among the age category of above 65 are projected to rise to about 64 per 100,000 by 2080, having been increased eightfold compared to the past (4 deaths per 100,000 during the period of 1961-1990, in the same population category). In addition, the deterioration of mental health, including heightened levels of stress, anxiety and trauma, is particularly prevalent in populations facing displacement; approximately 130,000 Iraqis have been displaced due to climate change.[44] This trend not only exacerbates psychological stress but also increases morbidity, further straining Iraq's healthcare system as the number of patients requiring medical care rises sharply.

The above add further pressure to the already strained healthcare system of Iraq, which is currently facing significant issues in terms of the operational condition of the supplied services. Out of over 5,000 healthcare facilities, approximately 14.0% of them are facing significant infrastructure damages, 45.8% of the installed equipment is malfunctioning, while important resource shortages are noted overtime.[45] This situation is aggravated by recurrent power outages, which disrupt medical services and intensive care, particularly in the peak summer months.

The NDC identifies the need for establishing a strong, resilient healthcare system that can withstand difficult conditions and protect human health, safeguard natural systems and biodiversity, and enhance resilience to the impacts and risks of climate-related disasters, especially in vulnerable sectors and parts of the country. Towards this target, the relevant policies foresee the need for implementing actions to prevent climate-related diseases, designing rehabilitation procedures for health-vulnerable communities and raising health awareness across the population. As per the NAP, climate risk factors will be considered in the revision and design of new health and healthcare policies, while similarly, relevant strategies are expected to be developed for planning and building healthcare infrastructure. Finally, in the next period, the government will proceed in including in the development of subsidized health services to poorer population groups, the prevention and treatment of climate change related diseases. Annex 4 presents a study on vulnerability assessment of the health sector in Iraq.

4.1.5 Biodiversity

Climate change affects significantly Iraq's biodiversity, with rising temperatures, water scarcity, and habitat degradation directly threatening the ecological characteristics and survival of various species and ecosystems.

Unique ecosystems such as the Southern Marshes serve as critical biodiversity hotspot; these are facing climate related environmental degradation due to particularly prolonged droughts, increased temperature and enhanced evaporation rate in the last two decades. The drying of rivers and wetlands, intensified by upstream water diversions from neighboring countries due to hydraulic projects, disrupts the habitats of numerous species. Besides the disruption in ecological balance, the livelihoods of communities that depend on natural resources for agriculture, fishing, and livestock are also affected. As noted also in the health section above, population displacement is frequent.

In addition to habitat loss, climate change accelerates the spread of invasive species and diseases, further endangering the characteristics of the local ecosystems. As vulnerability increase, the impacts of climate change will in turn reduce anew the resilience of these ecosystems, impairing their ability to support biodiversity and human activities further.

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44 Islam, I., Wilson, T., "Extreme heat, drought and displacement in Iraq", Humanitarian Practice Network, Issue 84, 2024

45 HeRAMS Iraq Baseline Report 2023. The operational status of the health system, a comprehensive mapping of the operational status of health facilities. World Health Organisation, 2023.

Iraq’s NDC and NAP emphasize the importance of incorporating climate risk in biodiversity conservation. This is expected to start from bridging existing policy gaps to protect this vital sector. Based on different scenarios, climate change in Iraq will continue affecting biodiversity loss. Expanding of nature reserves to protect as many endangered species as possible, designing and implementing reforestation projects which will also increase carbon sequestration potential, and promoting sustainable and integrated forest management are considered key strategies for protecting biodiversity.

Furthermore, the NAP builds on the NDC's recommendations by emphasizing the "climate-biodiversity nexus". The Plan foresees the inclusion of efforts to safeguard critical ecosystems from the impact of rising sea levels, increased salinity, and changing precipitation patterns. It also suggests integrating climate adaptation into Iraq’s National Biodiversity Strategy and Action Plan (NBSAP), promoting nature-based solutions (NbS) and Ecosystem -Based Adaptation (EbA) to improve climate resilience.
This includes creating protected areas, restoring degraded habitats, and managing ecosystems sustainably to reduce climate risks.

In addition, in 2022 Iraq set the foundations for establishing a national network of Protected Area aiming also in securing biodiversity and ecosystems from environmental challenges and climate change. A site-specific management plan to include a series of procedures for the protection and confronting disasters and threats is foreseen to be developed in the next period. Currently, the government of Iraq is in the process of initiating the drafting of the relevant, collecting relevant information and data on the impact of climate change for specific ecosystems and areas.

Additionally, the NAP further recommends mainstreaming climate-resilient biodiversity management into Iraq's development plans. This involves the development of climate risk assessments and vulnerability studies to identify those species and ecosystems threatened most and implement measures to mitigate the effects of climate change. The introduction of drought-resistant species and the enhancement of water management in biodiversity hotspots are considered core priorities. Protecting biodiversity is regarded as a key element of Iraq’s broader climate adaptation strategy, supporting both ecosystem services and human livelihoods that depend on natural resources.

4.2 Impacts, risks and vulnerabilities, as appropriate

Following the sectoral presentation of the national circumstances in the previous section, this chapter identifies the vulnerabilities identified in each of the key sectors. The vulnerabilities are presented at a high level below, itemizing basic factors that increase exposure to climate change. However, the government of Iraq is considering initiating a process of designing concrete vulnerability studies that will be linked with specific climate scenarios and can be used for further policy making on increasing resilience.

4.2.1 Water-resources management

Water resources in Iraq are critically affected by increased temperature, and reduced rainfall. An increase in the mean temperature by 1.0°C by 2050 and 10% reduction in rainfall could cause a 20% decline in freshwater availability.[46] It is noted that demand for water resources has outstripped availability already in 2016 and currently a widening deficit is noted over the years. Another factor heightening the sector’s vulnerability is the issue of transnational water resources –hydraulic projects in neighboring countries that reduce Iraq’s water volume and flow. Climate change is intensifying this challenge by also affecting neighboring countries, which will increase their own water demands over time, further limiting water availability to Iraq. The absence of permanent agreements on water allocation and quality from major rivers exacerbates the sector’s vulnerability. Consequently, Iraq’s water scarcity is projected to worsen

46 Strategy for Water & Land Resources in Iraq, 2014

by 2035, with anticipated shortages of up to 11 billion cubic meters, equivalent to approximately 43% of the current demand.[47]

Furthermore, the increasing demand from several linked sectors is another element that affects the importance of strategic changes in water management. Approximately 10% of the electricity is generated from hydropower stations, while 78% of electricity is produced from thermal power plants for cooling and steam generation, while 12% is produced from gas-fired power plants.[48] One way or another, the electricity sector relies heavily on water resources for 78% of its annual production. In addition, enhancing the value added of the primary sector, essential for food security and diversifying the oil-dependent economy, will increase further the demand for water resources.

4.2.2 Agriculture sector

The agricultural sector supports households' income of rural communities, while it also contributes strategically to food safety. However, approximately 1.77 million people in Iraq are still at the risk of food insecurity and financial instability.[49]

The agricultural sector in Iraq is vulnerable to the climate change due to its high dependency on water resources, which are increasingly constrained by climate change, transboundary water disputes, and inadequate infrastructure. Climate-induced temperature increases and shifts in rainfall patterns have led to more frequent and severe droughts, directly impacting crop yields, livestock health, and soil fertility. With the agriculture sector relying heavily on river systems for irrigation, changes in water flow from neighboring countries discussed also in previous sections further exacerbate water scarcity and will continue to affect agricultural productivity.

Iraq's agricultural systems are also affected by extreme weather events, including heatwaves and dust storms, which damage crops and reduce soil quality. The lack of robust adaptation measures and insufficient investment in alternative/resilient agricultural practices leave the sector particularly exposed. Additionally, the sector's limited technological advancement and reliance on traditional farming methods hinder its ability to adapt to these climate challenges, increasing the vulnerability of relevant linked stakeholders (farmers and the wider supply chain).

Considering climate models projections that foresee reductions in water availability and rising temperatures, the vulnerability of the agricultural sector is expected to worsen. The agricultural production, assessed for wheat crops, shows potential decline by 2100 under both moderate and severe climate change scenarios, affecting both food security and income of rural households.[50]

4.2.3 Biodiversity

Iraq's biodiversity is increasingly vulnerable due to environmental pressures exacerbated by climate change, including rising temperatures, decreased precipitation, and intensified extreme weather events. These factors disrupt natural habitats, particularly in wetlands, marshlands, and riparian zones, which support a wide variety of species. As per the IUCN Red list criteria, approximately 648 species are at risk in Iraq, due to climate change and also other anthropogenic activities affecting the environment.[51]

Water scarcity and altered hydrological cycles threaten the survival of flora and fauna by reducing habitat availability and shifting ecological balances. As these ecosystems degrade, species face increased

47 Ministry of Water Resources, Iraq
48Ministry of Water Resources, Iraq
49 Iraq Second National Communication and Initial Biennial Update report, 2024
50 FAO. 2021. Agricultural value chain study in Iraq – Dates, grapes, tomatoes and wheat. Bagdad. https://doi.org/10.4060/cb2132en
51 Sixth national report of Iraq to the convention on biological diversity, 2018

stress, affecting their reproductive cycles, migration patterns, and overall resilience. Similar threats exist also across the marine environment of Iraq, with coral reefs facing extreme temperatures and increase salinity.

The sector is vulnerable to climate change, but also to other relevant human-driven activities such as agricultural expansion, urban development, and pollution. These lead to habitat loss and fragmentation. This degradation limits species' adaptive capacity, as their habitats become increasingly isolated and resources scarcer. Overgrazing and deforestation further diminish the quality of remaining habitats, undermining ecosystem services essential for both biodiversity and local communities.

4.3 Adaptation priorities and barriers

Iraq's initial biennial update report outlines the country's adaptation priorities and barriers across the key sectors also identified in the NDC and the NAP. Indicatively, these adaptation priorities focus on securing water resources through infrastructure improvements and early warning systems, enhancing agricultural productivity with climate-smart practices, conserving biodiversity through expanded nature reserves, and strengthening health systems to address climate-related risks. However, significant barriers impede progress in these areas, including dependence on external water sources, limited access and capacity to digitalise the sectors, enforcement gaps in biodiversity protection laws, and resource constraints in healthcare. These challenges underscore the need for integrated and sustained efforts to overcome obstacles and support Iraq's climate resilience journey.

The adaptation priorities and barriers for each of the 4 adaptation strategic sectors (water management, agricultural sector, health and biodiversity) are presented in Table 4-1. It is noted that the priorities presented closely follow the identification of the risks and vulnerabilities denoted in the previous section, while some have been also identified in the description of the national circumstances.

Albeit different barriers among the key sectors, capacity building and technology transfer among stakeholders is a horizontal challenge that needs to be strengthened and prioritized. Enhancing technical expertise, institutional capacities, and knowledge-sharing mechanisms is crucial for enabling effective implementation of adaptation measures. Facilitating technology transfer can support the adoption of innovative solutions, improve sectoral efficiency, and bridge existing gaps in infrastructure, digitalization, and resource management. This collaborative approach will empower local institutions and communities to better respond to climate risks and drive sustainable progress across water management, agriculture, health, and biodiversity conservation sectors.

Table 4-1 Indicative adaptation priorities and barriers for selected sectors

Sector	Adaptation priorities	Barriers
Water	Sustainable groundwater management and water harvesting techniques to address water scarcity. Developing desalination plants and reservoirs to supplement water supply, particularly in drought-prone regions. Establishing early warning systems for climate risks, including droughts and floods, to better manage water resources. Promoting international cooperation with neighboring countries to secure Iraq's water rights from shared rivers and reduce dependency risks.	Iraq's heavy reliance on upstream countries for water supply limits control and security over its water resources. Insufficient infrastructure and technical expertise hinder effective water management and adaptation efforts. Financial constraints delay the development of critical water infrastructure.
Agriculture	Climate-smart agriculture. Development of resilient crop varieties Efficient water management affects both supply and demand. Desalination techniques, sustainable groundwater management and water harvesting techniques. Implementation of water-saving irrigation techniques. Soil preservation combating desertification, limiting soil degradation, and rehabilitating soil through remote sensing and geographical information systems. Encouraging research on crop resilience and sustainable agricultural practices.	Economic and production constraints: low productivity, inefficiencies and aging infrastructure. Environmental resources challenges. Infrastructure damages and in some cases, displacement. Technological and investment limitations. Limited access in financial and technological capital. Skills development.
Health	Establishing early warning systems for health risks associated with climate change, such as heatwaves and vector-borne diseases. Building and strengthening healthcare infrastructure to better respond to climate-induced health challenges. Raising public awareness on climate-related health risks and promoting preventive care.	Healthcare resources are limited, making it challenging to address the rising demand due to climate-related health issues. Public awareness on the health impacts of climate change remains low, affecting community engagement in preventive measures. Funding limitations restrict the sector's ability to expand and adapt its infrastructure for climate resilience.
Biodiversity	Expanding protected areas and nature reserves to safeguard key species and ecosystems from climate change impacts. Reforestation and sustainable forest management initiatives to maintain biodiversity and support carbon capture. Promoting genetic conservation efforts to strengthen species' resilience to climate variability and extreme conditions	Insufficient enforcement of biodiversity protection laws and regulations. Legislative and institutional gaps hinder the effective management and conservation of natural resources. Limited funding and resources for long-term biodiversity conservation and reforestation efforts.

Source: Nationally Determined Contributions, National Action Plan, Second National Communication and Initial Biennial Update Report.

4.4 Progress on implementation of adaptation

Despite the early steps in designing and implementing adaptation policies, the government of Iraq has been implementing relevant adaptation projects, mostly with the support of external funders.

As of the end of 2024, Iraq was engaged in implementing at least nine adaptation-focused projects with a cumulative budget of over $75 million. These projects target critical sectors including agriculture, water resources, energy, biodiversity, and public health. The main objectives encompass strengthening climate resilience, enhancing water and food security, promoting sustainable energy practices, conserving biodiversity, and improving public health outcomes. Funded primarily through external sources, these initiatives aim to bolster Iraq's adaptive capacity to climate-related challenges, laying a foundation for long-term environmental sustainability and socio-economic stability.

The projects that have been recently implemented or are currently in progress are briefly presented in Table 4-2. More information for most of the projects is available in the links provided below.

Table 4-2: Indicative list of projects towards climate change adaptation and details Multiple sources – please use the links available in the last column.

Title	Sector	Status	Duration	Total Grant (in USD)	Funding	Objectives	More information
Building Resilience of the Agriculture Sector to Climate Change in Iraq	Agriculture	Ongoing	2019-2025	9,999,660	Adaptation Fund	Enhance the resilience of the agriculture sector by implementing climate-smart agricultural practices that not only protect agricultural productivity but also ensure strategic long-term food security.	https://www.adaptation-fund.org/project/building-resilience-agriculture-sector-climate-change-iraq-brac-2/
Building Capacity to Advance the National Adaptation Plan Process in Iraq	Agriculture, Water, Biodiversity	Completed	2019-2024	2,632,053	UNEP/Green Climate Fund	Build institutional capacity for the development and the implementation of a National Adaptation Plan	https://open.unep.org/project/GCF-IRQ-RS-003
Human and Biodiversity Resilience in the Iraqi Marshlands	Water Biodiversity	Ongoing	2023-2027	5,000,000	UNDP	Enhance the ecological resilience of Iraq's marshlands and support local communities by restoring water quality, promoting sustainable fishing, and empowering women in water management.	https://w05.international.gc.ca/projectbrowser-banqueprojets/project-projet/details/p011570001
Enhancing Climate Resilient Agriculture in Southern Iraq	Agriculture, Water	Ongoing	2023-2027	N/A	FAO	Increase the resilience of agriculture households, focusing on water scarcity and climate change adaptation in vulnerable southern governorates.	https://openknowledge.fao.org/server/api/core/bitstreams/29700ecb-bfc4-4de9-bb2e-efbf88c1f178/content
Leveraging the private setcor for increased climate investment	Agri, Energy, Health	Ongoing	2023-2027	4,012,198	Islamic Development Bank	Increase private sector investment in climate resilience across West Asia by building capacity, improving policy frameworks, and fostering partnerships, with a focus on overcoming barriers to green investment and promoting gender inclusion	https://www.greenclimate.fund/document/leveraging-private-sector-increased-climate-investment-and-strengthened-partnerships-west
Sustainable Land Management for Improved Livelihoods in Degraded Areas of Iraq	Land degradation, Agriculture	Completed	2019-2023	24,749,321	GEF	Reverse land degradation and promote the sustainable management of land and water resources in Iraq's southern marshlands, enhancing both ecosystem resilience and local livelihoods	https://www.thegef.org/projects-operations/projects/9745
Promotion of Integrated Biodiversity Conservation and Land Degradation Neutrality in Highly Degraded Landscapes of Iraq	Land degradation, Biodiversity	Ongoing	2023-2028	30,038,128	UNEP/GEF	Integrate biodiversity and land degradation neutrality into Iraq's sectoral policies by promoting sustainable land management and nature-based solutions to rehabilitate ecosystems and restore agro-ecosystem services	https://www.thegef.org/projects-operations/projects/10672
Restoration and Preservation of Key Biodiversity Areas and Ecosystems in Anbar Province, Iraq	Biodiversity	Ongoing	2023-2027	52,165,750	UNDP/GEF		https://www.thegef.org/projects-operations/projects/11426

4.5 Monitoring and evaluation of adaptation actions and processes

The establishment of a comprehensive monitoring and evaluation (M&E) framework is an essential step for ensuring proper design and implementation of the adaptation strategies in Iraq. The government of Iraq is currently in the process of designing such an M&E framework, which is based on a two-pillars approach that focuses on the monitoring of the progress of adaptation actions and the evaluation of adaptation outcomes. These pillars work in parallel to provide a comprehensive view of Iraq's adaptation strategy and progress, while also facilitating data-driven improvements and aligning policies effectively.

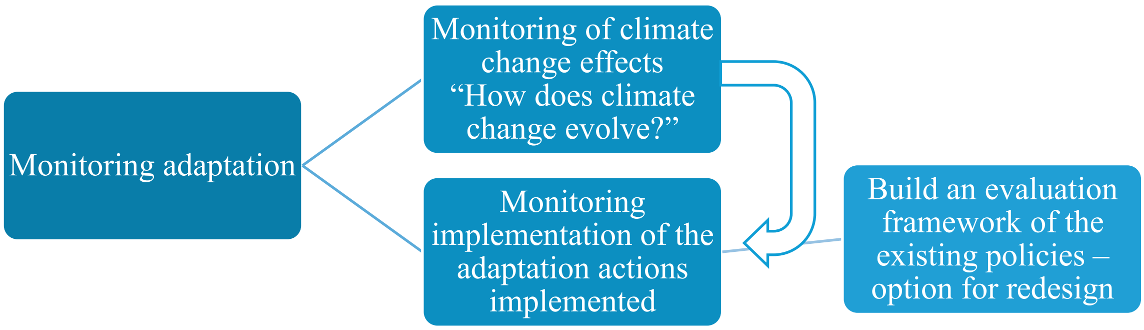

Figure 4-2 The two pillars of monitoring and evaluating climate change adaptation in Iraq.

The currently being developed methodology aims in assessing progress, informing policy adjustments, and ensuring alignment with Iraq's adaptation goals. A significant part of it is done through the use of Key Performance Indicators (KPIs), that will provide a quantitative approach of adaptation progress.

These KPIs are carefully selected to be Specific, Measurable, Achievable, Relevant, and Time-Bound, with an added focus on local context and avoiding maladaptation risks. The above constitute the “SMART” methodology, a first draft of which is presented in the next section, below. This approach, as highlighted by UNEP’s guidelines on quality control and assurance[52], will support Iraq in implementing a transparent, adaptable, and rigorous M&E system capable of guiding effective climate adaptation.

The SMART+ Framework for KPI development for climate change adaptation

The SMART+ framework is fundamental to the M&E methodology, ensuring KPIs are not only measurable but also actionable and aligned with Iraq’s climate adaptation needs. During the design phase, the authorities of Iraq are ensuring that each KPI will directly target specific climate vulnerabilities in the key sectors discussed above (water resources management, agriculture, health, and biodiversity), aligning with the existing policy documents.

The design/selection of each KPI is based on the following characteristics:

- Specificity. Each KPI aligns directly with Iraq’s sector-specific adaptation objectives. For instance, KPIs addressing water resources may monitor groundwater levels, salinity, or efficiency in irrigation systems. In agriculture, KPIs could assess crop resilience under stress and the adoption of climate-smart practices, while health indicators may cover rates of climate-related illnesses and healthcare readiness.
- Measurability is another key element considering that quantifiable metrics should allow for collecting consistent data for monitoring adaptation progress overtime. It is though important to note that quantifying climate adaptation related indicators presents unique challenges. Many adaptation outcomes—such as enhanced resilience or improved health—are complex and not easily quantified. In cases where direct quantification is difficult, qualitative indicators and

52 Guidelines on quality control and quality assurance for climate applications, WMO,2021

scenario- based assessments will be used to provide a better picture of adaptation effectiveness. This approach allows the monitoring framework to remain flexible and responsive, capturing both the tangible and less quantifiable impacts of adaptation actions.

- The selection of the KPIs should also consider current challenges and risks towards climate change adaptation. Achievability, thus setting realistic and attainable targets, is considered critical as it ensures that the M&E framework remains on track to meet adaptation objectives without placing unrealistic pressure on resources. In that way, the framework supports steady progress allowing for gradual increase in capacity building while delivering results aligned with the Iraq's core policy documents.
- Besides the above, each selected KPI should be relevant to all peculiarities of Iraq. In that sense, the selected KPIs are selected to be aligned with the relevant policy priorities, the characteristics of the competent authorities and elements of the relevant stakeholders. The enhancement of the participatory approach, also discussed in the NDCs and the NAP, is expected to significantly support this objective.
- As with any monitoring framework, a well-established monitoring timeline is necessary to ensure a structured approach to monitoring progress. This will allow regular data collection, assessment and reporting providing consistent basis; this is fundamental for generation of credible timeseries that will be used in the future to revise/redesign adaptation policies, as the climate change phenomenon evolves.

The "+" factor of SMART+, brings in refinement through consultation with a wide array of stakeholders, including policymakers, scientists, and sector-specific experts. This collaborative approach ensures that the selected KPIs are both relevant and feasible for Iraq's adaptation needs. Moreover, it includes context-specific considerations, such as socio-economic, environmental, and cultural factors unique to Iraq. These additions ensure that KPIs are not only contextually appropriate but also guard against unintended consequences or maladaptation, such as excessive groundwater extraction in vulnerable areas. It is imperative to note that this methodology will work in parallel with the expected Loss and Damage methodology (described in section 1.6), using information related with the total impact of loss and damage in the Iraqi economy, setting the baseline of the cost of adaptation if no actions take place.

The Design of the Monitoring and Evaluation Methodology

The proposed M&E methodology extends beyond the SMART+ framework to include detailed processes for data collection, stakeholder engagement, transparent reporting, and continuous improvement. All these elements are interconnected and provide a robust foundation for Iraq's adaptation strategy.

Following KPIs selection, Iraq will initiate the process for a standardized protocol for data collection, which defines sources, collection frequency, and quality control procedures. Key ministries—including the Ministry of Environment, Ministry of Water Resources, Ministry of Health, and Ministry of Agriculture— with the collaboration of the Central Statistical Organization will develop and organize data collection, storing and use. These authorities will be supported through capacity-building initiatives currently taking place, which are developing necessary structures.[53]

Regular collaboration with scientific experts, universities, and research institutions will ensure that the M&E framework is used properly and respected throughout the sectors. Furthermore, cross-sectoral collaboration will foster this integrated monitoring, ensuring that actions taken in one sector do not inadvertently hinder progress in another. As an example, adaptive actions in water resources must align

53 The project "Building Capacity to Advance the National Adaptation Plan Process in Iraq" aims on gathering and improving climate data, through transparent processes, essential for informed decision making. For more details, refer to section 1.4, above.

with agricultural needs, thus reducing the risk of maladaptation. This "no-harm" approach is vital to avoid cases of maladaptation and significant damages in other sectors.

To support transparency and accountability, the M&E framework is considered to include an efficient reporting mechanism. This will produce annual reports which will be providing an insight of adaptation per sector, highlighting also possible needs for revision and improvements. These reports will be made publicly available promoting transparency and accountability, while on the other hand, allowing scientists, academics and researchers to use existing data and KPIs for promoting relevant research.

Continuous Improvement and Policy Alignment

As noted, the SMART+ M&E framework incorporates a continuous improvement cycle to ensure that Iraq's adaptation strategies remain dynamic and responsive to the evolution of climate change. This feedback loop will involve periodic assessments of KPI efficiency, allowing for adjustments based on the latest data, climate change development and political priorities. Data from the monitoring process will directly inform policy makers, ensuring that adaptation practices evolve in line with emerging climate threats and vulnerabilities. For example, if monitoring data indicates increasing water scarcity, adaptation policies related to water management can be strengthened, with KPIs adjusted to reflect new resilience goals.

This approach also ensures that M&E insights are integrated into Iraq's broader policy framework. Alignment with Iraq's NAP and NDCs is core of the M&E methodology. The M&E process will provide essential data to support the achievement of NAP and NDC goals, while also facilitating alignment with emerging adaptation needs. This integration will help Iraq fulfill its commitments under international frameworks, including the ETF of the Paris Agreement.

4.6 Information related to averting, minimizing and addressing loss and damage associated with climate change impacts

Iraq is increasingly vulnerable to the effects of climate change, particularly in critical sectors like water management, agriculture, health, and biodiversity conservation. Despite the urgent need and the intensification of climate change the country is facing significant challenges in implementing integrated adaptation measures. However, despite recognizing the Loss and Damage as a key pillar of its climate policy, Iraq has not yet established a formal framework for assessing it. Averting loss and damage is expected to be accelerated once the climate change adaptation policy framework, described in previous sections, will be finalized and implemented.

The Ministry of Environment and especially the Climate Change Directorate is the central authority responsible for losses and damages in Iraq, also serving as the national focal point for loss and damage under the UNFCCC. In the meantime, a Loss and Damage Assessment Division within the Adaptation section of the Climate Change Directorate has been established. This is considered an essential organizational step to ensure systematic assessment, monitoring, and management of climate-related losses and damages, as well as to facilitate the development and implementation of effective mitigation and adaptation strategies. Following the above, a national team comprising representatives from all relevant departments has been formed to prepare a comprehensive national report calculating the climate-induced losses and damages experienced by Iraq across various sectors. The above led to the development of a specialized program for calculating losses and damages in the agriculture and water sectors, given their strategic importance and significant vulnerability to climate change. This program will be demonstrated through two new projects, that will be implemented in collaboration with UNDP and World Food Programme. The projects will assess climate-induced losses and damages in the marshlands and the agricultural sector.

Following the administrative structure described above, the government has recently initiated the process of developing the general Loss and Damage framework to assess the cost of the existing damages that could not have been averted by existing climate mitigation and adaptation policies. The development of the Loss and Damage methodology will become a mainstream tool for the revision and redesign of the climate policies in the medium and long run. The overview of the methodology proposed below is specialized for each of the key adaptation sectors identified in Iraq's policy documents. It is noted that the methodology described will be refined in the future as specific challenges related to data availability are addressed, facilitating an even more effective approach.

The process for the development of the Loss and Damage methodology, which was discussed during a capacity building workshop held by UNEP and the Ministry of Environment in Erbil Iraq, in July 2024 focuses on both economic and non-economic dimensions of climate change and it is expected to be structured around 4 main pillars.

The data and information collection will support the establishment of climate change vulnerability and adaptation baseline. This will be structured around the collection of data and timeseries, on work currently being implemented with regards to vulnerability assessments and on sectoral studies. The above will lead to a well-identified list of climate threats for the Iraqi economy. However, data collection is considered an important challenge which is intensified also from the structure of the Iraqi economy and the overall economic instability. External support will be needed to enhance data collection mechanisms and capacity-building efforts through targeted projects funded by UNEP and other international organizations. Recognizing the importance of cross-ministerial collaboration, the Government of Iraq is in the process of developing mechanisms to facilitate and improve the efficiency of interministerial collaboration.

Interministerial collaboration is essential for building climate resilience and effective adaptation in Iraq, as climate change impacts cut across multiple sectors and require coordinated responses. By fostering cooperation among Ministries responsible for water, agriculture, health, environment, and economic planning, Iraq can create a cohesive strategy that addresses the interconnected nature of climate risks.
This collaboration enables the sharing of data, resources, and expertise, allowing for comprehensive vulnerability assessments and the development of integrated adaptation measures. Moreover, a coordinated approach ensures that climate resilience efforts are embedded within sectoral policies and that adaptation initiatives are mutually reinforcing, avoiding duplication of efforts and maximizing resource efficiency.

The next methodological pillar proposed includes the identification of loss and damage from climate change, with a distinction between chronic and acute impacts. This approach includes a range of effects, including social, health, and cultural impacts that are more challenging to quantify but are essential for providing an integrated view of climate change effects. In some cases, such as the reconstruction of damaged infrastructure or buildings, the impacts are relatively easier to identify and monetize through direct market values. However, for other types of impacts, particularly non-economic such as the degradation of cultural heritage sites or health-related outcomes, more specialized methodologies are required. Non-economic loss assessment aims to capture the broader impacts that are often not reflected in direct monetary terms. For elements related to productivity loss, methods such as the Value of Statistical Life (VSL), the Value of a Life Year (VOLY) will be examined. In cases when socio-economic impact is necessary, surveys on vulnerable populations will be used.

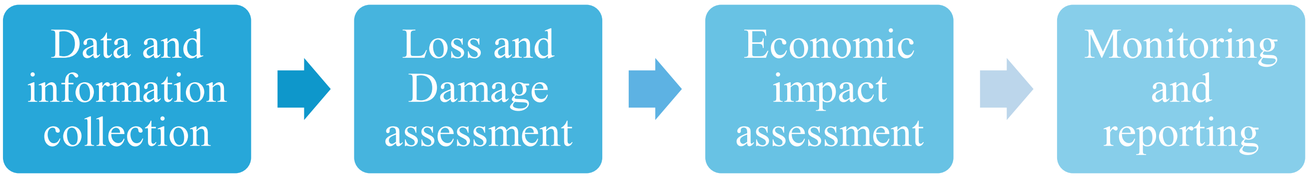

Figure 4-3 Conceptual methodological framework for assessing Loss and Damage in Iraq

After the assessment of costs stemming from non-economic and economic related losses has been concluded, the methodology will be built on the assessment of the consolidated economic impact of the damages that cannot be averted from mitigation and adaptation actions. As an example, a severe drought may not only reduce output in the agricultural sector but also will disrupt the entire supply and value chains (indirect impact), leading to higher food prices, reduced income for farmers and their suppliers and increased unemployment. This may intensify rural to urban population migration placing additional stress on urban structures and social services. The lost livelihoods and increased unemployment can lead also to reduced consumer spending (induced effect) slowing down economic growth, diminishing public revenues and, in the longer term, limiting the ability of much needed climate change adaptation public investments in the strategic sectors noted above. To also capture the ripple economic effects of climate change for the economy presented above, the assessment framework might expand to include the use of macroeconomic tools such as the Input-Output and Dynamic Stochastic General Equilibrium (DSGE) models. However, especially for implementing economic modelling actions, the lack of official macroeconomic and climate data remains a significant barrier which the country has identified and needs to be addressed. In an oil-dependent country like Iraq, where economic diversification is limited, assessing the total impact of climate change through the above methodology is much necessary to ensure national stability, development and progress towards the Sustainable Development Goals.

The last pillar of the proposed methodology includes monitoring and reporting mechanisms. These will be established to ensure that the loss and damage methodology developed is continuously updated with new data as climate change progresses, allowing Iraq to track the effectiveness of adaptation efforts and the evolving climate risks over time in a more efficient matter. Transparent and regular reporting is considered key to identifying gaps and ensuring that climate resilience measures are relevant to the latest available information. The monitoring phase will be supported by cross-ministerial collaboration and will feed directly into Iraq’s climate strategies and international reporting obligations.

4.6.1 Challenges for developing a Loss and Damage Framework in strategic sectors.

The development of Iraq’s Loss and Damage assessment framework will be designed to address the unique vulnerabilities of key sectors identified in the NAP and the NDC. Targeting sector-specific needs ensures that the framework captures the challenges and capacities of areas critical for climate adaptation. This approach combines a consistent methodology with tailored applications for each sector, laying a solid foundation for more effective adaptation strategies.

The framework is currently being designed to include a comprehensive baseline assessment for each sector, focusing on data collection to understand current vulnerabilities and sectoral dependencies. For instance, hydrological data supports water resource management, while agricultural productivity metrics, health statistics, and biodiversity inventories inform the respective sectors. Recognizing Iraq's data limitations, UNEP and other international partners contribute to strengthening data collection mechanisms through funding projects that aim overall in enhancing capacity building. This process is

reinforced by cross-ministerial collaboration, facilitating data sharing and integration across sectors to enhance the robustness of the framework.
A fundamental aspect of the Loss and Damage methodology is the classification of climate impacts as acute or chronic. Acute impacts include sudden, extreme events such as floods, droughts, or heatwaves, while chronic impacts reflect long-term shifts like declining precipitation or rising temperatures. Acute impacts can often be monetized through the use of direct economic values, such as the costs of infrastructure repair. Chronic impacts, however, require scenario-based analyses to estimate indirect or long-term economic losses, often using non-market valuation techniques like contingent valuation or cost-benefit analysis to capture effects on productivity and health.

In water resource management, acute impacts from floods or contamination are straightforward to monetize through direct market costs, while chronic issues like reduced water availability in agriculture necessitate a scenario analysis to project productivity losses and impact to the local ecosystem. These assessments rely on cross-sectoral data to capture the value of ecosystem services, such as role of wetlands in flood mitigation and biodiversity support.

In the agriculture sector, loss and damage is assessed based on acute climate impacts like sudden crop failures due to drought or heatwaves, along with chronic challenges such as prolonged soil degradation and shifts in growing seasons. Baseline data on crop yields, livestock productivity, and regional climate variability are necessary for these analyses. Projected yield declines or soil quality degradation will be evaluated through non-market methods to estimate the broader economic impact on food security and rural livelihoods. Integrating these findings into macroeconomic models will provide a broader understanding of potential impact on agricultural GDP, food prices, and rural poverty rates.

Assessing loss and damages in the health sector includes the assessment of both acute impacts from extreme events, like hospital admissions during heatwaves or respiratory issues from dust storms, and chronic impacts such as increased respiratory illnesses from deteriorating air quality or chronic stress caused by climate/environmental factors.[54] By gathering baseline data on public health outcomes, healthcare infrastructure, and vulnerable populations, the framework enables a differentiated assessment of direct health losses and non-tangible effects, such as reduced quality of life. Tools like Quality Adjusted Life-Year (QALY) and the Value of Statistical Life (VSL) can be employed to capture these broader health impacts, which will be then integrated into macroeconomic models to inform projections of healthcare demand and public health spending.

Finally, loss and damage in the biodiversity sector includes data collection on species populations, ecosystem health, and biodiversity hotspots. Acute impacts, such as habitat destruction from drought-induced wetland shrinkage are assessed directly through habitat loss and species population declines. Chronic impacts, like gradual ecosystem degradation, are evaluated using scenario-based approaches that incorporate climate projections. In cases where direct economic valuation is not feasible, non-market methods will be used to estimate the cultural and ecological value of biodiversity losses. Data limitations will be addressed by using regional and international studies to approximate Iraq-specific losses, ensuring informed conservation planning and policy development.

To capture the wider economic ripple effects across all the above sectors, the framework uses macroeconomic models, such as Input-Output or applications of Dynamic Stochastic General Equilbrium (DSGE) models, which help translate sectoral losses into broader economic impacts on GDP, employment, and public revenues. Monitoring and reporting mechanisms allow for continuous updates to the framework as new data becomes available and climate risks evolve, ensuring Iraq's adaptation

54 PInchoff J., Regules R., Gomez A., Abularrage T., Chapela L., Coping with climate change: the role of climate stressors in affecting the mental health of young people in Mexico, Global Public Health, 2023

strategies remain responsive. Regular, transparent reporting will feed into Iraq's national climate policies and international reporting obligations, supporting alignment with the Sustainable Development Goals and reinforcing Iraq's resilience efforts.

Through this structured, sector-specific application of the Loss and Damage framework, Iraq aims to build a resilient and adaptive response to climate challenges, optimizing resources across sectors while addressing the distinct needs of each critical area.

4.7 Cooperation, good practices, experience and lessons learned (summary)

This section provides an overview of Iraq's climate adaptation efforts, focusing on the national strategic priorities. It highlights the nation's ongoing development of a Monitoring and Evaluation framework to assess adaptation progress and a Loss and Damage methodology aimed at quantifying unavoidable climate impacts. This summary captures Iraq's integrated approach to climate adaptation, addressing sector-specific vulnerabilities while reinforcing its broader sustainability.

Adaptation Policies and Sectoral Priorities

Iraq's climate adaptation efforts are shaped by the National Adaptation Plan (NAP) and its Nationally Determined Contributions (NDC), both of which focus on fostering resilience in critical sectors such as water management, agriculture, health, and biodiversity. These policies emphasize a multi-faceted approach to adaptation, prioritizing resource management, ecosystem preservation, climate-smart practices and human health. Given Iraq's location, water scarcity has intensified due to decreased precipitation, increased temperature and hydraulic projects in neighboring countries which reduce quantity and quality of water. Consequently, the NAP and NDC stress the need for integrated water management, including infrastructure upgrades, development of desalination plants, and enhanced groundwater monitoring. Moreover, water diplomacy is another main element highlighted to ensure increased resilience.

In agriculture, Iraq has initiated climate-responsive policies that integrate climate risk into agricultural planning, aiming to protect both crop yields and rural livelihoods. The government's climate-smart agriculture initiatives, implemented at pilot scale also through specific projects funded by international donors, address water use efficiency, soil conservation, and climate-resilient crop varieties, recognizing that climate-induced stress, such as severe drought and dust storms, directly impacts food security. The NAP highlights the collaborative approach needed among Ministries and international stakeholders to enhance adaptive agricultural practices, including drought-resistant crops and efficient irrigation techniques. These strategies are expected to mitigate impacts on the 1.77 million Iraqis currently at risk of food insecurity, highlighting agriculture as a pillar for Iraq's climate adaptation and economic diversification.

The health sector, also affected by rising temperatures, air pollution, and water scarcity, faces significant challenges due to climate change. Extreme heat has led to a surge in heat-related illnesses and cardiovascular diseases, particularly affecting vulnerable groups such as the elderly and outdoor workers. Iraq's adaptation priorities for health aim to fortify healthcare infrastructure, improve access to climate-resilient medical facilities, and enhance public health awareness to prevent climate-related diseases. The adaptation policies also target rural areas with high health vulnerability, prioritizing accessible care and preventive health education to reduce the sector's susceptibility to climate change impacts.

Finally, Iraq's biodiversity is under significant threat from habitat loss, increased salinity, and the disruption of critical ecosystems. Climate change exacerbates these challenges, endangering local species and impacting the livelihoods of communities dependent on natural resources. Iraq's NAP and NDC underscore the urgency of biodiversity conservation through nature-based solutions and ecosystem-based adaptation measures. Efforts are underway to expand protected areas, reforest degraded lands, and promote sustainable management practices, helping to preserve biodiversity and maintain ecosystem resilience.

Monitoring and Evaluation (M&E) Framework

Central to Iraq's adaptation strategy is a comprehensive Monitoring and Evaluation (M&E) framework currently being designed to assess and potentially enhance the effectiveness of adaptation actions. Iraq's M&E framework is built upon the SMART+ approach, which will set specific, measurable, achievable, relevant, and time-bound Key Performance Indicators (KPIs) across water, agriculture, health, and biodiversity sectors. This framework allows Iraq to track both the implementation and outcomes of adaptation measures, offering a solid basis for policy adjustments and continued alignment with adaptation goals in the NAP and NDC.

For example, in the water sector, KPIs may include metrics for groundwater salinity, irrigation efficiency, and water quality. In agriculture, climate-smart practices are monitored by assessing crop resilience under drought conditions, while in the health sector, indicators track heat-related illness rates and healthcare readiness. By ensuring that KPIs are designed tailored on Iraq's characteristics, the M&E framework offers a structured approach to adaptation progress. The collaborative design process involving multiple ministries, scientific experts, and research institutions enhances transparency and accountability. Regular data collection, assessment, and public reporting foster an open approach that supports both government and public engagement in Iraq's adaptation journey.

Loss and Damage (L&D) Methodology

Recognizing the increasing impact of climate change, Iraq is in the process of developing a formal Loss and Damage methodology to assess both economic and non-economic losses. This framework targets the four sectors outlined in the core national policy documents and aims to quantify both chronic and acute climate impacts. The current development of this methodology categorizes climate impacts as acute—such as extreme weather events like droughts and floods—and chronic, such as long-term water scarcity or temperature rises.

To address these impacts, the methodology foresees the use of both market and non-market valuation techniques. For quantifiable losses, like infrastructure repair costs following extreme weather, direct economic values are suggested to be applied. Non-economic losses, however, require specialized approaches to capture the intangible costs of climate change, such as cultural heritage degradation or health-related quality of life reductions. Tools like the Value of Statistical Life (VSL) and macroeconomic models, including Input-Output and applications of Dynamic Stochastic General Equilibrium (DSGE) models, are under consideration to estimate broader economic repercussions across sectors. For instance, the agriculture sector, heavily impacted by both acute drought and chronic soil degradation, is particularly vulnerable to climate-induced productivity losses, which can destabilize rural economies and accelerate migration to urban areas. A proper assessment of loss and damage will enable Iraq to evaluate the ripple effects of climate impacts on its economy, supporting informed decision-making for both adaptation and resilience planning.

Ongoing Adaptation Projects

Alongside policy and framework development, Iraq has initiated several adaptation projects with the support of external funders, contributing over $75 million to climate resilience across sectors. These projects are designed to support Iraq's adaptation goals, each addressing specific vulnerabilities in agriculture, water, health, and biodiversity.

CHAPTER 5

INFORMATION ON FINANCIAL, DEVELOPMENT, AND TECHNOLOGY TRANSFER SUPPORT, AND CAPACITY BUILDING NEEDED AND RECEIVED UNDER ARTICLES 9 TO 11 OF THE PARIS AGREEMENT

5 Information on Financial, Development, and Technology Transfer Support, and Capacity Building Needed and Received Under Articles 9 to 11 of the Paris Agreement

This chapter provides a comprehensive account of Iraq’s efforts to address its climate challenges in alignment with Articles 9–11 of the Paris Agreement. It outlines the financial, technological, and capacity-building support needed and received to enhance Iraq's adaptation and mitigation capacities. This chapter details financial contributions, including grants, loans, and technical assistance, which have been directed toward sectors such as agriculture, water management, renewable energy, and infrastructure. It also emphasizes the transfer of technologies for climate adaptation and mitigation, such as smart irrigation, renewable energy integration, and disaster risk reduction tools. Furthermore, the chapter highlights capacity-building initiatives aimed at strengthening institutional, technical, and community-level capabilities, particularly through training programs, international collaborations, and the development of transparent reporting mechanisms.

5.1 National circumstances, institutional arrangements, and country-driven strategies

Iraq’s Ministry of Environment (MoE) is the primary entity responsible for administrative and regulatory actions in response to national and international climate change requirements. The MoE oversees the implementation of Iraq’s climate policies, coordination with international frameworks, and participation in global agreements such as the UNFCCC, Kyoto Protocol, and the Paris Agreement.

The MoE serves as the lead institution for the NDC implementation and coordination of climate adaptation and mitigation actions, ensuring that Iraq’s commitments under international agreements are integrated into national development plans.

Climate finance in Iraq is mobilized through multiple sources, including the GCF, the GEF, the World Bank, bilateral development agencies, and multilateral institutions. Additionally, Iraq has received financing from the World Bank’s Climate Resilience and Adaptation Projects, the Japan International Cooperation Agency (JICA), the United Nations Development Programme (UNDP), and regional development banks. These funds are distributed among different ministries based on sectoral priorities, with implementation responsibilities falling on relevant technical ministries such as the Ministry of Oil, Ministry of Electricity, Ministry of Agriculture, Ministry of Water Resources, and Ministry of Industry and Minerals.

Despite these financial flows, Iraq faces several challenges in effectively managing and mobilizing climate finance. There is no unified national climate finance tracking system, making it difficult to assess the scale and efficiency of funding allocation and expenditure. The absence of a centralized Monitoring, Reporting, and Verification (MRV) system for climate finance, institutional fragmentation, overlapping mandates, and limited coordination between ministries further hinder the efficiency of climate finance utilization.

Security concerns, political instability, and economic dependence on oil revenues also pose significant constraints on financial planning for climate action. Iraq lacks a dedicated climate finance strategy that would allow for a systematic approach to resource mobilization, private sector engagement, and international cooperation. Developing such a strategy, aligned with the NDC, would be a key step in ensuring that available financial resources are directed toward the most impactful mitigation and adaptation measures.

Given Iraq's vulnerability to climate change, including desertification, water scarcity, and extreme weather events, mobilizing financial, technical and capacity building resources is critical to ensuring long-term environmental and economic sustainability. Addressing these challenges will require coordinated efforts from the government, international donors, and private sector stakeholders to secure and efficiently allocate resources.

Iraq's economy has experienced significant challenges due to climate-related impacts. Iraq's Gross Domestic Product (GDP) is recorded at $250.392 billion, while historical climate damage is estimated at $2.094 billion. When combining both figures, the total value stands at $252.497 billion. These numbers highlight the growing financial burden climate change places on Iraq's economy, which is already facing multiple stressors, including water scarcity, desertification, and rising temperatures. Iraq falls under the category of Developing Recipient (DR), indicating that it remains highly vulnerable to climate risks and requires substantial support to strengthen its resilience. Addressing these climate-induced economic challenges will require strategic interventions, including increased investment in adaptation and mitigation initiatives, as well as collaboration with international financial institutions and development partners to mobilize the necessary resources.[55]

In May 2024, Iraq announced the inception of a five-year Climate Investment Plan (CIP) [56], representing a strategic milestone to align public and private investments with the country's climate commitments for the period 2025–2030. The CIP aims to integrate climate considerations into national and regional investment strategies, foster a resilient low-emission economy, and create an enabling environment for both local and international investors. Jointly developed by the National Investment Commission (NIC), Ministry of Environment, Ministry of Planning, the Board of Investment, and the Kurdistan Regional Government (KRG), the plan reflects a whole-of-government approach toward sustainable economic transformation.

The CIP is supported technically by the United Nations Development Programme (UNDP) and financially by the United States Agency for International Development (USAID). It identifies priority investment sectors, including climate-smart agriculture, water security, ecosystem restoration, low-emission transport, renewable energy, and circular urban economies. In the Kurdistan Region, the initiative is led in collaboration with the Environmental Protection and Improvement Board and the Ministry of Planning, with a technical committee established across sectoral entities and the Prime Minister's Office to ensure comprehensive and realistic planning.

5.2 Underlying Assumptions, Definitions, and Methodologies

Before detailing the financial, technological, and capacity-building support Iraq has received and required, it is essential to outline the assumptions, definitions, and methodologies used for calculating financial flows, assessing climate finance needs, and ensuring consistency in reporting.

Definitions Used for Climate Finance Reporting

For the purpose of this report, climate finance refers to all financial resources mobilized from domestic and international sources to support climate change mitigation and adaptation activities in Iraq. This includes:

- Public climate finance: Funding received from bilateral and multilateral donors, government budget allocations, and international climate funds (e.g., GCF, GEF, and World Bank climate financing mechanisms).

55 Ministry of Environment, 2025
56 Ministry of Environment, 2024

- Private climate finance: Contributions from private sector investments, public-private partnerships, and international financial institutions.
- Capacity-building support: Financial and technical assistance provided to strengthen Iraq's ability to implement and monitor climate-related policies.
- Technology transfer support: Funding and in-kind contributions allocated to facilitate the adoption of clean technologies and innovative climate solutions.

Methodologies for Financial Data Collection and Reporting
The financial data presented in this report is collected from multiple sources, including:
- Government budget allocations: Ministry of planning data for climate-related projects in sectors such as energy, water, and agriculture.
- International donor reports and agreements detailing funding commitments and disbursements.
- Multilateral fund tracking systems, including the GCF, GEF, and World Bank financial mechanisms.
- Data from national implementing entities, such as the Ministry of Finance, Ministry of Environment, and sector-specific ministries.

To ensure consistency and comparability, the financial figures are reported in United States Dollars (USD). Since Iraq's financial records are often maintained in Iraqi Dinar (IQD), all reported figures have been converted into USD using the official exchange rate set by the Central Bank of Iraq at the time of data collection. The official exchange rate applied in this report is 1 USD = 1320 IQD.

Ensuring Transparency and Consistency
To improve financial transparency and tracking, Iraq is working towards the establishment of a national climate finance tracking system, which will integrate data from government ministries, donor agencies, and private sector stakeholders. This system will:
- Enhance MRV of financial flows.
- Improve coordination among different agencies responsible for climate finance.
- Provide clear documentation of funding sources, allocations, and expenditures for future reporting cycles

5.3 Information on financial support needed under Article 9 of the Paris Agreement

Based on data availability and sources of data, this section is divided into three main subsections. The first one discusses financial support needed based on NDC projects (as identified by MOE), the second identifies financial support needed based on priority climate funding projects identified by the government (as per MOE and Ministry of Planning), and support needed based on the Iraq's Nationally Appropriate Mitigation Actions (NAMA) (as per MOE).

5.3.1 Information on financial support needed under Article 9 of the Paris Agreement based on NDC projects

According to the New Collective Quantified Goal (NCQG) framework on climate finance needs, Iraq's total climate finance requirement for the period 2025–2035 is estimated at $305.303 billion. This substantial financial need underscores the country's pressing challenges in addressing climate change impacts, including adaptation and mitigation efforts. On an annual basis, Iraq requires $27.755 billion to meet its climate goals, with a significant portion of this amount—$20.335 billion—expected to come from private sector investments, while the remaining $7.419 billion is projected to be sourced from public funds. The reliance on private sector funding highlights the importance of creating an enabling environment for investment in sustainable infrastructure, renewable energy projects, and climate resilience initiatives.[57]

Iraq stands at a pivotal point in addressing its pressing climate challenges. With its unique geographic and socio-economic vulnerabilities, the country is experiencing the adverse effects of climate change more acutely than ever before.[58] Issues such as water scarcity, desertification, rising temperatures, and declining agricultural productivity are compounded by economic dependence on oil, rapid urbanization, and a growing population. [59]

To tackle these challenges, Iraq has outlined an ambitious set of climate adaptation and mitigation initiatives that align with its NDCs under the Paris Agreement. Table 5-1 categorizes Iraq's key projects and strategic initiatives under its NDC across multiple sectors, reflecting the country's commitment to addressing climate change and enhancing resilience.

- The Water and Water Security Sector, comprising focuses on sustainable water management, resource conservation, and infrastructure development to ensure long-term water security.
- The Marine and Coastal Environment Sector, aims to protect and restore Iraq's coastal and marine ecosystems, addressing challenges such as pollution and habitat degradation.
- The Agriculture and Food Security Sector, emphasizes climate-smart agricultural practices and food system resilience to combat the adverse impacts of climate change on food production.
- The Energy and Transport Sector, targets the transition towards cleaner and more efficient energy sources while enhancing sustainable transportation infrastructure.
- The Industry, Oil, and Gas Production Sector, focuses on emission reductions, energy efficiency improvements, and sustainable resource utilization within Iraq's industrial and energy production sectors.
- The Climate Sector and Recurring and Slow-Onset Events and Risks Resulting from Climate Change, addresses cross-sectoral risks, disaster preparedness, and long-term resilience strategies to mitigate the impacts of climate change on communities and infrastructure.

These projects collectively represent Iraq's strategic approach to mitigating and adapting to climate change while promoting sustainable development across key sectors. By implementing these initiatives, Iraq aims to enhance national resilience, reduce greenhouse gas emissions, and ensure long-term environmental sustainability in alignment with its international climate commitments.

The total estimated cost of projects identified in Iraq’s NDCs amounts to approximately USD 31.49 billion, reflecting the scale of ambition and the breadth of climate action required across sectors. Of this amount, USD 2 billion is allocated for adaptation projects, targeting climate resilience in water, agriculture, and disaster risk reduction. Mitigation-related interventions—particularly those aimed at reducing emissions in energy, transport, and industry—are estimated at USD 4.78 million. A substantial share of the financial requirements, totaling USD 29.31 billion, falls under cross-cutting initiatives, which span both mitigation and adaptation objectives, such as integrated infrastructure development, capacity-building, and sustainable urban planning. Additionally, USD 167.15 million is dedicated specifically to support-type interventions, including institutional strengthening and monitoring systems. These figures underscore Iraq’s pressing need for international climate finance, technical assistance, and private sector engagement to successfully implement its NDCs and transition toward a climate-resilient and low-carbon economy.

57 NCQG Climate Finance Needs Report, 2025–2035
58 UNFCCC, Paris Agreement: Articles 9–11: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.
59 United Nations Development Programme (UNDP). Climate Adaptation Planning. Accessed via: https://www.undp.org/.

The sectoral breakdown of Iraq's NDCs highlights the country's climate investment priorities and the significant financial requirements to implement targeted actions. The Oil and Gas sector, including both mitigation and adaptation components, represents the largest share of financial needs with an estimated USD 29 billion, underscoring the central role of energy transition and emissions reduction in Iraq's climate agenda. Risk management interventions, including disaster preparedness and early warning systems, require USD 311.55 million, while agriculture and irrigation projects—critical for food security and rural livelihoods—are estimated at USD 460.26 million. The water sector, encompassing water resources, storage, and management, collectively demands over USD 1.58 billion, reflecting Iraq's urgent need to enhance resilience against water scarcity and climate-induced hydrological shifts.

Additional sectoral needs include wastewater treatment (USD 384,615), forestry (USD 11,115), and rural development (USD 275,385), each contributing to the broader adaptation framework. The energy sector, including energy efficiency and renewable energy initiatives, requires approximately USD 4.38 million, while waste management and environmental policy and governance account for USD 527,459 and USD 419,230 respectively. A separate allocation of USD 167.15 million has also been identified for support measures within the Oil & Gas sector, specifically addressing institutional and technical capacity needs. This distribution of sectoral financing reflects Iraq's integrated approach to climate action, balancing emission reductions, adaptation needs, and governance reforms across high-impact sectors.

Table 5-1 Iraq's NDC Key Projects and Strategic Initiatives

Title (of activity, program, or project)	Expected Time frame (year)	Location	Implementation Entity	Estimated amount in (USD)*	Type of Support	Sector & Subsector	Contribution to Technology Development, Transfer, and/or Capacity-Building
Hydrological Assessment of the Southern Desert Area	1	Basra	Ministry of Water Resources/General Authority for Groundwater (MWRGAGW)	29,230	Adaptation	Water Resources	Capacity-building (improving water resource management)
Hydrological Assessment of the Al-Shabaka Area	1	Najaf and Muthana	MWRGAGW	29,230 each area	Adaptation	Water Resources	Capacity-building
Establishment of a Groundwater Monitoring and Observation Center (ongoing)	1	All governorates	MWRGAGW	23,076,923	Adaptation	Water Resources	Technology Transfer, Capacity-Building
Artificial Groundwater Recharge (ongoing)	3 - 5	Karbala, Muthanna, Anbar	MWRGAGW	384,615	Adaptation	Water Resources	Technology Transfer, Capacity-Building
Rehabilitation and Expansion of Tharthar Canal (ongoing)	15-16	Salah Al-Din / Anbar	MWRGAGW	115,609 Investment	Adaptation	Water Management	Infrastructure Development
Completion of Al-Masad Dam (ongoing)	2	Anbar/Ramadi/ Rutba/Wadi Horan	MWRGAGW	7,981,863 Investment	Adaptation	Water Storage	Infrastructure Development
Water Harvesting Dams -Abu Takiya Dam (ongoing)	2	Nineveh / Mosul / Baaj - Abu Takiya	MWRGAGW	10,526,325 Investment	Adaptation	Water Storage	Technology Transfer
Completion of Landslide Treatment for Darbandikhan Dam (ongoing)	1	Sulaymaniyah /Darbandikhan	MWRGAGW	1,346,154 Investment	Adaptation	Water Resources	Technology Transfer
Shatt Al-Arab Irrigation Project (Sector G)	NA	Basra / Basra	Ministry of Water Resources/General Authority for Irrigation and Reclamation Projects (MWRGAIRP)	NE	Adaptation	Agriculture/Irrigation	Capacity-Building

Al-Shanafiya Irrigation Project (ongoing)	NA	Dhi Qar/ Nasiriyah	MWRGAGW	NE	Adaptation	Agriculture/Irrigation	Capacity-Building
Al-Muthanna Irrigation Project	NA	Muthanna / Samawah	MWRGAGW	48,846,154	Adaptation	Agriculture/Irrigation	Capacity-Building
Cleaning of Canals and Drains - Phase III	5	Multiple Locations	Ministry of Water Resources / General Directorate for the Operation and Maintenance of the Euphrates River	105,384	Adaptation	Water Management	Capacity-Building
Lining Irrigation Canals with Concrete Mattresses	5	Multiple Locations	Ministry of Water Resources / General Directorate for the Operation and Maintenance of the Tigris River	137,596	Adaptation	Water Management	Technology Transfer
Monitoring Water Resource Quality in Diyala (New)	1	Diyala	Ministry of Environment / Diyala Environment Directorate	961,538 Investment	Adaptation	Water Management	Technology Transfer
Tender for Supplying and Implementing Karbala Treatment Plants	4	Karbala	General Directorate of Sewage (GDS)	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Supply and Implementation of Sewage Networks for Residential Areas in Karbala	2	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Design, Supply, and Implementation of Sewage Network	NA	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Implementation and Supply of Al-Hurr Sewage Treatment Plant (Design Capacity: 37,000 m^3/day)	2-3	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Supply and Implementation of Sewage Networks for Al-Hurr District, Karbala	2	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Construction and Equipment of Al-Hindiya Sewage Treatment Plant, Karbala, with a Design Capacity of 25,000 m^3/day	2-3	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development

Tender for the Supply, Execution, Operation, and Maintenance of Complementary Works for Rainwater and Sewage Networks, Including Secondary and Main Sewage Lines and Pumping Stations for Unserviced Areas	1-2	Salah al-Din / Al-Dujail	GDS	NE	Adaptation	Agriculture	Technology Transfer
Project for the Supply, Execution, Operation, and Maintenance of a Wastewater Treatment Plant, Heavy and Rainwater Sewage Networks, Pumping Stations, Transmission Lines, and Related Services for Samarra City	3	Salah al-Din	GDS	NE	Adaptation	Land Management	Capacity-Building
Supply, Execution, Operation, and Maintenance of Complementary Works for Tikrit Wastewater Treatment Plant / Industrial Zone	1-2	Salah al-Din	GDS	NE	Adaptation	Land Management	Capacity-Building
Hamdaniya Sewage Project with a capacity of 41,000 m³/day (Turnkey)	2	Nineveh/ Hamdaniya	GDS	NE	Adaptation	Forestry	Technology Transfer
Reviewing designs, supplying, implementing, operating, and maintaining Bartella sewage network, Nineveh, with a design capacity of 4,942 m³/day	1	Nineveh	GDS	NE	Adaptation	Rural Development	Capacity-Building
Supply, implement, and operate Mosul Left Bank treatment plant (Phase 1)	2	Nineveh	GDS	NE	Mitigation	Energy Efficiency	Technology Transfer
Supply, implement, and operate Mosul Left Bank treatment plant (Phase 2)	2	Nineveh	GDS	NE	Mitigation	Energy	Technology Transfer
Supply, implement, and operate Mosul Right Bank treatment plant (Phase 1)	2-3	Nineveh	GDS	NE	Mitigation	Renewable Energy	Technology Transfer

Supply, implement, and operate Mosul Right Bank treatment plant (Phase 2)	2	Nineveh	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Supply and implement heavy transmission lines for Mosul city, right bank / M3	1-2	Nineveh	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Supply and implement storm transmission lines with SL46 / SL47 lift stations	1-2	Nineveh	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Implementation and supply of heavy sewage transmission lines with four stations for Mosul city / left side / Phase IV	2-3	Nineveh	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Implementation and supply of stormwater transmission lines with a lifting station for the right side of Mosul city / Phase IV	1-2	Nineveh	GDS	NE	Mitigation	Waste Management	Technology Transfer
Sewage Network Project / Right Side / Mosul City	3	Ninewah	GDS	NE	Mitigation	Waste Management	Technology Transfer
Construction, Operation, and Maintenance of the Treatment Plant (Hamdan Filtration Center M5)	4	Basra, Hamdan	GDS	NE	Mitigation	Waste Management	Technology Transfer
Construction, Operation, and Maintenance of the Treatment Plant (Hamdan Filtration Center M4)	3	Basra, Hamdan	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Design, Supply, and Maintenance of Al-Zubair Sewage System (Turnkey) Design Capacity of 120,000 m^3/day	3-4	Basra, Al-Zubair	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Rainwater and Sewage Networks for Zone 14 + Zone 15 in Ramadi (Part of Ramadi Sewage Project 1 / Phase 1)	1-2	Anbar / Ramadi	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Sewage Networks for Fallujah Capacity of 35,000 m^3/day (Turnkey Project)	2-3	Anbar / Fallujah	GDS	NE	Mitigation	Renewable Energy	Technology Transfer

Construction of Rawah Sewage Building in Anbar Governorate	1	Anbar / Rawah	GDS	NE	Mitigation	Renewable Energy	Technology Transfer
Ramadi Sewage Project / M1 (Capacity:100,000 m³/day, Turnkey)	3	Anbar / Ramadi	GDS	NE	Mitigation	Industrial Emissions	Technology Transfer
Rehabilitation of Four Treatment Units in Fallujah	2	Anbar / Fallujah	GDS	NE	Mitigation	Oil & Gas	Technology Transfer
Integrated Sanitation Project with Treatment Unit for the City of Hit, Anbar	3	Anbar / Hit	GDS	NE	Mitigation	Oil & Gas	Technology Transfer
Sanitation Project for Al-Diwaniyah M2 with a Capacity of 100,000 m³/day (Turnkey)	3	Al-Diwaniyah	GDS	NE	Mitigation	Oil & Gas	Technology Transfer
Sewage Project for Ghammas M1	3	Al-Diwaniyah/ Ghammas	GDS	NE	Mitigation	Oil & Gas	Technology Transfer
Tender for Completing Deficiencies in Baquba City Network - Diyala	2	Diyala	GDS	NE	Mitigation	Oil & Gas	Technology Transfer
Procurement, Execution, Operation, and Maintenance of Complementary Works for Stormwater and Wastewater Networks, Pumping Stations, and Treatment Plant (Phase 2)	2	Diyala / Baquba	GDS	NE	Cross-Cutting	Policy & Governance	Capacity-Building
Procurement and Execution of Wastewater Treatment Plant (Phase 2)	3	Karbala	GDS	NE	Cross-Cutting	Policy & Governance	Capacity-Building
Enhancing Sanitation Monitoring Program	NA	Al-Diwaniyah	Implementing entity and other parties	11,538 Operational	Cross-Cutting	Policy & Governance	Technology Transfer
Regional Water Quality Monitoring Program (Proposed)	2	Basra	Ministry of Environment / Technical Department, Water Monitoring and Evaluation Section	307,692	Cross-Cutting	Employment & Economy	Capacity-Building
Rehabilitation of Early Detection Devices for Oil Pollution (Proposed)	2	Baghdad	Private sector companies and public sector institutions	88,462 Operational	Cross-Cutting	Risk Management	Capacity-Building

Monitoring and Evaluation of Oil Pollution in Local and Regional Waters	1	Basra Governorate	Urban Environment Directorate with the Southern Environment Protection Directorate	153,846 Operational	Type of Support	Sector & Subsector	Contribution to Technology Development, Transfer, and/or Capacity-Building
Completion, Design, Implementation, Operation, and Maintenance of Al-Nu'maniyah Sewage Networks (Turnkey)	1.5	Wasit / Al-Nu'maniyah	GDS	30,368	Adaptation	Water Resources	Capacity-building (improving water resource management)
Implementation of Al-Kut Sewage Network	1.5	Wasit / Al-Kut	GDS	32,846	Adaptation	Water Resources	Capacity-building
Development and Rehabilitation of Infrastructure in Al-Hay District	2	Wasit / Al-Hay	GDS	42,978	Adaptation	Water Resources	Technology Transfer, Capacity-Building
Development and Rehabilitation of Infrastructure in Al-Suwaira District, Wasit	2	Wasit / Al-Suwaira	GDS	41,265	Adaptation	Water Resources	Technology Transfer, Capacity-Building
Design, Supply, and Maintenance of Aziziyah Sewage Networks (Turnkey Project)	NA	Wasit	GDS	NE	Adaptation	Water Management	Infrastructure Development
Supply and Implementation of Treatment Plant, Rainwater Networks, Pumping Station (Phase I)	3	Wasit, Al-Suwaira	GDS	NE	Adaptation	Water Storage	Infrastructure Development
Preparation of Study and Designs for Sewage Treatment Project with Networks for Rainwater and Heavy Sewage and Pumping Stations	3	Kirkuk	GDS	104,663	Adaptation	Water Storage	Technology Transfer
Al-Rashid Sewage Project	2	Baghdad	GDS	NE	Adaptation	Water Resources	Technology Transfer
Al-Husseiniyah Sewage Project	2.5	Baghdad	GDS	NE	Adaptation	Agriculture/Irrigation	Capacity-Building
Supplementary Works for Balad Treatment Plant in Salahuddin Province	1	Salahuddin	GDS	NE	Adaptation	Agriculture/Irrigation	Capacity-Building

Supply and Implementation of Two Treatment Plants in Nasiriyah (Al-Jazeera 70,000 m³/day and Al-Shamia 65,000 m³/day)	3	Nasiriyah	GDS	NE	Adaptation	Agriculture/Irrigation	Capacity-Building
Preparation of Study and Design for Sewage Treatment Project with Stormwater and Wastewater Networks (Main/Secondary)Phase 1	3	Dhi Qar, Shatra	GDS	NE	Adaptation	Water Management	Capacity-Building
Complementary Works for Supply and Implementation of Sewage Treatment Plant in Al-Rifai with a Design Capacity of 60,000 m³/day (Implemented by Al-Barih Company on Nakal Account)	2	Dhi Qar, Al-Rifai	GDS	NE	Adaptation	Water Management	Technology Transfer
Supply, Implementation, and Installation of Sewage Treatment Plant in Najaf with a Design Capacity of 100,000 m³/day	3	Najaf	GDS	NE	Adaptation	Water Management	Technology Transfer
Supply and Implementation of Sewage Network with Pumping Stations (5 Rainwater + 4 Heavy Sewage) for Al-Rumaitha District	2.5	Al-Muthanna / Al-Rumaitha	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Supply and Implementation of Rainwater and Heavy Sewage Transmission Lines for Street 60 within the Sewage Network Project in Hilla City	1.5	Babil	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Supply, Implementation, Operation, and Maintenance of Sewage Networks in Nasiriyah	3	Dhi Qar - Al-Rifai	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Supply, Implementation, Operation, and Maintenance of Rainwater and Sewage Transmission Lines (Hillah-	2	Babylon	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development

Diwaniyah Street) as part of the Hillah City Sewer Network Project							
Design, preparation, and implementation of sewage and rainwater networks, treatment plants, and execution of the first phase of treatment stations (Large Side and Small Side) for Hillah City	1	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Karbala Sewage Project / Cubic Meter (Treatment Plant with Transmission Line)	3	Karbala	GDS	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Utilizing Modern Irrigation and Mechanization Techniques (proposed for 2027)	NA	Baghdad	NA	3,846,154	Adaptation	Agriculture	Technology Transfer
Sand Dune Stabilization Project	21	Multiple	NA	NE	Adaptation	Land Management	Capacity-Building
Desert Oasis Project	12	Multiple	Forestry and Desertification Directorate	NE	Adaptation	Land Management	Capacity-Building
Forest Development and Improvement Project	21	Multiple	Ministry of Agriculture / Forestry and Desertification Directorate	11,115	Adaptation	Forestry	Technology Transfer
Modern Villages Establishment Project (11 Villages)	10	Multiple Governorate s	NA	275,385	Adaptation	Rural Development	Capacity-Building
Mother Orchards and Tissue Culture Seedlings Project	24	Baghdad, Anbar, Diyala, Karbala, Najaf, Babel, Wasit, Diwaniya, Amara, Thi-Qar, Basra, Mosul	NA	45,369	Mitigation	Energy Efficiency	Technology Transfer

Establishment of a Tissue Culture Laboratory	3	Anbar Governorate / Ramadi District	Anbar Environment Directorate	1,025,385 Operational	Mitigation	Energy	Technology Transfer
Zero Grid Consumption	0.5	Baghdad	Ministry of Electricity (MoEl)	1,923,077	Mitigation	Renewable Energy	Technology Transfer
Building Production Location	NA	Baghdad	MoEl	76,923 Operational	Mitigation	Renewable Energy	Technology Transfer
Gas Projects Building Location	NA	Baghdad	MoEl	153,846 Operational	Mitigation	Renewable Energy	Technology Transfer
Production Projects Building Location	NA	Baghdad	Ministry of Electricity, Climate Change Directorate	230,769 Operational	Mitigation	Renewable Energy	Technology Transfer
6 Solar Energy Project / Basra	TBD	Basra/Abu Khaseeb/Na siriyah DhiQar/Kar bala/ Al-Muqaddasa	Ministry of Environment, Climate Change Directorate (MOECCD)	NE	Mitigation	Renewable Energy	Technology Transfer
Solar Energy Projects / Najaf - Aqua Power	NA	Samawah	MOECCD	527,459	Mitigation	Waste Management	Technology Transfer
6 Solar Energy Project / Kirkuk - Al-Hawija	NA	Kirkuk Maysan Anbar-Ramadi 1 Anbar Ramadi-2 Dhi Qar Kerbala	MOECCD	NE	Mitigation	Waste Management	Technology Transfer
Solar Power Plant Project / Basra / Rumaila	NA	Basra	MOECCD	NE	Mitigation	Waste Management	Technology Transfer
Wind Energy Project / Al-Shihab Site	NA	Wasit	MOECCD	NE	Mitigation	Renewable Energy	Technology Transfer
Ministry of Electricity Headquarters 1 MW Project	NA	Baghdad	MOECCD	769,231	Mitigation	Renewable Energy	Technology Transfer
Waste-to-Energy Plant Project / Nahrawan	NA	Baghdad / Rusafa	MOECCD	NE	Mitigation	Renewable Energy	Technology Transfer
Waste-to-Energy Plant Project / Baweza – Trade Exchange	NA	Nineveh / Tel Kaif	MOECCD	NE	Mitigation	Renewable Energy	Technology Transfer

Waste-to-Energy Plant Project / Karkh	NA	Baghdad Karkh Abu Ghraib	MOECCD	NE	Mitigation	Renewable Energy	Technology Transfer
Solar Energy System Installation Project	NA	Nineveh / Mosul	MOECCD	NE	Mitigation	Industrial Emissions	Technology Transfer
Solar Power System Installation (200 kW)	NA	Babylon	MOECCD	NE	Mitigation	Oil & Gas	Technology Transfer
Solar Power Systems / 15KW Capacity	NA	Babylon	MOECCD	15,692	Mitigation	Oil & Gas	Technology Transfer
Solar Power Systems / 40KW Capacity	NA	Kerbala	MOECCD	NE	Mitigation	Oil & Gas	Technology Transfer
Solar Power Systems / 30KW Capacity	NA	Najaf	MOECCD	NE	Mitigation	Oil & Gas	Technology Transfer
Installation of Solar Power Systems (ON GRID)	NA	Kerbala	MOECCD	14,615	Mitigation	Oil & Gas	Technology Transfer
Installation of Integrated Solar Power System	2	Anbar / Ramadi	Joint Implementation	176,923	Cross-Cutting	Policy & Governance	Capacity-Building
Solar Energy System for Ministry HQ (2025)	5	Nationwide	Ministry of Planning	NE	Cross-Cutting	Policy & Governance	Capacity-Building
Diesel Generator Pollution Control	1	Diwaniya	Joint Implementation	230,769 Operational	Cross-Cutting	Policy & Governance	Technology Transfer
Investment in Associated Gas Industry	6	Southern regions	Ministry of Oil (MoO)	29,000,000,000 Investment	Cross-Cutting	Employment & Economy	Capacity-Building
Gas Collection and Compression for Nasiriyah Oil Field	3	Dhi Qar	MoO via SCOP/PEG Consortium	311,461,538	Cross-Cutting	Risk Management	Capacity-Building
Gas Drying Unit / Phase 1	NA	Dhi Qar	Ministry of Oil via SCOP/PEG Consortium	167,000,000	Cross-Cutting	Risk Management	Contribution to Technology Development, Transfer, and/or Capacity-Building
EPC Agreement for Gas Sweetening Unit	NA	Maysan	Ministry of Oil via HBP Company	36,000,000	Adaptation	Water Resources	Capacity-building (improving water resource management)
EPC Agreement for Natural Gas Plant	NA	Maysan	Ministry of Oil via HBP Company	165,900,000	Adaptation	Water Resources	Capacity-building
Transfer of Surplus Gas from Bazargan Field to Halfaya Field	NA	Maysan	Maysan Oil Company via Maysan Investment Company	221,000,000	Adaptation	Water Resources	Technology Transfer, Capacity-Building

Gas Processing Project at Halfaya Field	NA	Maysan	Maysan Oil Company(Petroganiya)	1,070,000,000	Adaptation	Water Resources	Technology Transfer, Capacity-Building
Flaring Gas Recovery Project	NA	Baghdad	MoO	NE	Adaptation	Water Management	Infrastructure Development
Vapor Recovery Unit	NA	Baghdad	MoO	NE	Adaptation	Water Storage	Infrastructure Development
Leak Detection and Repair (LDAR) Project	NA	Baghdad	MoO	NE	Adaptation	Water Storage	Technology Transfer
Mishrif Gas Utilization Project	NA	Basrah	MoO	NE	Adaptation	Water Resources	Technology Transfer
Siba Gas Field	NA	Basrah	Basrah Oil Company	NE	Adaptation	Agriculture/Irrigation	Capacity-Building
Block 9 Development Project - EPCC CPF Gas Treatment	NA	Basrah	Basrah Oil Company	411,000,000	Adaptation	Agriculture/Irrigation	Capacity-Building
Nahr Bin Omar Gas Investment Project(NGL Plant)	NA	Basrah	Basrah Oil Company	NE	Adaptation	Agriculture/Irrigation	Capacity-Building
Majnoon Field Acid Gas Treatment Plant (SGTF)	NA	Basrah	Basrah Oil Company	263,846	Adaptation	Water Management	Capacity-Building
Climate Standards Guide Preparation	2	Baghdad	MOE & Relevant Ministries	NE	Adaptation	Water Management	Technology Transfer
Climate Governance Project	2	Baghdad	Relevant Ministries	NE	Adaptation	Water Management	Technology Transfer
Ministry Systems Digitization	5	Nationwide	NA	NE	Adaptation	Wastewater Treatment	Infrastructure Development
Green Jobs Governance and Professionalization	5	Nationwide	NA	NE	Adaptation	Wastewater Treatment	Infrastructure Development
National Risk Registry	3	Nationwide	NA	384,615	Adaptation	Wastewater Treatment	Infrastructure Development

*1 USD = 1,300 IQD
NE: Not Estimated
NA: Not Available

5.3.2 Information on financial support needed under Article 9 of the Paris Agreement based on priority climate funding projects

Table 5-2 highlights the priority projects that reflect Iraq's integrated approach to addressing climate impacts while striving to achieve sustainable development. These initiatives focus on the critical sectors of agriculture, water, energy, biodiversity, and urban infrastructure, balancing immediate adaptation needs with long-term mitigation goals. Designed to build resilience and reduce emissions, these projects also highlight the importance of cross-sectoral collaboration, innovative technologies, and inclusive development to create a robust and climate-resilient future. The priority projects underscore Iraq's commitment to leveraging innovative solutions and fostering partnerships with international entities to address its climate challenges effectively. These projects represent opportunities to mobilize funding, technology transfer, and capacity-building to create sustainable and scalable climate action across the country.

As per Table 5-2, mitigation projects in Iraq play a crucial role in addressing the country's climate challenges by focusing on reducing greenhouse gas emissions, improving energy efficiency, and promoting sustainable development across key sectors. These initiatives are designed to transform Iraq's energy, transportation, and industrial systems to align with its NDCs under the Paris Agreement.[60] The total estimated funding for mitigation-focused projects amounts to approximately $858.3 million USD, reflecting a significant investment in reducing greenhouse gas emissions and promoting a low-carbon development pathway in Iraq. These projects span a range of subsectors, including renewable energy, energy efficiency, and industrial processes. Key initiatives include the development of solar power infrastructure such as the 40 MW Solar Power Plant in Kurdistan, Solar Power Generation & Storage Systems in Buildings, and the 25 MW Solar Power Plant in Al-Shabaka, Najaf. In addition, the Municipal Waste to Energy project, valued at $600 million, represents one of the largest single investments in the mitigation portfolio, showcasing Iraq's growing commitment to sustainable waste management and energy transition. The inclusion of the Transition to Low-Carbon Cement Production project further underscores the country's efforts to decarbonize the industrial sector in line with international climate goals.

60 Ministry of Environment, Iraq. National Mitigation Projects Database. Received via direct communication, 2024.

Table 5-2 Priority Climate Funding Projects in Iraq

Title of the Project	Estimated amount (Million USD)	Expected Time frame	Type of Support	Sector/Subsector
Climate-Resilient Transformation in Iraq's Agricultural and Water Sectors Along Competitive and Climate-Smart Value Chains	60	2024	Adaptation	Water
Enhancing Iraq's Resilience Through Climate-Responsive Urban Development	60	2024	Cross-Cutting	Cross-cutting
Production of Solar Panels of Various Capacities	67	2024	Mitigation	Energy
Empowering Water and Food Security Sectors and Increasing Crisis Resilience	50	2025	Adaptation	Water
Carbon Capture in Soil, Agriculture, and Reforestation	29	2025	Adaptation	Agriculture / LULUCF
Enhancing Climate-Resilient Livelihoods for Food Insecure Populations in Southern Iraq	10	2025	Adaptation	Agriculture
Enhancing Early Warning Systems for Floods and Droughts in Kurdistan	10	2026	Adaptation	Cross-cutting
Enhancing Vulnerable Agricultural Livelihoods' Climate Resilience in Rural Communities	41	2026	Adaptation	Agriculture
40 MW Solar Power Plant in Kurdistan	40	2026	Mitigation	Energy
Solar Water Heater Production Plant	1.3	2026	Mitigation	Energy
Establishing Protected Natural Areas to Conserve Biodiversity in Kurdistan	30	2025	Adaptation	LULUCF
Municipal Waste to Energy (30-45 MW) in Kurdistan	600	2026	Mitigation	Waste
Solar Power Generation & Storage Systems in Buildings	57	2025	Mitigation	Energy
25 MW Solar Power Plant in Al-Shabaka, Najaf	40	2024	Mitigation	Energy
Five (5) Water Harvesting Ponds in Kurdistan	35	2025	Adaptation	Water
Rehabilitating Vulnerable Communities Affected by Climate Change	10	2025	Cross-Cutting	Cross-cutting
Bus Rapid Transit (BRT)	28	2026	Cross-Cutting	Energy
Transition to Low-Carbon Cement Production	53	2025	Mitigation	IPPU

In the energy sector, Iraq is prioritizing projects that leverage its abundant natural resources while minimizing environmental impact. The Gas Recovery Project in Baghdad targets the reduction of methane emissions by capturing flared gas for electricity generation, contributing to cleaner and more efficient energy production. Similarly, efforts to convert simple cycle power plants to combined cycle systems aim to enhance energy efficiency by utilizing waste heat to generate additional power. Large-scale solar power projects and wind energy installations, such as the proposed wind power station at Al-Hajjam Island, represent Iraq's commitment to diversifying its energy mix and expanding its renewable energy capacity[13]. These initiatives not only address environmental concerns but also improve energy security and support economic growth. Within the mitigation portfolio, the energy sector alone accounts for approximately $275.3 million USD in estimated funding. This includes strategic investments in solar energy infrastructure and technologies aimed at expanding Iraq's renewable energy capacity and enhancing energy efficiency. Notable projects under this sector are the Production of Solar Panels of Various Capacities ($67 million), 40 MW Solar Power Plant in Kurdistan ($40 million), Solar Water Heater Production Plant ($1.3 million), Solar Power Generation & Storage Systems in Buildings ($57 million), 25 MW Solar Power Plant in Al-Shabaka, Najaf ($40 million), and the Bus Rapid Transit (BRT) project ($28 million), which integrates clean transport solutions into urban planning. These initiatives underscore Iraq's growing prioritization of clean and sustainable energy solutions to achieve its emission reduction targets.

In the transportation sector, Iraq is advancing sustainable infrastructure to reduce its carbon footprint. Energy efficiency upgrades aim to set a benchmark for green building practices. Additionally, projects like solar-powered public transport systems are being implemented to reduce dependence on fossil fuels and promote cleaner, more sustainable mobility options. Within the mitigation portfolio, the transportation sector is represented by a single but impactful project: the Bus Rapid Transit (BRT) system, with an estimated funding of $28 million USD. This project aims to introduce efficient, low-emission public transport infrastructure, contributing to reduced urban air pollution and greenhouse gas emissions. The BRT initiative not only supports Iraq's climate mitigation commitments but also enhances urban mobility and resilience, aligning with broader sustainable development goals.

The industrial and waste management sector is also a critical focus area. Initiatives such as recycling hot gases in Basra's steel industry aim to enhance energy efficiency while reducing emissions. Similarly, waste-to-energy projects, like the tire recycling initiative in Najaf, address environmental pollution while creating green jobs and supporting circular economy principles. In the mitigation portfolio, the industrial and waste management sectors collectively account for a substantial investment of $653 million USD. The industrial sector is represented by the Transition to Low-Carbon Cement Production project, valued at $53 million USD. This initiative targets emissions reductions in one of the most carbon-intensive industries by introducing cleaner technologies and production processes, aligning with the IPPU (Industrial Processes and Product Use) sector under the MPGs.

The waste management sector is led by the large-scale Municipal Waste to Energy (30–45 MW) in Kurdistan project, with an estimated budget of $600 million USD. This project exemplifies Iraq's shift toward integrated solid waste management solutions that convert waste into renewable energy, significantly reducing methane emissions from landfills and contributing to a circular economy.

These mitigation projects demonstrate Iraq's proactive approach to balancing economic growth with environmental responsibility. By adopting innovative technologies and sustainable practices, these initiatives aim to reduce emissions, foster resilience, and pave the way for a low-carbon future. However, achieving these goals requires substantial investment, international support, and collaboration to ensure successful implementation and scalability.

Similarly adaptation projects in Iraq are essential to enhancing the country's resilience to climate change impacts, particularly in addressing vulnerabilities in water resources, agriculture, and infrastructure. These initiatives aim to safeguard vital resources and ensure sustainable development in the face of rising temperatures, water scarcity, and other climate-related challenges. Table 5-2 shows that total adaptation priority areas reach. The total estimated funding allocated for adaptation-focused projects amounts to approximately $310 million USD. These projects are designed to strengthen Iraq's resilience to the impacts of climate change, with a particular focus on water security, agricultural livelihoods, ecosystem restoration, and disaster risk reduction.

In the water sector, Iraq is implementing innovative solutions to improve water management and ensure long-term sustainability. Renewable energy stations in Al-Faw, located in Basra, aim to enhance water resource management while reducing reliance on fossil fuels, providing a dual benefit of sustainability and efficiency[14]. Additionally, efforts to restore water supply systems for food production focus on repairing irrigation infrastructure and water delivery networks in post-conflict areas, thereby bolstering agricultural productivity and food security.[61] The total funding allocated specifically to the water sector amounts to approximately $145 million USD.

The agriculture sector is another critical area for adaptation. Residential solar panel installations across five major cities—Baghdad, Karbala, Babil, Anbar, and Mosul—are designed to provide sustainable energy for agricultural and household needs. This initiative not only reduces dependency on conventional energy sources but also strengthens rural resilience. Moreover, steam recovery systems in oil production are being explored to enhance water efficiency, ensuring that valuable water resources are utilized sustainably while mitigating climate impacts on agricultural processes. The total funding allocated to the agriculture sector amounts to approximately $91 million USD, focusing on enhancing the climate resilience of rural livelihoods, promoting sustainable agricultural practices, and strengthening food security in vulnerable regions.

Cross-cutting projects integrate both mitigation and adaptation strategies to address systemic challenges in energy, infrastructure, and governance. These initiatives aim to provide comprehensive solutions that enhance resilience while reducing emissions.The total estimated funding allocated to cross-cutting projects amounts to approximately $108 million USD.

In the energy and infrastructure domains, retrofitting the Meteorological Authority headquarters in Baghdad to create an energy-efficient building showcases Iraq's commitment to integrating sustainable practices into public sector operations. Similar efforts are being undertaken to improve energy efficiency in transport infrastructure, such as the transition from diesel generators to solar power systems in Baghdad's passenger transport facilities. These projects demonstrate Iraq's focus on reducing emissions while enhancing operational efficiency.

By tackling overlapping challenges and fostering resilience across multiple sectors, these adaptation and cross-cutting projects represent Iraq's proactive approach to addressing climate vulnerabilities and ensuring sustainable growth. However, these initiatives require significant financial support and international collaboration to achieve their full potential, ensuring that Iraq remains resilient in the face of future climate challenges.

61 Ministry of Environment, Iraq. National Adaptation Projects Database. Received via direct communication, 2024.

5.3.3 Information on financial support needed under Article 9 of the Paris Agreement based on NAMA

Table 5-3 highlights Iraq's Nationally Appropriate Mitigation Actions (NAMA) projects, which embody a strategic approach to tackling climate change while advancing sustainable development. These initiatives are designed to reduce greenhouse gas emissions through targeted, sector-specific interventions, with a focus on enhancing energy efficiency, promoting renewable energy, and developing low-carbon infrastructure.[62,63] Aligned with Iraq's NDCs, these projects require significant financial support to be effectively implemented. Securing international financial and technical assistance is critical to addressing environmental challenges while delivering socio-economic benefits, such as job creation, improved energy security, and sustainable economic growth.[64] The total estimated amount of Iraq's NAMA projects is approximately $6,350,537,339 USD.

Table 5-3: Iraq’s Nationally Appropriate Mitigation Actions (NAMA) - Priority Projects for Climate Mitigation and Sustainable Development

Sector	Project Title	Estimated Amount (USD)	Project Description	Financial Needs
Energy	Gas Recovery Project	35–40 million	Capture flared gas in Baghdad for electricity generation, reducing GHG emissions.	Funding needed for infrastructure and technology to support sustainable energy use.
	Leak Detection and Repair	NE	Identify and repair leaks within gas and oil infrastructure to prevent methane emissions.	Support required for advanced equipment and training.
	Bus Rapid Transit Project	NE	Increased use of public transportation	Financial Investment
	Wind Power Plant in Al-Hijam Island	38,461	Reducing dependence on oil derivatives in generating electricity	Financial Investment
	Study to Establish Two Types of Renewable Energy Stations in Al-Faw/Basra	NE	Reduce GHG emissions	Financial Investment
	Solar Power Investment Project	428.9 million	Install solar panels in multiple regions to boost renewable energy capacity.	Substantial investment required for procurement, installation, and maintenance.
	Combined Cycle Power Plants Conversion	1 billion	Convert simple cycle plants into combined cycle ones, using waste heat to generate extra power.	Major funding needed for technology upgrades and implementation.

62 Ministry of Environment, Iraq. National Mitigation Projects Database. Received via direct communication, 2024.
63 UNFCCC. Nationally Determined Contributions of Iraq. https://unfccc.int [Accessed November 2024].
64 UNDP. Catalytic Climate Action for Iraq: Technical Support and Roadmap Implementation Report. 2023.

	Residential Solar Panel Installations	2.35 billion	Install solar panels on rooftops in five new cities (Baghdad, Karbala, Babil, Anbar, Mosul) for sustainable household energy.	Support needed for equipment, installation, and maintenance.
	Installation of Solar Water Heaters at Baghdad International Airport	18,000	The project contributes to rationalizing the annual consumption of electrical energy, reducing it by 103 megawatt hours per year.	Support needed for equipment, installation, and maintenance.
	Two Solar Panel Stations Installed at Baghdad International Airport	3,697,500	The project contributes to rationalizing the annual consumption of electrical energy by 4093 MWh/year	Support needed for equipment, installation, and maintenance.
IPPU	Steam Recovery Unit	NE	Capture steam for reuse to lower greenhouse gas emissions in oil production.	Funding for technology integration and implementation
	Solar Air Conditioning Production	2.5 billion	Produce solar-powered air conditioners in Baghdad to improve energy efficiency and cut emissions.	Financial support for facilities setup, technology transfer, and workforce training.
	Hot Gas Recycling in Steel Industry	10 million	Implement hot gas recycling in steel production in Basra to improve energy efficiency.	Funding for technology installation and process optimization.
Waste	Tire Recycling Project in Najaf	6 million	Recycle used tires in Najaf, reducing environmental pollution and creating jobs.	Funding required for waste-to-energy technology.
	Ramadi Sanitary Landfill Project	NE	In progress (2023-2025).	Budget of the Ministry of Construction, Housing, and Public Municipalities
	Sanitary Landfill Project in Karbala and Tikrit	NE	In the listing stage (2025-2030).	Budget of the Ministry of Construction, Housing, and Public Municipalities
	Sanitary Landfill Project in Amara, Mosul, Diwaniyah, Samawah, Nasiriyah, Kut, Baqubah	NE	In the listing stage, will be implemented gradually in the coming years.	NA

Crosscutting	Waste Recycling Projects in Mosul, Ramadi, and Karbala	NE	NA	NA
	Converting the General Authority of Meteorology and Seismic Monitoring Building into an Energy-Saving Building	NE	Reducing dependence on oil derivatives in generating electricity	Financial Investment
	Using Solar Energy Instead of Electric Generators in the Building of the General Company for Transporting Passengers and Delegation	826.92	Transforming the building into an energy-efficient facility by replacing electric generators with solar energy systems	Financial Investment
	Rehabilitation of the Buildings of the General Company for Iraqi Airways to Install Solar Panels (General Company for Iraqi Airways)	2 million	NA	Financial Investment
	Rehabilitation of the Building of the General Company for Maritime Transport	377,639	NA	NA
	Installation of a Solar Energy System for the General Company for Passenger and Delegation Transport	2 million	NA	NA

5.4 Information on financial support received by developing country Parties under Article 9 of the Paris Agreement

Iraq has demonstrated its commitment to addressing the multifaceted challenges posed by climate change through the mobilization and utilization of financial support from diverse national and international sources.[65] The financial resources received have been critical in advancing the country's adaptation, mitigation, and cross-cutting climate actions, helping to bridge gaps in institutional capacity, technological advancement, and community resilience.

While significant progress has been made, the need for sustained financial resources remains critical. Many ongoing and planned projects, such as those targeting methane emissions, waste management, and rural livelihood restoration, depend on continuous international collaboration and funding.

65 UNDP. Capacity-Building and Financial Support Initiatives in Iraq. 2023.

Table 5-4 provides a detailed overview of the financial support received, highlighting key projects, funding sources, and their alignment with Iraq's climate priorities. Financial support plays a critical role in advancing Iraq's climate adaptation and mitigation efforts. The country receives financial assistance through a mix of grants, concessional loans, and investments from international organizations, multilateral development banks, and bilateral donors. These funds are directed towards projects in energy, water, agriculture, and infrastructure to enhance Iraq's resilience to climate change and transition towards a low-carbon economy. Based on the consolidated project data, Iraq has received approximately $4.33 billion USD in total climate-related funding across adaptation, mitigation, and cross-cutting initiatives. Iraq has mobilized significant climate finance to support both resilience and emissions reduction. Approximately $2.24 billion USD has been allocated to cross-cutting initiatives, $1.89 billion USD to adaptation projects, and around $200.78 million USD to mitigation efforts. This reflects Iraq's commitment to integrated, long-term climate action.

Capacity-building efforts focus on enhancing institutional, technical, and governance capabilities to address climate change. These activities include training programs, policy formulation, stakeholder engagement, and strengthening monitoring, reporting, and verification (MRV) systems. Iraq collaborates with development partners to equip government institutions and civil society organizations with the necessary knowledge and skills. According to the consolidated data, Iraq has mobilized approximately $61.05 million USD specifically for capacity-building initiatives, reflecting its strong commitment to long-term institutional resilience and effective climate governance.

Technology transfer is essential for Iraq to implement low-carbon and climate-resilient solutions. Investments in renewable energy, waste-to-energy systems, early warning systems, and energy-efficient infrastructure contribute to reducing emissions and enhancing adaptation efforts. Development partners support Iraq in acquiring advanced technologies to accelerate climate action. Iraq has received approximately $2.1 billion USD in funding dedicated to technology development and transfer, enabling the country to access and apply innovative climate solutions across key sectors.

Table 5-4: Overview of Financial Support Received for Climate Projects in Iraq

Title of the Project	Estimated Amount (USD)	Funding Source	Status	Time Frame	Type of Support	Sector	Contribution to Technology Development, Transfer, and/or Capacity-Building
Emergency Operation for Development	750,000,000	World Bank	Ongoing	2015–2023	Cross-cutting	Cross-cutting	Financial Support
Iraq Emergency Fiscal Stabilization, Energy Sustainability	1,200,000,000	World Bank	Completed	2015–2018	Cross-cutting	Cross-cutting	Financial Support
Basra Electricity Dissemination and Development Project	200,000,000	World Bank	Ongoing	2019–2024	Mitigation	Energy	Financial Support
Safe Returns Project – Ninewa	NA	Australian Government DFAT	Ongoing	N/A	Adaptation	Livelihoods	Financial Support
Conversion of Gas Stations (South Baghdad 1, Karbala, Hilla 2, Najaf, Al-Najibiya)	650,000,000	Investment Budget - China Framework	Ongoing	N/A	Adaptation	Energy	Technology Development/Transfer
Conversion of Gas Stations (Khor Al-Zubair, Diwaniyah, Akkaz, Mansuriyah, Al-Quds 1, Al-Quds 2)	1,100,000,000	Investment Budget - China Framework	Ongoing	N/A	Adaptation	Energy	Technology Development/Transfer
Climate Investment Plan	NA	USAID	Ongoing	N/A	Cross-cutting	Policy/Planning	Capacity-Building
Green Growth Economy	NA	UNDP	Ongoing	NA	Cross-cutting	Green Economy	Capacity-Building
National Adaptation Plan (NAP)	2,500,000	GCF	Ongoing	NA	Adaptation	Planning	Capacity-Building
Strengthening Inclusive Local Governance in Iraq	18,300,000	BMZ	Ongoing	2022–2025	Adaptation	Governance	Capacity-Building
Improving Climate Resilience and Social Cohesion in Anbar	10,800,000	BMZ	Ongoing	2024–2027	Adaptation	Resilience	Capacity-Building
Climate and Security Nexus – Improving Peace and Stability	9,180,000	German Federal Foreign Office	Ongoing	2023–2025	Adaptation	Security	Capacity-Building
Leveraging the Private Sector for Increased Climate Investment	2,600,000	GCF	Completed	2021–2023	Cross-cutting	Finance	Capacity-Building
Creating the Enabling Conditions for Eliminating Open Burning of Waste	NA	UNEP	Ongoing	2024–2026	Mitigation	Waste	Technology Development/Transfer
Developing a Vapor Recovery Roadmap and Guidelines	550,000	CCAC	Planned	2024–2025	Mitigation	Oil & Gas	Technology Development/Transfer

Waste Sector Strategy to Support NDC Action Plan and NAMA Projects	125,000	UNEP	Ongoing	2024–2025	Mitigation	Waste	Technology Development/Transfer
Delivering a National Methane Emission Inventory and Mitigation Assessment	105,000	UNEP	Ongoing	2023–2025	Mitigation	Oil & Gas	Technology Development/Transfer
Basrah Water Project	6,400,000	Government of the Netherlands	Ongoing	2020–2023	Adaptation	Water	Technology Development/Transfer
Solar Power Plant Project / Basra / Rumaila	NA	Investment Budget	Ongoing	NA	Mitigation	Energy	Financial Support
Waste-to-Energy Plant Project / Nahrawan	NA	Investment Budget	Ongoing	NA	Mitigation	Waste	Financial Support
NDC Roadmap	NA	GEF	Ongoing	NA	Cross-cutting	Planning	Capacity-Building
Biennial Transparency Reports (BTR)	250,000	GEF	Ongoing	NA	Cross-cutting	MRV/Transparency	Capacity-Building
Adaptation Planning Support for Iraq through UNEP	2,600,000	GCF	Completed	2019–2021	Cross-cutting	Adaptation Planning	Capacity-Building
NDA Strengthening in Iraq	936,000	GCF	Completed	2021–2023	Cross-cutting	Institutional Capacity	Capacity-Building
Catalytic Climate Action in Iraq	5,000,000	FCDO	Ongoing	2022–2025	Cross-cutting	Climate Finance	Financial Support
Transboundary Water Management in Iraq	1,500,000	Global Affairs Canada	Ongoing	2022–2025	Adaptation	Water	Financial Support
Nationally Appropriate Mitigation Actions (NAMA)	NA	USAID	Completed	NA	Mitigation	Waste/Energy	Capacity-Building
Build Capacities for Governorates-Level Climate Actions	NA	NDCP	Ongoing	2024–2025	Adaptation	Subnational Capacity	Capacity-Building
Enhancing Communities' Ability to Adapt and Face Shocks	NA	Aktion Deutschland Hilft	Ongoing	NA	Adaptation	Resilience	Capacity-Building
Strengthening Community Capacity for Recurrent Disasters	NA	Aktion Deutschland Hilft	Ongoing	NA	Adaptation	Disaster Risk Reduction	Capacity-Building
Local Adaptation Plans (LAP)	165,000	BMZ	Ongoing	NA	Adaptation	Local Governance	Financial Support
Baghdad Water Supply and Sewerage Improvement Project	210,000,000	World Bank	Completed	2018–2023	Cross-cutting	Water & Sanitation	Technology Development/Transfer
Climate Resilient Community-Based Actions	32,000,000	Co-financed	Completed	2020–2024	Cross-cutting	Community Resilience	Technology Development/Transfer
Sustainable Land Management for Improved Livelihoods	3,400,000	GEF	Ongoing	2019–2023	Adaptation	Land Use	Capacity-Building

Support Agricultural Livelihoods in Nineveh Governorate	8,100,000	EU	Completed	2019–2022	Cross-cutting	Livelihoods	Financial Support
Rehabilitation of Solar Groundwater Irrigation-Pumping Systems	625,000	Government of Japan	Completed	2019–2020	Cross-cutting	Energy for Agriculture	Technology Development/Transfer
Restoring Water Supply for Food Production	7,100,000	EU	Completed	2018–2022	Adaptation	Water for Agriculture	Technology Development/Transfer
Climate Change Governance	5,600,000	USAID	Completed	2021–2022	Cross-cutting	Governance	Capacity-Building
The EU Facility Supporting Policy Dialogue and Technical Assistance	4,800,000	European Union	Ongoing	2022–2025	Cross-cutting	Policy Dialogue	Capacity-Building
Improve Municipal Drinking Water Utilities	14,000,000	AFD	Ongoing	2021–2024	Cross-cutting	Water & Sanitation	Technology Development/Transfer
Iraq Crisis - WASH and Protection Assistance	3,700,000	Global Affairs Canada	Completed	2020–2021	Adaptation	WASH	Technology Development/Transfer
WASH, Health and Protection Assistance	4,800,000	Global Affairs Canada	Completed	2020–2022	Adaptation	WASH	Technology Development/Transfer
Support Integration of Climate Change Risks	86,400	BMZ/NDCP	Ongoing	NA	Adaptation	Climate Risk Management	Capacity-Building
Eco-Friendly Buildings	63,300,000	Investment Budget	Ongoing	NA	Adaptation	Buildings	Technology Development/Transfer
Iraq Crisis - WASH and Protection Assistance	3,700,000	Global Affairs Canada	Completed	2020–2021	Adaptation	WASH	Technology Development/Transfer

5.5 Information on technology development and transfer support needed under Article 10 of the Paris Agreement

Technology is a cornerstone of Iraq's efforts to combat climate change, underpinning both its mitigation and adaptation strategies. Recognizing the urgent need for innovative solutions, Iraq has identified critical technological priorities to address the challenges posed by climate variability and environmental degradation.

Iraq's climate response is contingent on access to cutting-edge technologies that address its unique vulnerabilities. Adaptation technologies such as smart irrigation systems, rainwater harvesting mechanisms, drought-resistant crop varieties, and advanced early warning systems are pivotal for enhancing resilience in agriculture and water resource management. On the mitigation front, investments in solar and wind energy infrastructure, methane capture systems, and waste-to-energy technologies are essential for reducing greenhouse gas emissions and transitioning to a low-carbon economy.

It is crucial to emphasize the need for technology transfer to support stakeholders addressing losses and damages caused by the adverse effects of climate change. Advanced technologies, such as geographic information systems (GIS), climate modeling tools, and early warning systems, are essential for accurately assessing and managing the impacts of climate-related events. Stakeholders, including governmental agencies, local authorities, and NGOs, require access to these technologies to improve their capacity to monitor, evaluate, and respond to climate-induced losses. Furthermore, transferring technologies such as automated data collection systems, disaster risk reduction software, and tools for economic impact analysis can enhance their ability to design and implement effective adaptation and mitigation strategies.

Under adaptation technology priorities, enhancing resilience in agriculture and water resource management is critical for Iraq's adaptation strategy. The country prioritizes:

- Smart Irrigation Systems: Deployment of precision irrigation techniques to optimize water use and improve agricultural productivity.
- Rainwater Harvesting Mechanisms: Expansion of storage and rainwater collection systems to support water-scarce regions.
- Drought-Resistant Crop Varieties: Development and integration of genetically modified and resilient crops to withstand extreme climatic conditions.
- Advanced Early Warning Systems: Strengthening meteorological and climate monitoring infrastructure to improve disaster preparedness and minimize agricultural losses.
- Climate-Resilient Infrastructure: Implementing flood-resistant urban planning and nature-based solutions for cities and vulnerable rural areas.

Under mitigation technology priorities, to achieve its NDC emission reduction targets, Iraq is prioritizing:

- Renewable Energy Expansion: Scaling up solar and wind energy projects to reduce dependence on fossil fuels.
- Methane Capture Systems: Enhancing gas flaring reduction and utilizing methane for power generation in oil and gas operations.
- Energy Efficiency Improvements: Upgrading industrial energy use and deploying smart grid technologies to enhance efficiency.
- Waste-to-Energy Technologies: Implementing biogas and waste incineration plants to convert municipal waste into renewable energy sources.
- Carbon Sequestration & Green Infrastructure: Expanding afforestation programs, sustainable land management, and soil carbon capture to mitigate emissions.

Iraq's technology priorities directly support the key pillars of its NDC implementation strategy, including:

- Transition to a Low-Carbon Energy Sector by integrating renewables and energy efficiency technologies.
- Sustainable Water and Agricultural Systems through innovative irrigation and climate-resilient farming practices.
- Enhancing Disaster Preparedness via early warning systems and infrastructure resilience investments.
- Sustainable Waste Management through the introduction of circular economy solutions and waste-to-energy technology.
- Carbon Capture and Utilization strategies that support forest conservation and carbon storage mechanisms.

Significant progress has been made in the deployment of advanced climate technologies in Iraq, underscoring the country's commitment to sustainable development. For example, smart irrigation systems, piloted in drought-prone regions, have achieved a remarkable 25% reduction in water use, while simultaneously boosting agricultural productivity. Similarly, Iraq has expanded its renewable energy capacity through the installation of solar panels and wind energy systems, reducing dependence on fossil fuels and enhancing energy security.

In the area of disaster risk management, early warning systems, developed in collaboration with UNEP, have been implemented to improve preparedness for floods and sandstorms. These tools are instrumental in mitigating the impacts of extreme weather events, safeguarding both lives and livelihoods.

The transfer and scaling of these technologies have been facilitated by strategic partnerships with international organizations such as UNEP, FAO, and UNDP. However, challenges persist, particularly in securing sufficient financial resources and building technical expertise to support widespread adoption. Addressing these barriers is critical for ensuring that Iraq can fully harness the potential of advanced climate technologies to achieve its adaptation and mitigation goals.

Through these ongoing efforts, Iraq demonstrates its dedication to leveraging technology as a driver of climate resilience and sustainable development, while also highlighting the need for continued international collaboration and investment to bridge existing gaps.

5.6 Information on capacity-building support needed under Article 11 of the Paris Agreement

Capacity-building is a cornerstone of Iraq's strategy to combat climate change and address its associated challenges. Recognizing the importance of building robust institutional frameworks, enhancing technical expertise, and empowering communities, Iraq has prioritized capacity-building initiatives across multiple sectors to ensure the effective implementation of its climate strategies and commitments under the Paris Agreement.

Iraq faces a range of capacity gaps that impede the full realization of its climate objectives. One pressing need is the strengthening of institutional frameworks for climate governance. This involves enhancing the ability of governmental institutions to coordinate and implement climate policies effectively at both national and local levels. There is an urgent need for greater integration of climate considerations into

Iraq's broader policy and planning processes to ensure a unified approach to adaptation and mitigation efforts.[66]

In addition to addressing institutional gaps, there is a critical demand for capacity-building initiatives targeting stakeholders who are working on issues related to losses and damages caused by the adverse effects of climate change. These stakeholders, spanning governmental bodies, local authorities, NGOs, and private sector entities, require specialized training to understand and implement methodologies for assessing, reporting, and addressing losses and damages. This includes developing skills to evaluate the economic, social, and environmental impacts of climate-related disasters and implementing measures to reduce vulnerabilities and enhance resilience. Such targeted capacity-building efforts will ensure that Iraq is better prepared to handle climate-related risks and fulfill its obligations under international frameworks.

In addition, there is a critical demand for technical expertise in key sectors such as renewable energy, agriculture, and water resource management. The energy sector, for example, requires trained professionals to design, implement, and manage renewable energy projects such as solar and wind installations. Similarly, the agriculture sector needs experts capable of introducing innovative climate-resilient techniques to address the challenges posed by water scarcity, rising temperatures, and declining productivity.

Community-level capacity-building also remains a vital area of focus. Iraq's diverse communities, many of which are particularly vulnerable to the impacts of climate change, require targeted awareness programs and practical training to build resilience. Equipping communities with the knowledge and tools to adapt to changing environmental conditions not only strengthens their capacity to withstand climate impacts but also promotes inclusive and sustainable development.

5.7 Information on capacity-building support received under Article 11 of the Paris Agreement

Significant progress has been made in addressing Iraq's capacity-building needs through various international initiatives and collaborations. These efforts have provided essential support in areas such as adaptation planning, renewable energy development, and compliance with global climate reporting mechanisms.

The National Adaptation Plan (NAP) Training, supported by the United Nations Development Programme (UNDP), has been instrumental in strengthening Iraq's ability to integrate adaptation strategies into its national development plans. This training has equipped government officials and stakeholders with the skills and methodologies needed to identify climate risks, prioritize interventions, and allocate resources effectively.

In the field of renewable energy, initiatives led by the Food and Agriculture Organization (FAO) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) have made notable contributions. Over 500 engineers and technicians have been trained in the design, installation, and maintenance of renewable energy systems, including solar and wind technologies. These programs have not only enhanced Iraq's technical capacity but also contributed to the country's transition toward sustainable energy solutions.

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66 UNEP, FAO, and UNDP. Partnership Initiatives for Iraq's Climate Resilience and Sustainability. 2024. Available at: https://www.unep.org, https://www.fao.org, and https://www.undp.org.

Iraq's capacity to monitor and report on climate actions has also been strengthened through workshops on Monitoring, Reporting, and Verification (MRV) systems. Supported by international climate initiatives, these workshops have enhanced Iraq's ability to track progress, evaluate the effectiveness of interventions, and ensure compliance with the Enhanced Transparency Framework (ETF) under the Paris Agreement. The development of robust MRV systems is a critical step in building transparency and accountability in Iraq's climate efforts.[67]

5.8 Information on support needed and received for the implementation of Article 13 of the Paris Agreement and transparency-related activities, including for transparency-related capacity-building

Iraq has made significant strides in strengthening its transparency framework under Article 13 of the Paris Agreement, which mandates enhanced reporting on GHG emissions, climate actions, and financial, technical, and capacity-building support received and needed. This section details the support received and the gaps that remain in ensuring full compliance with the Enhanced Transparency Framework (ETF).

Iraq has received substantial international support in the form of financial assistance, technical cooperation, and capacity-building programs aimed at enhancing national climate reporting and ETF compliance. Key initiatives include:

GEF-Funded Biennial Transparency Report (BTR) Project: GEF provided funding for Iraq's First BTR, ensuring the country can meet its reporting obligations under the UNFCCC and the Paris Agreement. This support has helped enhance data collection, institutional coordination, and reporting methodologies.

Enabling Activities for Biennial Update Reports (BURs) and National Communications: GEF funding has also supported BURs and National Communications, allowing Iraq to track and report on GHG emissions trends, mitigation and adaptation efforts, climate finance received and needed. These activities are critical for improving Iraq's compliance with the ETF.

The United Nations Environment Programme (UNEP) has conducted multiple capacity-building workshops, strengthening Iraq's institutional capacity for climate transparency.

- Capacity Building Workshop on Adaptation and Loss and Damage (24-26 July 2024, Erbil, Iraq) focused on enhancing Iraq's adaptation reporting and developing methodologies for assessing loss and damage.

- Capacity Building Workshop on Preparation of National Inventory Report and Tracking Nationally Determined Contributions (30 September - 2 October 2024, Erbil, Iraq) trained national experts on GHG inventory methodologies and NDC tracking tools.

- Enhanced Transparency Framework Training (4-5 March 202, Erbil, Iraq) provided in-depth training on ETF compliance, data collection, and UNFCCC reporting.

- BTR1 Launching and Validation Workshop (6-7 March 2025, Erbil, Iraq) facilitated the final review and validation of Iraq's BTR1 before its submission to the UNFCCC.

67 FAO and GIZ. Climate Resilience and Renewable Energy Programs in Iraq. Available at: https://www.fao.org and https://www.giz.de.

While significant progress has been made, Iraq continues to require additional financial, technical, and institutional support to fully implement the ETF. A key priority is the development of a robust MRV system that aligns with international standards and ensures accurate and reliable climate-related reporting.

Establishing a National Climate Data Management System: Iraq requires support to develop a centralized digital system for climate data collection and management, ensuring seamless data integration from various ministries and agencies, automated tracking of GHG emissions, adaptation actions, and financial flows, and interoperability with MRV platforms to enhance transparency and data accessibility.

Strengthening the National MRV System: a well-established MRV system is essential to ensure consistency, transparency, and accuracy in climate reporting. Iraq seeks support for:

- Developing sector-specific MRV frameworks for energy, transport, agriculture, industry, and waste.
- Capacity-building programs to train stakeholders on MRV methodologies.
- Enhancing emission factor databases to improve calculation accuracy.
- Standardizing data collection templates across ministries and agencies to ensure consistency in reporting.

Institutional Strengthening for Climate Reporting: Further institutional support is required to:

- Strengthen coordination among key ministries (Environment, Oil, Electricity, Agriculture, etc.).
- Establish dedicated climate transparency units within key ministries to ensure ongoing compliance with ETF requirements.
- Expand ETF-related training programs to enhance technical expertise across institutions.
- Improve inter-ministerial collaboration mechanisms through formal agreements and joint committees.

Improving GHG Inventory and Data Collection: Iraq seeks technical assistance to:

- Upgrade from Tier 1 to Tier 2 and Tier 3 methodologies for more accurate GHG reporting.
- Implement real-time emissions monitoring systems to improve data precision.
- Utilize satellite technology and remote sensing for land-use change and forestry data collection.
- Enhance data-sharing mechanisms between government agencies and private sector entities.

Enhancing Capacity for Adaptation and Loss and Damage Reporting: Iraq requires further support to:

- Develop standardized adaptation indicators for tracking progress in resilience-building efforts.
- Improve reporting on vulnerability assessments to identify climate risks at the sectoral level.
- Strengthen data collection mechanisms for tracking loss and damage caused by climate-related events.
- Establish a national adaptation MRV system to ensure the systematic monitoring of adaptation actions and impacts.

Developing a Climate Finance Tracking System: To improve financial transparency and accountability, Iraq aims to establish a comprehensive climate finance MRV system that will:

- Monitor financial support received and needed for mitigation and adaptation efforts.
- Ensure alignment of climate finance flows with NDC priorities and national policies.
- Enhance reporting capabilities in compliance with UNFCCC guidelines.
- Develop public and private sector engagement strategies to mobilize additional financial resources.

Long-Term Strategy for Transparency: Iraq seeks to develop a long-term roadmap for transparency to ensure:

- Sustainability of reporting processes beyond project-based activities.
- Integration of transparency requirements into national development policies.
- Continuous improvements in institutional frameworks, MRV methodologies, and data management systems.
- Engagement with regional and international partners for knowledge-sharing and capacity development.

Iraq is committed to strengthening its transparency framework under the Paris Agreement. While substantial support has been received, additional financial and technical resources are needed to fully operationalize transparency mechanisms.

- Iraq will continue engaging with international partners to secure further funding and technical assistance.
- The MOE will lead efforts to develop a national transparency roadmap.
- Capacity-building programs and technical assistance projects will be expanded to enhance data accuracy and institutional coordination.

CHAPTER 6

INFORMATION ON FLEXIBILITY

6 Information on Flexibility

Due to time limitations, data unavailability and capacity constraints, Iraq is using several flexibility provisions for this BTR. Flexibility provisions under the Paris Agreement allow Iraq to adapt its reporting processes to evolving capacities and data availability, ensuring a transparent and accountable system for monitoring climate actions. As per paras. 4–6 of the MPGs, Iraq used the below flexibilities:
Flexibility in terms of GHG emission inventory estimation and reporting:

- Iraq has decided to apply the flexibility mechanism and consider key categories with a threshold no lower than 85%.
- Iraq has not yet developed a proper QA/QC plan and is thus applying the flexibility mechanism described in paras. 34 and 35 of the MPGs. Iraq provided a qualitative discussion of the latest inventory year/trend
- Iraq included only the 3 following gases: CO_2, CH_4 and N_2O.
- Iraq considered emissions to be insignificant when the likely level of emissions was below 0.1% of total GHG emissions or 1000 kt CO2eq.
- Iraq included the most recent year of 2021 in its 2024 BTR submission (i.e. three years prior to the year of submission)

Flexibility applied in reporting of mitigation policies and measures, actions and plans:

- Mitigation achieved in 2021 and 2022 was not reported in Iraq's first BTR but will be included in subsequent BTR submissions, in accordance with the flexibility provisions outlined in paragraph 85 of the MPGs.

Flexibility provisions outlined in paragraphs 92 and 102 of the MPGs, as annexed to Decision 18/CMA.1, which are associated with the reporting of projections of GHG emissions and removals. More specifically:

- Flexibility provision in paragraph 98 of MPGs, related to the requirement to report projections on a sectoral basis and by gas.
- Flexibility provision in paragraph 100 of MPGs, related to the requirement to report projections with and without LULUCF.

CHAPTER 7

IMPROVEMENTS IN REPORTING OVER TIME

7 Improvements in Reporting Over Time

The Government of Iraq expects that the BTR reporting will improve over time especially as the institutional, and technical capacities increase.

Mainly the following improvements are expected:

- Recalculations in the NIR section will be performed and evaluated
- Preparation of an energy balance by the different relevant government entities, in order to use only country data, and not rely on the UN Energy Balance
- Enhancing data collection in all sectors and collect precise activity data to have results which are more reflective of the national/regional makeup.
- Estimating emissions based on the 2019 IPCC Refinement
- Enhancing the reliability of data and quantifying categories that are currently not estimated.
- After recalculations in GHG emission, a recalculation to the base year of the BAU scenario will be incorporated into subsequent BTRs. This approach ensures that Iraq's reporting remains accurate and aligned with the latest data and techniques, maintaining transparency and reliability in tracking progress towards its climate targets.

ANNEX

1: KEY CATEGORIES

2: DESCRIPTION OF THE REFERENCE APPROACH

3: COMMON REPORTING TABLES

4: VULNERABILITY ASSESSMENT OF HEALTH SECTOR IN IRAQ

Annex 1: Key categories

Level of disaggregation: category level, gas are not disaggregated.

Tables 4.2 of volume 1 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, excluding LULUCF:

A/B	C	D	E	F	G	H
CRF Category	Gas	Last year emissions kt CO2e	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F	KCA rank T1 in level
1.A.1 - Energy Industries	CO_2 (CH_4 and N_2O)	68 532	68 532	34%	34%	1
1.A.3 - Transport	CO_2 (CH_4 and N_2O)	33 853	33 853	17%	51%	2
1.B - Fugitive emissions from fuels	CH_4 and CO_2 (N_2O)	24 080	24 080	12%	63%	3
1.A.2 - Manufacturing Industries and Construction	CO_2 (CH_4 and N_2O)	16 388	16 388	8%	71%	4
2.C.1 - Steel production	CO_2	14 434	14 434	7%	78%	5
1.A.4 - Other Sectors	CO_2 (CH_4 and N_2O)	9 751	9 751	5%	83%	6
5D. Wastewater treatment	CH_4 (N_2O)	6 925	6 925	3%	86%	7
5A. SWDS	CH_4	6 385	6 385	3%	89%	8
2.A.1 - Cement production	CO_2	6 069	6 069	3%	92%	9
3.A - Enteric fermentation	CH_4 (N_2O)	5 676	5 676	3%	95%	10
3.D - Agricultural soils	N_2O (CH_4)	4 909	4 909	2%	98%	11
5C. Open burning and Incineration	CO_2 (CH_4 and N_2O)	1 695	1 695	1%	98%	12
2.A.2 - Lime production	CO_2	1 266	1 266	1%	99%	13
2.B.1 - Ammonia production	CO_2	667	667	0%	99%	14
3.C - Rice cultivation	N_2O	661	661	0%	100%	15
3.B - Manure management	CH_4 (N_2O)	284	284	0%	100%	16
3.H - Urea application	N_2O	271	271	0%	100%	17
1.A.5 - Non-Specified	CO_2 (CH_4 and N_2O)	-	-	0%	100%	18

Tables 4.2 of volume 1 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, including LULUCF:

A/B	C	D	E	F	G	H
CRF Category	Gas	Last year emissions kt CO2e	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F	KCA rank T1 in level
1.A.1 - Energy Industries	CO_2 (CH_4 and N_2O)	68 532	68 532	34%	34%	1
1.A.3 - Transport	CO_2 (CH_4 and N_2O)	33 853	33 853	17%	50%	2
1.B - Fugitive emissions from fuels	CH_4 and CO_2 (N_2O)	24 080	24 080	12%	62%	3
1.A.2 - Manufacturing Industries and Construction	CO_2 (CH_4 and N_2O)	16 388	16 388	8%	70%	4
2.C.1 - Steel production	CO_2	14 434	14 434	7%	77%	5
1.A.4 - Other Sectors	CO_2 (CH_4 and N_2O)	9 751	9 751	5%	82%	6
5D. Wastewater treatment	CH_4 (N_2O)	6 925	6 925	3%	85%	7
5A. SWDS	CH_4	6 385	6 385	3%	89%	8
2.A.1 - Cement production	CO_2	6 069	6 069	3%	92%	9
3.A - Enteric fermentation	CH_4 (N_2O)	5 676	5 676	3%	94%	10
3.D - Agricultural soils	N_2O (CH_4)	4 909	4 909	2%	97%	11
4. LULUCF	CO_2	1 779	1 779	1%	98%	12
5C. Open burning and Incineration	CO_2 (CH_4 and N_2O)	1 695	1 695	1%	98%	13
2.A.2 - Lime production	CO_2	1 266	1 266	1%	99%	14
2.B.1 - Ammonia production	CO_2	667	667	0%	99%	15
3.C - Rice cultivation	N_2O	661	661	0%	100%	16
3.B - Manure management	CH_4 (N_2O)	284	284	0%	100%	17
3.H - Urea application	N_2O	271	271	0%	100%	18
1.A.5 - Non-Specified	CO_2 (CH_4 and N_2O)	-		0%	100%	19

Annex 2: Description of the reference approach

See section 3.2.1 for the description and results.

National energy balance for 2020 and 2021 used as inputs for the reference approach are presented below:

ENERGY BALANCE - 2020

	Primary oil products			Petroleum Products														
	Crude oil	Natural gas liquids	Refinery gas	Total	Motor Gasoline	Kerosene & Jet Fuel	Gas / Diesel Oil	Fuel Oil	Liquefied Petroleum Gas (LPG)	Naphta	Other kerosene	Bitumen	Lubricants	Parrafin waxes	Other petroleum products	Natural gas (incl. LNG)	Charcoal	Fuelwood
	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	TJ	000 tons	000 m3
TOTAL PRIMARY ENERGY SUPPLY																		
Total Energy supply acc. to UNDATA																		
1. Production	199 453	1 977		-												280 060	20	223
2. Imports				3 675	1 994	42	1 413	-			225					433 580		-
3. Exports	- 168 881			- 7 992	-	-	-	- 6 600	- 166	- 1 227	-							
4. International marine				- 259				- 259										
and aviation bunkers				- 137		- 137												
5. Stock changes	- 137			-	-	-	-											
Statistical differences				-														
Transfers and recycled products	4 393			- 4 393	733		61	- 4 393		- 733	- 61							
TRANSFORMATION	- 33 896	- 1 977		- 729			- 729											190
6. Electricity production	- 7 151			- 2 351			- 729	- 1 622								- 508 891		
7.a. Oil refineries	- 26 745	- 437	- 178	25 643	2 063	106	5 239	14 169	237	2 063	1 312	208	77	4	167			
7.b Other transformation		1 540		1 540					1 540									
8.a. Energy industries own use	- 2 573		- 178	- 1 263				- 1 160		- 103								
8.b. Losses	- 191			-														
FINAL CONSUMPTION - TOTAL	-			**14 801**	**5 110**	**11**	**5 982**	**137**	**1 631**	-	**1 475**	**208**	**77**	**4**	**167**	**188 022**	**20**	**33**
Total Final consumption acc. to UNDATA				**14 780**	**5 110**	**11**	**5 982**	**137**	**1 610**		**1 475**	**208**	**77**	**4**	**167**	**188 022**	**20**	**33**
Energy use - total	-			**14 347**	**5 110**	**11**	**5 982**	**137**	**1 631**	-	**1 475**	-	-	-	-	**172 780**	**20**	**33**
Manufacturing - Industry				2 152			1 994	137	21							172 780		
Transport				9 110	5 110	11	3 988											
Road				9 098	5 110		3 988											
Domestic aviation				11		11												
Railways																		
Domestic navigation																		
Commercial and public services				-														
Households				3 086					1 610		1 475							
Agriculture				-														
Other				-													20	33
Non-energy use - total				**454**								**208**	**77**	**4**	**167**	**15 242**		

ENERGY BALANCE - 2021

	Primary oil products			Petroleum Products												Natural gas (incl. LNG)	Charcoal	Fuelwood
	Crude oil	Natural gas liquids	Refinery gas	Total	Motor Gasoline	Kerosene & Jet Fuel	Gas / Diesel Oil	Fuel Oil	Liquefied Petroleum Gas (LPG)	Naphta	Other kerosene	Bitumen	Lubricants	Parrafin waxes	Other petroleum products			
Precise the unit	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	000 tons	TJ	000 tons	000 m3
TOTAL PRIMARY ENERGY SUPPLY																		
Total Energy supply acc. to UNDATA	29 280	2 076	203	21 567	5 411	21	6 043	5 372	1 715	1 068	1 593	247	91	4		734540	21	
1. Production	198 058	2 076		-											-	364 420	21	240
2. Imports				4 911	3 470	151	1 067	-			223					370 120		-
3. Exports	-168 968			- 9 332	-	10	-	- 7 828	- 137	- 1 388	11							
4. International marine				- 259				- 259										
and aviation bunkers				- 295		- 295												
5. Stock changes	190			-	-	-	-											
Statistical differences				-														
Transfers and recycled products	3 012			- 3 012	945		136	- 3 012		- 945	- 136							
TRANSFORMATION	- 32 282	- 2 076		- 1 854			- 662	- 1 192										204
6. Electricity production	- 6 880			- 1 854			- 662	- 1 192								- 523 523		
7.a. Oil refineries	- 25 402	- 459	- 203	24 966	1 940	176	4 976	13 458	236	2 456	1 382	247	91	4	-			
7.b Other transformation		1 617		1 617					1 617									
8.a. Energy industries own use	- 2 555		- 203	- 1 190				- 1 067		- 123								
8.b. Losses	- 184			-														
FINAL CONSUMPTION - TOTAL																		
Total Final consumption acc. to UNDATA				16 157	6 838	21	5 682	100	1 715		1 457	247	91	4	-	193 428	21	35
Energy use - total				15 814	6 838	21	5 682	100	1 715	-	1 457	-	-	-	-	177 749	21	35
Manufacturing - Industry				1 994			1 894	100								177 749		
Transport				10 647	6 838	21	3 788											
Road				10 626	6 838		3 788											
Domestic aviation				21		21												
Railways																		
Domestic navigation																		
Commercial and public services				-														
Households				3 173					1 715		1 457							
Agriculture				-														
Other				-													21	35
Non-energy use - total				343								247	91	4	-	15 680		

Annex 3: Common reporting tables

Submitted in excel format

Annex 4: Vulnerability Assessment of Health sector in Iraq

Study was prepared to addresses the associations between climate change and health in Iraq to develop evidence-based priority actions for adaptation within Iraq's health sector. This study is submitted separately.

Vulnerability of health care is highlighted using data provided by the Statistical Department of Iraq from its annual 2021 report. The impacts of heatwaves as the single most important climate exposure risk were highlighted whilst acknowledging there are other important risks from dust storms, water scarcity, flooding, and drought. Following, the relation between the reported annual incidence of climate sensitive infectious and chronic diseases to their occurrence in governorates of Iraq is analyzed. Nine case studies are presented to showcase a multisectoral approach that allows developing early warning, prevention, and adaptation approaches to climate change health impacts. These case studies are organized to respond to the WHO Health and Climate Change Iraq Profile report on action items needed to address the gap in the Health National Adaptation Plan (HNAP) for Iraq.

The major findings of the report include:

- Iraq has had temperatures consistently recorded at the highest level globally leading to potential serious health impacts from these extreme temperatures. All past temperature trends for the different governorates indicate all Iraqi governorates are on a trajectory of increasing the number of days with these extreme temperatures with Southern governorates having the highest temperatures, especially Al-Diwaniyah, Thi-Qar, Maysan, and Al-Basrah.
- Some governorates with weaker health system indicators are also in the Southern region that is vulnerable to extreme temperatures, with Al-Basrah being the most notable governorate. Ninewa in the North and Diyala and Wasit in the middle of the country are also suffering from weaker health systems making them more vulnerable to climate change impacts in the future.
- Climate sensitive infectious diseases such as Leishmaniasis and Crimean-Congo Hemorrhagic Fever in Thi-Qar governorate, Dengue fever in Al-Basrah governorate, Typhoid in Maysan, and Tuberculosis in several governorates demonstrate potential higher risks in these areas due to future wider spread of these diseases as a result of climate change.
- Chronic diseases of renal, ischemic heart disease, hypertension, and diabetes are also impacted by rising temperatures and there is variability in reporting of these conditions according to governorates with Kerbala and Al-Najaf having on average higher rates.
- A comprehensive multidisciplinary and multisector approach is needed to tackle health vulnerability to climate change in Iraq with adoption of a revised Health National Adaptation Plan (HNAP). Several case studies and examples are provided as guidance on how such approaches can address these climate change impacts.

Background

Climate change is an existential threat and is considered the most critical public health problem in the 21st Century.[68] Heatwaves and high temperatures are the most common climate exposure in Iraq. The lack of electricity and dependence on generators puts the most vulnerable low-income communities at a disadvantage if they cannot afford to operate air conditioning leading to heat-related illnesses. Furthermore, heatwaves and droughts that lead to loss of crops have been related to the increase of mental disorder like depression and anxiety and intensifying pre-existing mental illnesses issues.

Additionally, extreme heat and elevated temperatures have been associated with heightened aggression and an increased incidence of domestic violence. [69]

Figure 1 demonstrates all the health outcomes from climate exposures. Countries like Iraq are likely to suffer all these conditions to a certain extent, making it one of the more vulnerable to climate change health impacts.[70]

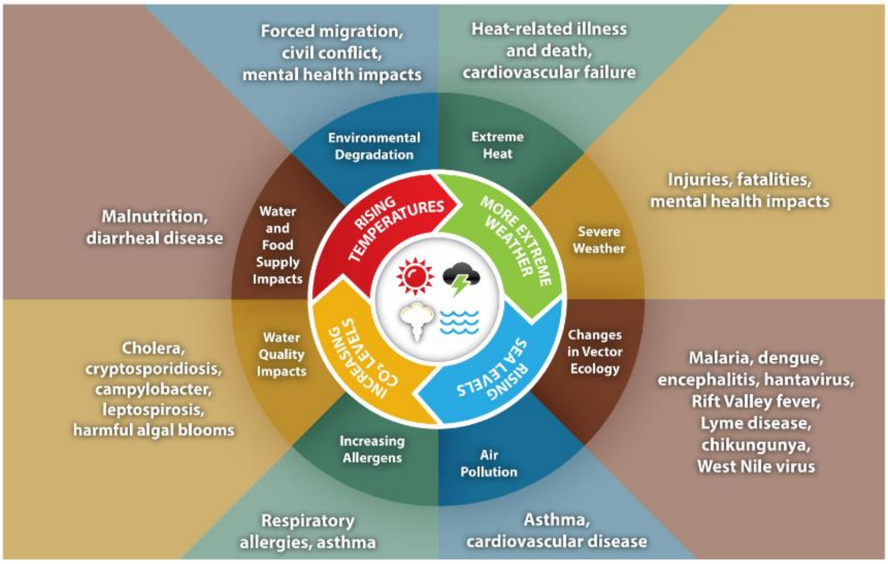

Figure 1 : Impact of climate change on health (Source: National Center for Environmental Health. US Center for Disease Control.)

A major challenge is that the complications of climate change are not well highlighted or fully linked to climate change in Iraq and many other developing countries. This is mainly attributed to the lack of specific focus on Health National Adaptation Plans (HNAP) and limited data sources to inform such plans. The interventions needed to adapt to heat waves, dust storms, and other climate events and exposure can only be developed and implemented with proper data collection. Data collection must follow careful research and study design to use the proper approaches and tools. The analysis and interpretation of such data is another stage that is critical to prepare Health National Adaptation Plan (HNAP).

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68 The Lancet. The 2023 report of the Lancet Countdown on health and climate change: the imperative for a health-centred response in a world facing irreversible harms. The Lancet. 2023;402(10419):2346-2394. doi: 10.1016/S0140-6736(23)01859-7.
69 Van Sustern L and Al-Delaimy W (2020) Psychological impacts of Climate Change and Recommendations. In Health of People Health of Planet and Our Responsibilities Al-Delaimy W, Ramanathan V, Sorondo MS Eds. Springer Nature Publisher 2020.
70 Luber, G. (2014). National Center for Environmental Health, Division of Environmental Hazards and Health Effects. US Center for Disease Control.

In the following sections the aspects of climate change and health impacts are focused on heat and rising temperatures as the main exposure of interest in Iraq. There is brief description of past temperature trends between 1950 and 2020 to demonstrate the trends for each governorate in Iraq in terms of number of days where temperatures exceed 35°C. This leads to how the geographical areas represented by each governorate can be impacting vulnerability of the health system. Then the indicators of Iraq's health system in terms of expenditure, number of beds, number physicians and nurses, and number of primary health care center is provided for each governorate to link the weaker health systems with higher risk from extreme temperatures. Climate sensitive diseases are also presented in terms of reported frequency for each governorate as another layer of higher climate relevant health vulnerability. The final section provides holistic approaches to address climate change and health through case studies relevant to Iraq and the steps needed to address them in the context of the Health National Adaption Plan and according to the WHO assessment of the Iraq National Health Response to climate change and adaptation.[71]

Climate Change and Health

In public health, vulnerability is the "the degree to which a system is susceptible to injury, damage, or harm".[72] The process of factors that lead to vulnerability of people and places starts from climate-related exposure that has negative impacts on health, such as heatwaves, flooding, or drought. As shown in Figure 2, exposure for Iraq would be extreme temperature. Then based on the sensitivity of the individuals or communities impacted by this exposure and their ability to withstand its impacts, there is varying potential impact from the exposure on those communities. For example, older individuals with heart disease, or renal disease for each governorate in Iraq would be more sensitive and will be impacted more than healthy young adults exposed to the same exposure level (represented as sensitivity). Adaptive capacity will moderate this exposure and impact if there are Health Care Facilities (HCF) and infrastructure that can prevent the impact. Therefore, the strength of the health care system will determine the availability of capable health care facilities as part of adaptive capacities. Ultimately, these factors together would determine the vulnerability of people or places and the capacity of the Health Care Facilities (HCF) and institutions to cope with climate change impacts.[73]

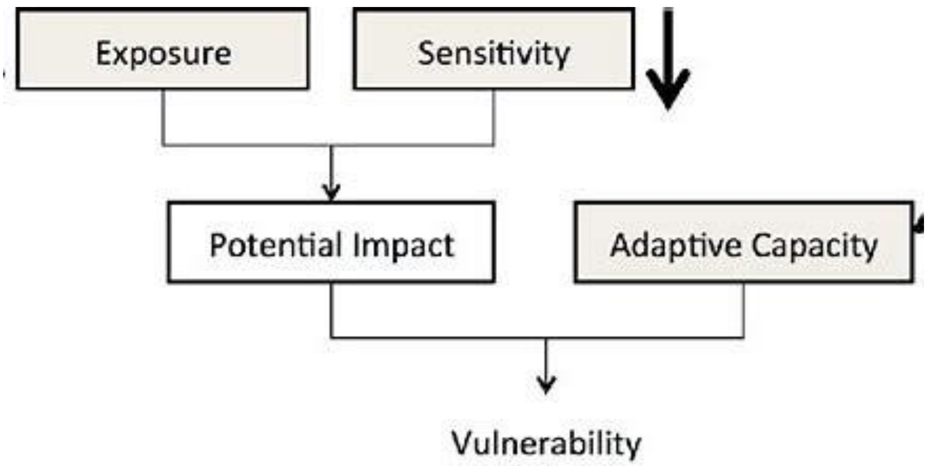

Figure 2: Vulnerability determined by exposure, sensitivity, and adaptive capacity (Source: Centers for Disease Control and Prevention)

71 World Health Organization. (2022, June 1). Crimean-Congo hemorrhagic fever - Iraq. Disease Outbreak News. https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON386.
72 Manangan AP, Uejio CK, Saha S, Schramm PJ, Marinucci GD, Brown CL, Hess JJ, Luber G. Assessing Health Vulnerability to Climate Change: A Guide for Health Departments. US Centers for Disease Control and Prevention; 2014.
73 Manangan AP, Uejio CK, Saha S, Schramm PJ, Marinucci GD, Brown CL, Hess JJ, Luber G. Assessing Health Vulnerability to Climate Change: A Guide for Health Departments. Climate and Health Technical Report Series. Climate and Health Program, United States Centers for Disease Control and Prevention; 2014.

Iraq Temperature Trends impacting health

Iraq experiences some of the highest temperature records around the globe. Several record temperatures have been documented in the past few years. In July 2020 Baghdad city shattered an all-time record temperature recording reaching 52°C (125.2°F).[74] In June 2024, 11 of the highest temperatures recorded around the globe were in Iraqi cities.[75]

Clear variability in the temperatures is apparent where the Northern region is much less prone to extreme temperatures compared to the Middle and South of Iraq. As shown from the trends of recorded temperatures for each governorate in Iraq since 1950 there is wide variability. Using the number of days with a heat index higher than 35°C as a measure of extreme heat, each three governorates are listed in a Figure 3 below.

- In the Northern Kurdish Governorate in Kurdistan Iraq, all of Duhuk, Erbil and Al-Sulaymaniyah had some increase in the number of days with high temperatures. Erbil was reporting more of the days with a heat index higher than 35°C, but reaching no more than 15 days in any year.
- Western and Western-Northen Governorates of Ninewa, Kirkuk and Al-Anbar have had more high temperatures days in the past three decades, with Kirkuk reaching more than 40 days annually with temperatures more than 35°C.
- The Eastern border Governorates of Salah Al Din, Diyala, and Wasit in Middle and upper South of Iraq reported higher number of hot days and especially the Southern most of these in Wasit where more than 80 days of the year for several decades had high temperatures.
- Baghdad, Babil, and Kerbala were within the same range as Wasit and these high temperatures consistently increasing at a higher rate since 1950.
- The governorates that reported the highest temperatures were those of Thi-Qar, Al-Diwaniyah, Maysan, and Al-Basrah reporting 100 or more days with temperatures above 35°C each year for several decades now.[76]

The rapid and consistent rise in temperatures will impact the Southern governorates and the capital Baghdad more than the Northern and Middle or Western Governorates. This requires better planning focused on the most vulnerable communities without air conditioning in rural areas, and especially in Southern cities. But all of Iraq will be affected by the increase in temperatures as demonstrated in 2024 when 11 cities out of the total 15 highest recorded temperatures in a certain hot day globally were from Iraq.[77]

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74 Washington Post. (2020). Baghdad Iraq Heat Record. Retrieved from https :// www.Washingtonpost.com/weather/2020/07/29/baghdad-iraq-heat-record/.
75 Kurdistan 24. (2024). 11 Iraqi cities record highest temperatures globally in past 24 hours. Retrieved from https://www.kurdistan24.net/en/story/395497/11-Iraqi-cities-record-highest-temperatures-globally-in-past-24-hours.
76 World Bank. (2024). Iraq. Retrieved from https://www.worldbank.org/en/country/iraq.
77 Kurdistan 24. (2024). 11 Iraqi cities record highest temperatures globally in past 24 hours. Retrieved from https://www.kurdistan24.net/en/story/395497/11-Iraqi-cities-record-highest-temperatures-globally-in-past-24-hours.

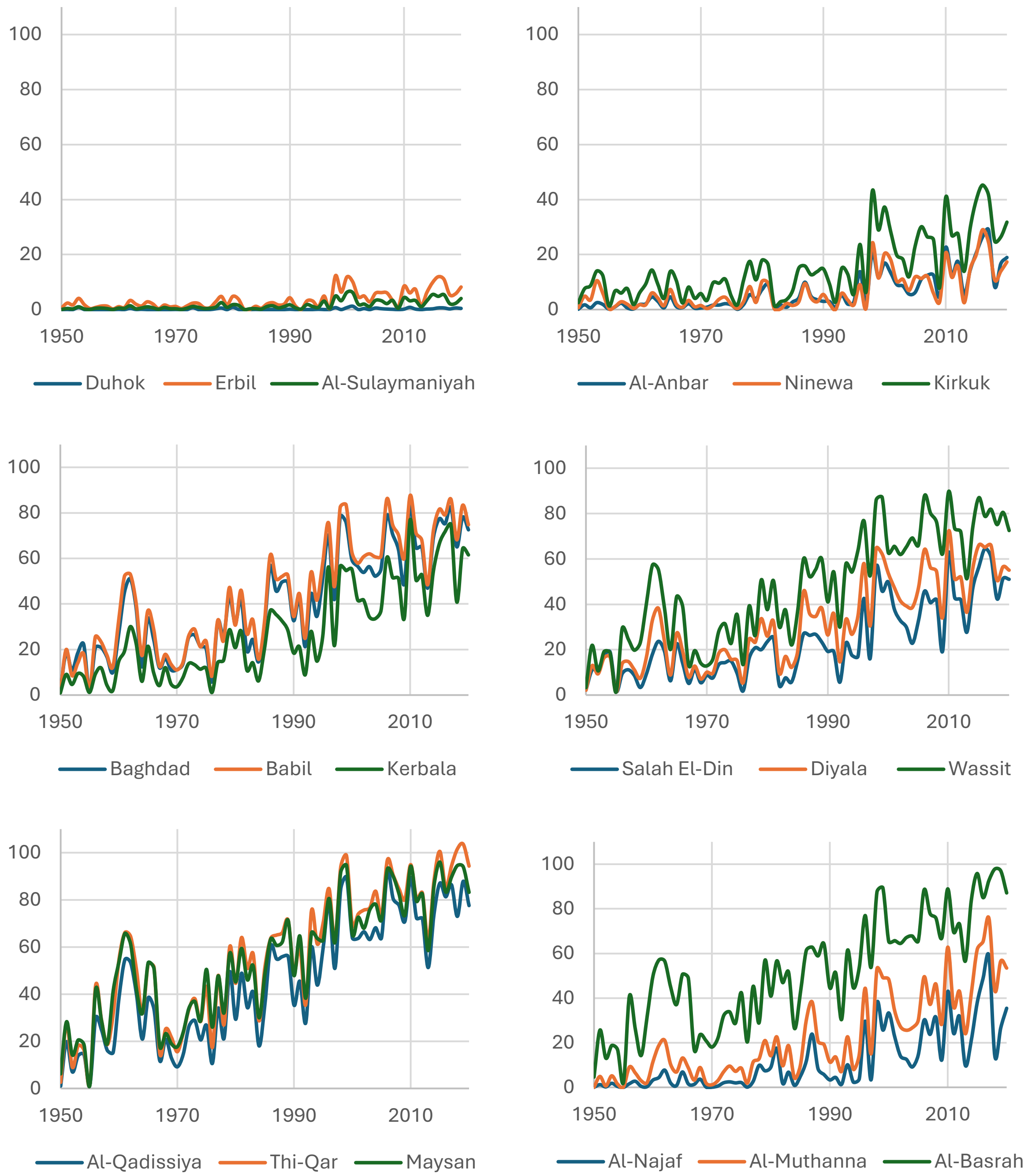

Figure 3: The annual number of days with heat index more than 35°C between 1950 and 2020 in Iraq

Furthermore, based on Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) projections models for temperatures changes between 2021 and 2060, several areas in Iraq will suffer a higher increase in temperatures, especially in the worst case scenario of SSP 5-8.5 where Western Iraq (Al-Anbar Governorate), South West (Al-Muthanna Governorate), and all of the Northern Kurdistan Governorates will have a disproportionate increase in temperatures. This change and increase are relative to the baseline historical temperature data between 1995 and 2014 for these areas compared to Southern Iraq. However, when using a different measure of projected number of days per year with temperatures exceeding 50° C, clearly the middle of the country (such as Diyala, Salah Al Din) and mid-South West

(Babil and Kerbala) as well as the South (Al-Basrah, Al-Muthanna and Thi-Qar) are going to suffer the most in the number of days of extreme temperatures above 50° C each year.[78]

In summary, there is a clear and consistent indication that Iraq is one of the most vulnerable countries in the world to extreme heat events and rising temperatures that will impact all of its governorates, though to varying degrees. This will necessitate the preparation of the health care system and put in place policies and prevention measures that will protect the most vulnerable populations. Although the climate impacts require mitigation at the local and global levels and is more challenging to achieve, adaptation is feasible and necessary to save lives of the most vulnerable populations in Iraq.

There is a need for cross collaboration between the Iraqi meteorological department, the Ministries of Health, Planning, Finance, modelling scientists, and other stakeholders to take a closer look at how this serious rise in temperatures across Iraq and in vulnerable communities and high-risk governorates to create a plan through Health National Adaption Plan. This would require assessment of health care facilities and their readiness for the incoming years of extremely hot weather in terms of expertise and staff, number of beds, funding resources, and outreach to the most impacted communities. Heat alert systems must be in place and based on evidence at the local and national level rather than relying on international data and measures since each country has its own unique risk factors and adaptation measures.

Health Care Facilities Vulnerability

Health Care Facilities (HCF) are at the forefront of climate change and extreme weather events impacts. When there are disasters such as flooding, or extreme heat, or outbreak of climate relevant infectious diseases such as dengue, the Health Care Facilities (HCF) are be required to be prepared for these events in terms of providing rapid responses to care for the most vulnerable and prevent complications and death of the populations that are affected the most. Vulnerable populations are usually the youngest children and the older population. The children lose fluids easily and do not have the insight and consciousness to prevent dehydration, and potential death from extreme heat events. For example, if they develop diarrhea from an infectious disease such as Typhoid or Cholera it will exacerbate and worsen the capacity to withstand the heat wave impacts and dehydration. Without prompt treatment, skilled healthcare staff, adequate facilities, and necessary medical supplies, the risk of fatal outcomes becomes exceedingly high. Similarly, the elderly, especially those with chronic diseases such as diabetes, hypertension, heart diseases, or renal diseases are most vulnerable to the acute impacts from climate change such as heatwaves. This impacts their body's capacity and metabolism and leads to complications and poor control of their medical conditions.[79] They need to have prevention measures, awareness, access to health care, and an educated family to help them cope with these extreme events.

Combining the governorates exposed to extreme heat with the quality of Health Care Facilities (HCF) can help identify regional higher risk of climate change related health impacts due to poor facilities and support during extreme events. Climate-resilient Health Care Facilities (HCF) are defined according to the WHO as the facilities that are prepared to respond, manage, and recover from climate-related events. This involves infrastructure readiness, water and energy sustainability, and a trained health workforce. A major limitation and problem in heatwave events are access to cooling facilities and air conditioning. This is a major problem for Iraq which suffers severe electricity shortages and is highly dependent on privately owned diesel generators to secure regular electricity. But the burden on the grid becomes challenging during a heat wave and can overwhelm electricity generators. In this report the focus is on

78 RICCAR. (2024). Retrieved from https://www.riccar.org.

79 Gouveia, N., Hajat, S., & Armstrong, B. (2003). Socioeconomic differentials in the temperature–mortality relationship in São Paulo, Brazil. International Journal of Epidemiology, 32(3), 390–397. Retrieved from https://doi.org/10.1093/ije/dyg077.

high average temperatures and extreme heat events as the main climate change exposure of interest given Iraq ranks as one of the most extreme hot climates and regularly has record temperatures documented in any summer day. However, this does not preclude other important climate relevant factors, including low precipitation, drought, water scarcity; dust storms; and flooding from torrential rain, which have become increasingly frequent.

Table 1 presents the availability of Health Care Facilities (HCF) for each governorate standardized per population to allow comparison across governorates. The 2021 data provide a general indication of the status of healthcare; however, it is important to note that this data is three years old and may have changed in the past three years. The indicators that are used include the number of primary health care centers, specialized health care centers, hospitals, beds, as well as the level of financial expenditure on health care in each governorate.

Health care indicators have been divided into three categories of strength. The darker the color, the weaker the healthcare facilities for a specific governorate compared to the others. This categorization serves as a relative indicator to give a general impression about the performance of each governorate health systems and therefore their potential vulnerability to climate change health impacts. The governorates names are also color coded so that the ones with yellow highlight are more vulnerable than the light blue highlighted ones, while the non-colored are generally better performing overall relative to all Iraqi governorates. This simple approach is used given the limitation of available data and lack of full health care vulnerability assessment using the WHO tools for measuring vulnerability to climate resilience and environmental sustainability.[80]

Although there is some variability in the indicators, it is apparent that:

- The Ninewa governorate is the worst performing in health care quality on all indicators, making this governorate vulnerable to disease outbreaks or need for health care from extreme climate events. Being the third largest governorate in population size, this is a serious concern. This low quality in health care is likely the result of the damage and destruction from the war during 2014 and 2017. Rehabilitation of the healthcare system in Ninewa is urgently needed to better prepare for climate-related health impacts.
- Al-Basrah is within the group of weaker health care systems despite being the second largest governorate. Furthermore, Al-Basrah is going to be the most vulnerable to climate change impacts from consistently higher average temperatures and projected high increase in extreme temperatures above 35°C compared to the other governorates.
- Diyala and Wasit are similar among the weaker governorates in terms of health care quality indicators. Wasit and Diyala are also within these categories of projected number of days with temperatures above 35°C. These governorates also have lower health care expenditure compared to the other governorates.
- Salah Al Din, Kirkuk, and Al-Anbar governorates are moderately weak in health care indicators, although they mostly do better in the number of primary health care centers per population.
- Baghdad, and several Southern Governorates (Al-Najaf, Kerbala, Babil) that suffer from high temperatures generally have more positive indicators in health care except for primary care centers are also weaker than the rest of the governorates.
- In general, the Northern Kurdistan governorates of Duhuk, Erbil, and Al-Sulaymaniyah outperformed the rest of the governorates in Iraq in terms of health indicators. There was no data

80 World Health Organization. (2021). Checklists to assess vulnerabilities in health care facilities in the context of climate change. Geneva: World Health Organization. Licence: CC BY-NC-SA 3.0 IGO. Retrieved from https://apps.who.int/iris/handle/10665/340656.

about their health expenditure to determine if this better performance is linked to higher investment in healthcare and infrastructure.

Table 1: The population rates of health care indicators of the number of health care facilities, beds, and expenditure according to each governorate in Iraq.

Governorate	# of PHC/100,000 population	# of Specialized PHC/100,000 population	# of Hospitals per/100,000 population	#Beds per 1000 population	Expenditure for health care (Iraqi Dinar per person)
Ninewa	4.9	1.7	0.5	0.6	108095
Al-Basrah	4.3	5.1	0.5	1.4	105931
Diyala	5.9	1.1	0.5	0.9	137592
Wasit	5.5	2	0.5	1.3	151267
Salah Al Din	7.4	2.3	0.7	0.7	148055
Kirkuk	7.4	3.5	0.5	1.0	123942
Al-Anbar	9.8	1.1	0.7	0.8	163478
Maysan	7.1	4.2	0.7	1.1	130617
Al-Muthanna	8.1	3.4	0.6	1.3	130862
Thi-Qar	7.6	3.5	0.4	1.3	163729
Babil	5.5	4.5	0.8	1.4	178782
Al-Diwaniyah	6.0	5	0.8	1.2	188184
Kerbala	4.8	7.6	0.9	1.6	199157
Al-Najaf	5.2	8.2	1.1	1.9	211187
Baghdad	3.0	4.7	0.6	1.5	402940
Duhuk	12.2	3.6	1.6	1.3	
Erbil	13.6	15.5	1.2	1.4	
Al-Sulaymaniyah	14.8	8.1	1.8	1.6	

(Darker color indicates poorer performance in the respective indicator compared to the rest of governorates). Yellow highlighted governorates are the ones with the weakest overall health care systems followed by blue highlighted governorates, while non-highlighted governorate names are ones that are overall better related to other governorates.

Table 2 demonstrates another aspect of health care quality in terms of health care capacity at the health care facilities in each governorate, again prorated according to the population size for proper comparison. The number of physicians per population is one of the most important indicators of the capacity of health care systems to be resilient in addressing climate change impacts on health systems. There is a wide range of numbers ranging from 7 physicians per 10,000 population for most governorates up to close to 25 physicians per 10,000 population in Erbil governorate.

Table 2:The population rates of health care personal of physicians and nursing staff according to each governorate in Iraq.*

Governorate	Physicians per 10,000 population	Nursing per 10,000 population
Al-Basrah	7.9	13.25
Salah Al Din	7.9	18.36
Al-Anbar	7.7	18.24
Ninewa	7.3	27.69
Maysan	7.3	27.69
Kirkuk	6.7	27.72
Wasit	7.6	25.33
Diyala	7.2	33.05
Thi-Qar	7	38.53
Baghdad	11.4	17.48
Duhuk	11.79	10.88
Al-Sulaymaniyah	15.6	18.86
Al-Muthanna	10.2	24.63
Babil	10.1	34.75
Kerbala	11.6	36.57
Al-Najaf	10.9	40.79
Al-Diwaniyah	10	48.62
Erbil	24.9	25.35

(Darker color indicates poorer performance in the respective indicator compared to the rest of governorates). Yellow highlighted governorates are the ones with the weakest overall health care systems followed by blue highlighted governorates, while non-highlighted governorate names are ones that are overall better related to other governorates).

This high disparity most likely reflects the settlement of many highly specialized physicians in Erbil to escape the wars and violence that Erbil was spared from to practice health care and making it a hub for more advanced and higher quality health care. Nursing staff are not prioritized in most governorates, which is why even governorates with higher numbers of physicians, such as Al-Sulaymaniyah and Erbil, have lower nursing staff per population ratios. Interestingly, Southern Governorates like Thi-Qar, Babil, Kerbala, Al-Najaf, and particularly Al-Diwaniyah, show higher nursing personnel per population rates. Conversely, Al-Basrah, Salah Al Din, and Al-Anbar have the lowest ratios of physicians and nursing staff per population in Iraq, followed by Ninewa, Maysan, Kirkuk, and Wasit. This highlights a significant regional variation in healthcare workforce distribution, which could affect the resilience of these areas during climate-related health emergencies.

Based on the 2021 data from Iraq regarding health care quality indicators, clear weaknesses in healthcare facilities and personnel are evident for several governorates. Notably, some of these governorates, such as Al-Basrah, are already experiencing extreme temperatures and are projected to face even more frequent and intense heat events in the future. Al-Basrah is the second most populous governorate in Iraq and reports higher rates of climate-related diseases compared to many other regions, highlighting the critical need for enhanced healthcare infrastructure and personnel to address these climate challenges. Ninewa shows weaknesses in healthcare quality indicators, but this might be a temporary situation after as the region recovers from the war that destroyed its infrastructure and undermined health care services. Diyala, Wasit, Salah Al Din, Al-Anbar, and Kirkuk are also to a certain degree not among the better performing governorates in health care, and these regions are projected to have extreme heat events in the future as shown in the section on Extreme Temperatures in Iraq.

Recommendations for Improvements

A multidisciplinary approach is needed to prepare health care for climate-related health impacts. The WHO health and climate change country profile report on Iraq in 2022 provided a clear assessment of a major gap in the health system capacity and adaptation in relation to climate change on all fronts of governance and leadership, on lack of evidence for vulnerability and adaptation of health care system at the national level, and capacity, infrastructure and sustainability.[81] The report indicated that on all these fronts there was either no data, no preparedness, or unclear path forward. The recommendations from that country profile report were for Iraq to develop a Health National Adaption Plan, which is currently under development; to strengthen multisectoral collaboration on health and climate change; to strengthen integrated risk surveillance and health early warning systems; and to build climate resilient and environmentally sustainable health care facilities. These activities should start at the national level but also target the most vulnerable and weak health care facilities and governorates to prepare for the climate change extreme events that will be increasing in intensity and frequency.

- Health Care facilities in Iraq show variable levels of strengths and weaknesses according to the available indicators in this section. But this is a simple assessment of vulnerability for adaptive capacity to address climate change health impacts and there is a need for comprehensive surveys and monitoring of health care facility vulnerability.
- In the context of climate change and heat waves, community effort serves as the first line of defense. It is crucial for the community members and families to be aware of the potential risks and identify the most vulnerable individuals such as elderly with chronic diseases or children who can become dangerously dehydrated. This requires a systematic effort of education and outreach by health professionals to these communities on ongoing basis to prepare them for the increasing average temperatures and extreme heat events that are impacting Iraqis. This is especially important for those who are in rural communities or urban communities with no air conditioning and poor housing. But realistically, this community approach will take time and long-term investment by the Iraqi government.
- The Ministry of Health and community serving organizations will need to collaborate with experts and other ministries in Iraq and create the national committee on climate change and health and make sure it becomes part of the Health National Adaptation Plan.
- The frontline for health care in relation to climate change are the primary health care clinics and emergency departments that will be the first point of contact for those in the community in need of health care services resulting from extreme climate events. The capacity of these health care facilities to handle a wave of patients suffering from heat stroke, exhaustion, dehydration, or complications from existing chronic diseases will be critical.
- Equally important is the capacity of healthcare providers to recognize and prioritize needs based on the severity of conditions, ensuring that they are not overwhelmed by demand. The health system in Iraq relies on physicians for primary healthcare, with nursing staff serving a supportive role. Consequently, the capacity of Iraq's healthcare system is directly tied to the number of physicians available in any healthcare facility. There is a need to shift tasks to nurses in terms of addressing climate related impacts as they work closer with patients than physicians and are available at higher rates in some of the vulnerable governorates.

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81 World Health Organization, EMRO, United Nations Framework Convention on Climate Change. Health and climate change: country profile 2021: Iraq. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

- Even if there is an adequate number of qualified physicians and nurses, healthcare facilities will still struggle to provide necessary care during extreme climate events, such as prolonged heatwaves, unless there are sufficient beds, resources, medicines, electricity, air conditioning, and a robust infrastructure to support the demand.

Climate Sensitive Disease in Iraq 2021-2023

The following assessment addresses the occurrence of climate sensitive diseases at governorate level as another layer of higher climate relevant health vulnerability. Some diseases-related data was obtained from the 2021 annual statistical report of Iraq. Death and hospitalization data are available on annual basis only for the years 2022 and 2023.

Infectious Diseases

In Iraq, certain neglected tropical diseases (NTD) are also sensitive to climate such as Leishmaniasis which is transmitted by the phlebotomine sandfly. This sandfly thrives in warm, damp areas that make it highly susceptible to global warming and is likely to spread in new areas in the near future.[82] The endemic areas with Leishmaniasis in Iraq with favorable conditions for the sandfly activity and disease transmission are particularly vulnerable to climate change. While not all individuals bitten by the sandfly develop the disease, those who contract the visceral subtype of Leishmaniasis face a high risk of fatality. Fortunately, in Iraq, the predominant subtype is cutaneous Leishmaniasis, which, while not life-threatening, can cause scarring and disfiguring, especially that most bites and the resulting lesion happens to the face.

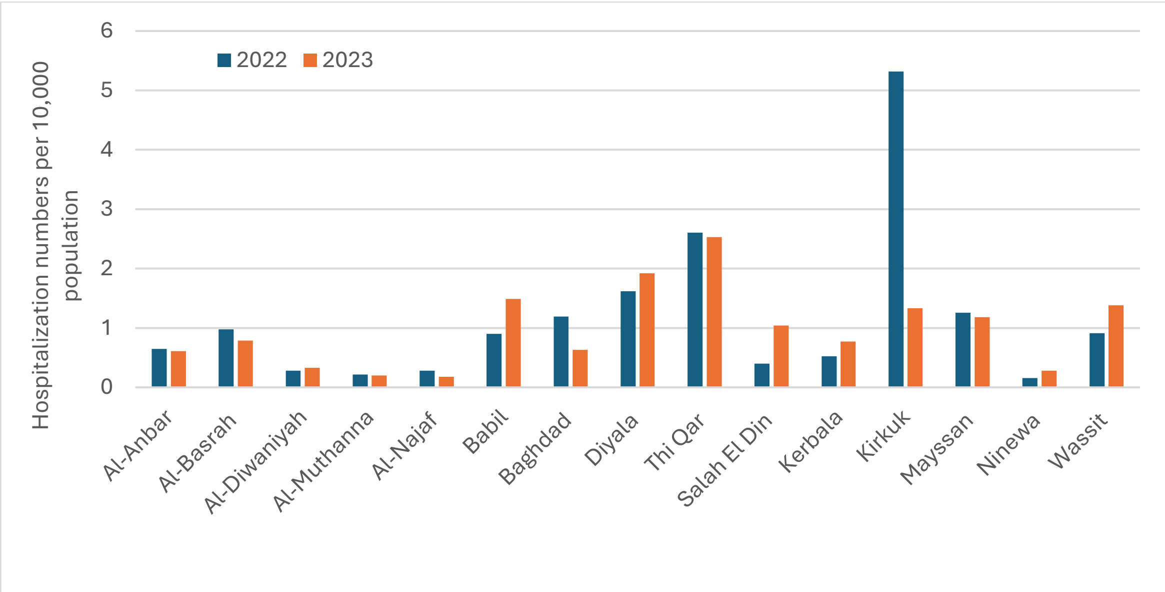

Figure 4: Reported rates of climate sensitive infectious diseases hospitalization in Iraq per 10,000 population in 2022 and 2023 (excluding Typhoid, Paratyphoid, and TB diseases).

As shown in the Figure 4, Thi-Qar Governorate consistently reported higher rates of infectious disease hospitalization, which was attributed mostly to Leishmaniasis. There were 359 Leishmaniasis cases reported in Thi-Qar in 2022 from a total of 458 cases for all of the country. In 2023, there were 379 cases in Thi-Qar out of 631 total nationally that year. As shown in Figure 3 in the previous section of extreme temperatures, Thi-Qar Governorate also has one of the highest number of days with temperatures above 35°C compared to the rest of the governorates. This disease-specific climate vulnerability within certain

82 Paz S. The potential of climatic suitability indicator for Leishmania transmission modelling in Europe: insights and suggested directions. The Lancet Regional Health – Europe. 2024;43:100995. doi: 10.1016/j.lanepe.2024.100995.

geographical areas of Iraq should be part of the planning of the Health National Adaptation Plan on climate change adaption in Iraq. Oher NTD diseases, such as Schistosomiasis, are also influenced by climate change. Rising temperatures increase snails' populations that are the vectors of this disease and shorten parasite cycle, while drought and heatwaves force people to use water sources infested with the parasite.[83,84]

Mosquito-borne diseases are spreading due to rising temperatures, with diseases such as yellow fever, Chikungunya and Zika becoming more prevalent. One of the most significant vector-borne diseases that is reflective of climate change is Dengue fever which has increased by 30 folds in the past decades. It has a worldwide burden with an estimated 400 million individuals infected although only a fourth of them are likely to develop clinical manifestations.[85] In Iraq, the first ever reports of Dengue were among troops stationed there in 1944.[86] In Al-Basrah, Dengue fever is reported much more than the rest of the governorate where in 2022, 56 out of the 66 cases in the country were located in Al-Basrah. In 2023 there were a lower number of cases but also Al-Basrah had the largest reported cases (20 out of 31 cases nationally were located in Al-Basrah). Al-Basrah is another climate vulnerable governorate on several fronts as it has one of the highest temperature recordings in Iraq (based on previous section on temperatures), as well as the weakest health system as discussed in the section on Health Care Facilities (HCF) in Iraq. The increasing burden of climate change and heatwaves is expected to exacerbate the prevalence of Dengue fever in Al-Basrah.

Crimean-Congo Hemorrhagic Fever is another fatal tick-borne disease endemic in Iraq since 1979, when the first case was diagnosed. This disease is transmitted by Hylomma tick species, primarily associated with livestock. Individuals can contract the disease either by being bitten by the tick or coming into contact with infected livestock blood during slaughtering and handling by butchers. Thi-Qar has the largest reports of the disease in Iraq, where in 2022 of the 97 laboratory confirmed cases, 47 of them (50%) were from Thi-Qar governorate. In total there were 212 cases of confirmed and suspected Hemorrhagic Fever in Iraq. [87] While there are limited studies in Iraq about the trends and risk factors for the disease, research from Turkey has shown factors such as humidity and precipitation can predict an increase in cases of Hemorrhagic Fever.[88]

The above vector-borne diseases have shown to be persistent in Iraq and are climate sensitive. Given the clear increasing trajectory of temperatures in Iraq, especially in the middle and Southern parts of Iraq where these conditions are more prevalent, these diseases are likely to spread into wider areas leading to an increase in the number of infected patients, resulting in more hospitalization and potentially death. The health care facilities in these high-risk areas must prepare for the increasing frequency of these diseases with rising temperatures caused by climate change.

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83 De Leo GA, Stensgaard A, Sokolow SH, N'Goran EK, Chamberlin AJ, Yang G, et al. Schistosomiasis and climate change. BMJ. 2020;371:m4324. doi: 10.1136/bmj.m4324.

84 Zhou XN, Yang GJ, Yang K, Wang XH, Hong QB, Sun LP, Malone JB, Kristensen TK, Bergquist NR, Utzinger J. Potential impact of climate change on schistosomiasis transmission in China. Am J Trop Med Hyg. 2008;78(2):188-194.

85 Ebi, K. L., & Nealon, J. (2016). Dengue in a changing climate. Environmental research, 151, 115–123. https://doi.org/10.1016/j.envres.2016.07.026.

86 Fleming, R.F., & French, J.M. (1947). Dengue in Iraq. Transactions of the Royal Society of Tropical Medicine and Hygiene, 40(6), 851-860.

87 World Health Organization. (2022, June 1). Crimean-Congo hemorrhagic fever - Iraq. Disease Outbreak News. https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON386.

88 Mehmood, Q., Tahir, M. J., Jabbar, A., Siddiqi, A. R., & Ullah, I. (2022). Crimean-Congo hemorrhagic fever outbreak in Turkey amid the coronavirus disease 2019 (COVID-19) pandemic; a debacle for the healthcare system of Turkey. Infect Control Hosp Epidemiol, 43(11), 1726-1727. https://doi.org/10.1017/ice.2021.343. Epub 2021 Jul 26. PMID: 34308813; PMCID: PMC8365041.

Typhoid

In addition to vector-borne diseases, water-borne and food-borne diseases are also sensitive to climate change. In Figure 4, for infectious disease hospitalization, there is a clearly high frequency of cases in Kirkuk in 2022 that exceed any other governorate. Kirkuk had a Cholera outbreak in 2022 that caused the reporting of 642 cases in that year in Kirkuk compared to 1094 cases for all of the country. In 2023, the number of cholera cases in Kirkuk dropped to 84. Cholera is caused by the bacterium Vibrio cholerae spread through the ingestion of contaminated water or food. Vibrio cholera can attach to plants such as phytoplankton, or marine animals such as copepods and other crustaceans and get into humans when consumed. Climate factors, including flooding, temperature, and climate variability have been shown to directly impact the spread of cholera.[89]

Typhoid fever is caused by Salmonella Typhi or the milder Salmonella Para-Typhi, which is transmitted through the ingestion of water or food contaminated by the bacterium. Higher temperatures are associated with higher spread of this infection.[90] That is why it occurs during the summer months. Typhoid is a deadly disease that spreads through poor hygiene via the feco-oral route from infected individuals. As shown in Figure 5, there is a consistent increase in the number of cases of typhoid in 2023 compared to 2022 in Iraq, especially in the governorates of the South in Al-Diwaniyah, Al-Najaf, Babil, Thi-Qar, Wasit, and the highest rates being in Maysan. These governorates are also experiencing a rapid increase in extreme temperatures as shown in the section on extreme temperatures. Similar to vector-borne diseases, the water and food borne diseases like Typhoid and Cholera are associated with rising temperatures. Southern Governorates of Iraq seem to be particularly vulnerable to Typhoid and paratyphoid.

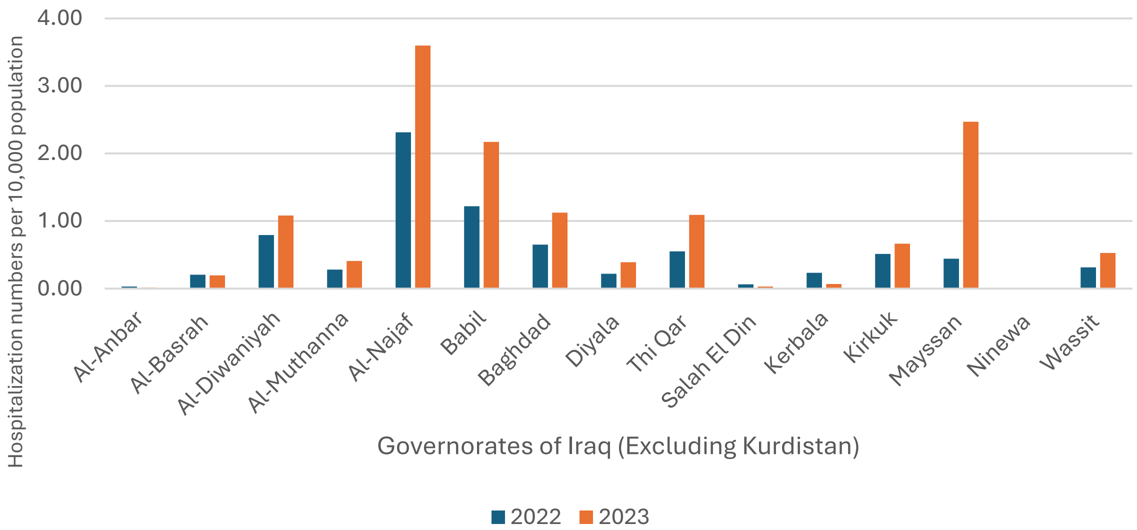

Figure 5: Reported rates of Typhoid and Paratyphoid hospitalization in Iraq per 10,000 population in 2022 and 2023

Tuberculosis (TB) is another important global indicator of poverty, poor hygiene, and low access to health care. TB is remerging with treatment-resistant strains leading to more infections and deaths. The main mode of transmission of TB is through droplets from infected individuals who often spread the disease to their family members. It has been shown that overcrowding in low income poorly ventilated housing is an important risk factor. The impact of climate on disease transmission may occur through

89 Constantin de Magny, G., & Colwell, R. R. (2009). Cholera and climate: a demonstrated relationship. *Trans Am Clin Climatol Assoc*, 120, 119-128. PMID: 19768169; PMCID: PMC2744514.
90 Jia, C., Cao, Q., Wang, Z., van den Dool, A., & Yue, M. (2024). Climate change affects the spread of typhoid pathogens. Microbial biotechnology, 17(2), e14417. https://doi.org/10.1111/1751-7915.14417.

the movement of climate refugees, causing overcrowding in a new area spreading the disease across and within the borders of a country.[91] In Iraq there is a clear presence of TB across most governorates, with Baghdad, Babil, Al-Basrah and Maysan showing almost double the prevalence compared to other governorates Figure 6, Access to high quality health care services and good outreach and education programs are crucial for TB prevention and treatment. Better assessment of the local risk factors for TB in each of these high-risk governorates will shed further light about the level of impact from higher temperatures and humidity on the spread of TB in Iraq.

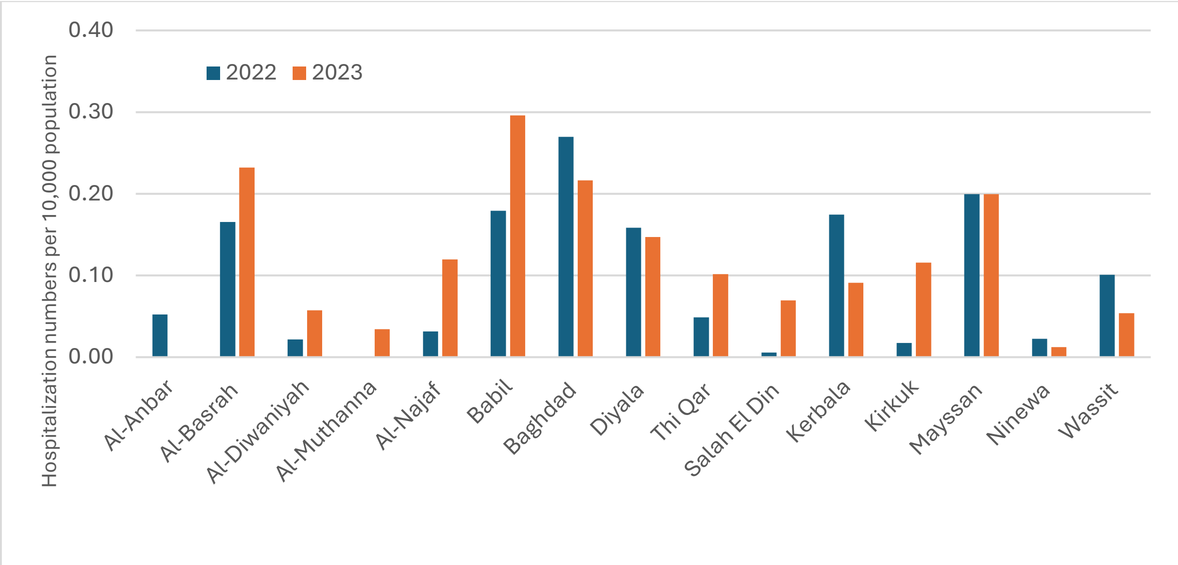

Figure 6: Reported rates of Tuberculosis hospitalization in Iraq per 10,000 population in 2022 and 2023

Chronic Diseases

Although infectious diseases are the main diseases that have been studied and linked to climate change variability, and global warming, chronic diseases are emerging as similarly important adverse climate change outcomes. Among the exposures of climate change and weather events, heatwaves and extreme temperatures are the main risk factors for chronic diseases. In Iraq, this is also concerning due to the rapid rise in average temperatures and the frequency of extreme heat events, as shown in the earlier section of extreme temperature projections in Iraq. Renal diseases, heart diseases, diabetes, and hypertension are some of the major chronic diseases in Iraq and are also sensitive to higher temperatures making those patients with these conditions more vulnerable to climate change.

For renal diseases, there are many subtypes ranging from kidney stones that are linked to high water salinity and dehydration from low fluid intake to nephritic syndrome, nephritis, or chronic kidney disease. Acute Kidney Disease can result from prolonged exposure to high temperatures leading to induction of rhabdomyolysis and inflammation which evolves into chronic kidney disease.[92] Agriculture workers are most vulnerable to these diseases given their long-term occupational exposure to heat. Low quality water with higher concentrations of contaminants can result from drought and extended heat, which further contributes to renal damage. The health care facilities will be impacted the most with these chronic debilitating conditions requiring long term treatment or dialysis. The kidney donor communities are also another outcome of these conditions because of high demand for kidney transplants and the financial return for donating kidney by low communities in most need. This situation exacerbates health

91 Maharjan, B., Gopali, R.S., & Zhang, Y. (2021). A scoping review on climate change and tuberculosis. *Int J Biometeorol*, 65, 1579–1595. https://doi.org/10.1007/s00484-021-02117-w.
92 Borg, M.A., & Bi, P. (2021). The impact of climate change on kidney health. *Nat Rev Nephrol*, 17, 294–295. https://doi.org/10.1038/s41581-020-00365-4.

inequity and injustice. Many individuals with chronic kidney diseases face fatal outcomes unless they can secure a kidney transplant.

As shown in Figure 7, the renal disease hospitalization is consistent across all governorates with the exception of the relatively low admissions in Salah Al Din and the very high prevalence in Kerbala followed by Al-Najaf governorates.

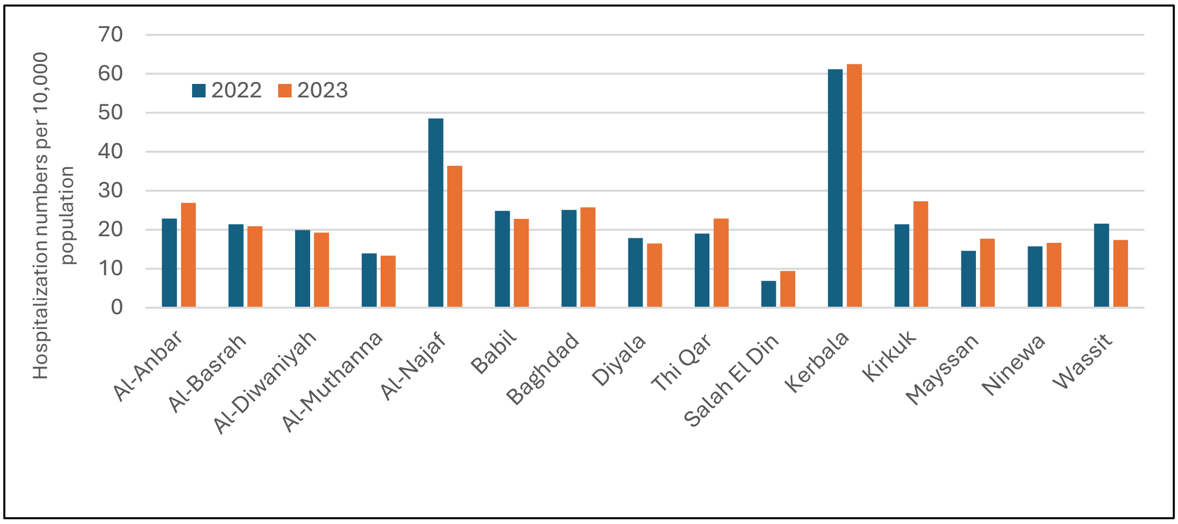

Figure 7 : Reported rates of renal disease hospitalization in Iraq per 10,000 population in 2022 and 2023

In terms of death from renal disease, as shown by Figure 8, Al-Najaf kept the high lead similar to renal disease hospitalization but there was low mortality from renal diseases in Al-Muthanna. This discrepancy might reflect different reporting strategies in certain governorates, or lower quality of proper reporting of death certificates in others. There are no known explanations for these differences, which require further assessment of the geographical risk factors including climate-related temperature extremes and water quality.

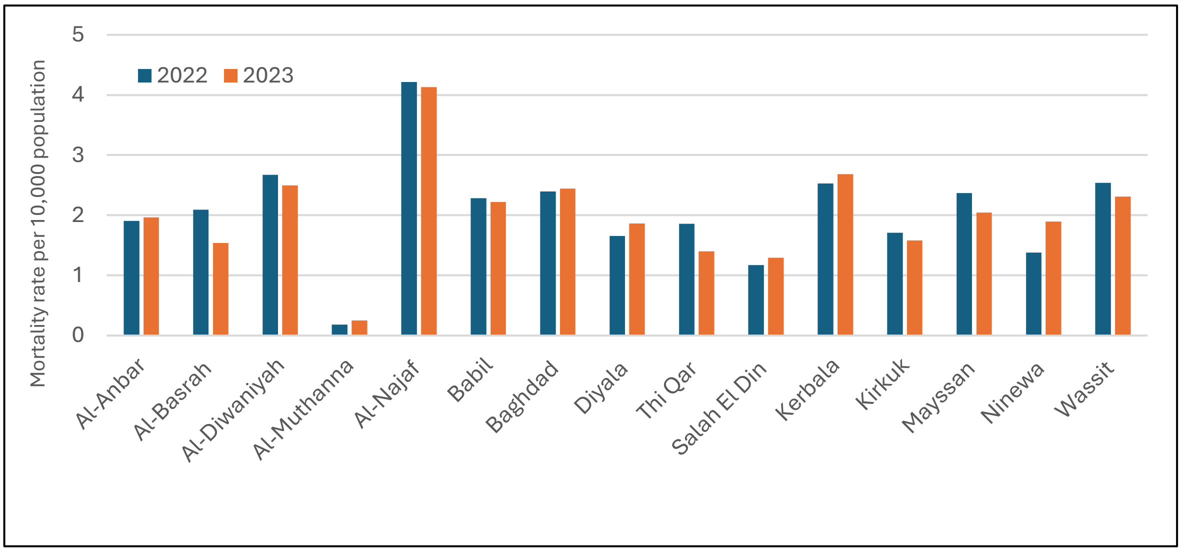

Figure 8: Reported rates of Renal Disease Mortality rates in Iraq per 10,000 population in 2022 and 2023

The link between climate change and heart disease is primarily driven by air pollution from wildfires, dust storms, and the use of fossil fuel. Heart diseases are part of cardiovascular diseases to include stroke and ischemic heart diseases, hypertension, arrythmias, peripheral vascular diseases, and heart failure. Based on the data available by the Iraqi Ministry of Health, ischemic heart diseases is the primary reported cardiovascular disease. Climate change impacts heart disease through both direct and indirect mechanisms. These mechanisms are also related to diabetes and hypertension. One of the common explanations for the association of temperature and these conditions is the role of higher temperatures in dehydration leading to hyper viscosity of blood and hemoconcentration, raising the risk of thrombotic events associated with ischemic heart diseases and stroke.[93] There is also an indication that air pollution as well as extreme heat events trigger inflammatory markers activation leading to higher risks for complications of cardiovascular diseases. The association of cold temperature and hypertension are related to peripheral vasoconstriction and increase in systolic blood pressure. As a result, the relationship between temperature extremes and heart disease follows a U-shaped curve, where both high and low temperatures pose elevated risks. Insulin resistance and elevated blood glucose levels are increasing in frequency in heatwaves leading to a worsening of complications for individuals with diabetes. Ozone air pollution also increases from global warming and has been linked to increased cardiovascular mortality. There are other indirect impacts from climate change and heatwaves on heart diseases in terms of the lack of electricity because of high demand during heatwaves, disruption of health care services, interaction between higher temperatures and medicines for these diseases, and the general lack of education and awareness of patients about the risks of climate exposures on their diseases.

As shown in Figure 9, the hospitalization from heart diseases in Iraq is rather variable between governorates although the reporting is consistent across the three years between 2021-2023. What is very notable is the higher reporting of cases of heart disease hospital admissions in Al-Najaf and Kerbala governorates. This higher reporting in Al-Najaf is also evident in the heart mortality (Figure 10), Kerbala governorate has a very high rate of hospital admissions for essential hypertension, hypertension mortality, and diabetes hospitalization. It can be assumed that Kerbala is visited by millions of people from the rest of Iraq and from outside Iraq during religious events leading to the higher-than-average reporting of these cases. Both Kerbala and Al-Najaf are within the group of Southern Governorates that are impacted by high temperatures but have stronger health care facilities compared to other governorates, except for the Kurdistan Governorates, which generally have the best health care quality indicators. For Kerbala health care preparedness, it seems that it is effective as evidenced by the very low mortality from heart diseases despite the high rates of hospitalization from these diseases. However, the mortality rate for hypertension in Kerbala remains the second highest in the country.

93 Khraishah, H., Alahmad, B., Ostergard, R.L., et al. (2022). Climate change and cardiovascular disease: implications for global health. Nat Rev Cardiol, 19, 798–812. https://doi.org/10.1038/s41569-022-00720-x.

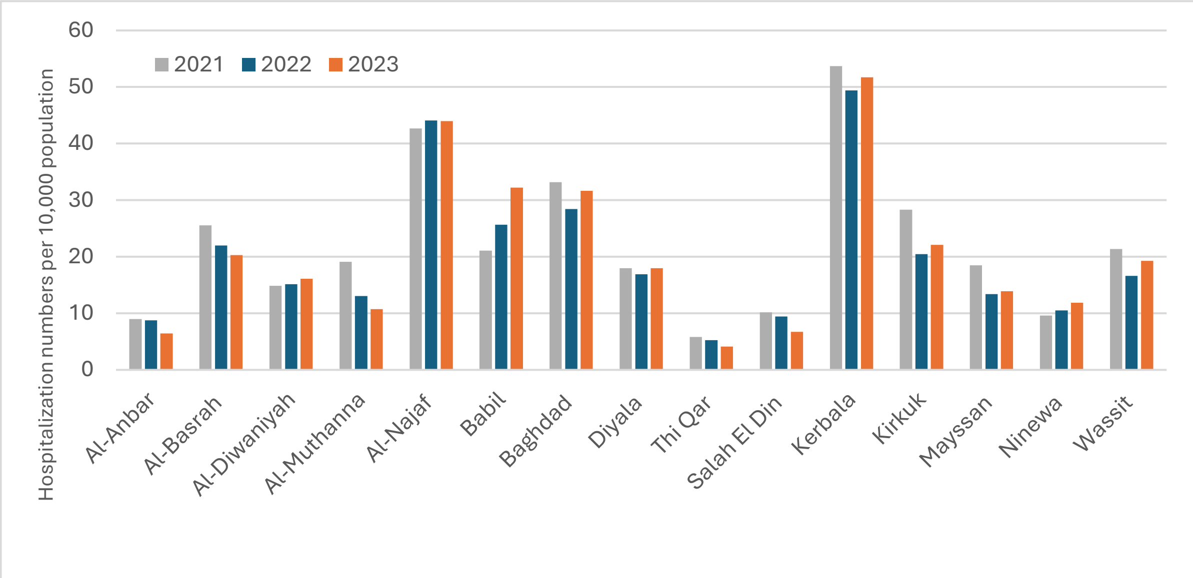

Figure 9 : Reported rates of Heart Disease Hospitalizations hospitalization in Iraq per 10,000 population between 2021-2023.

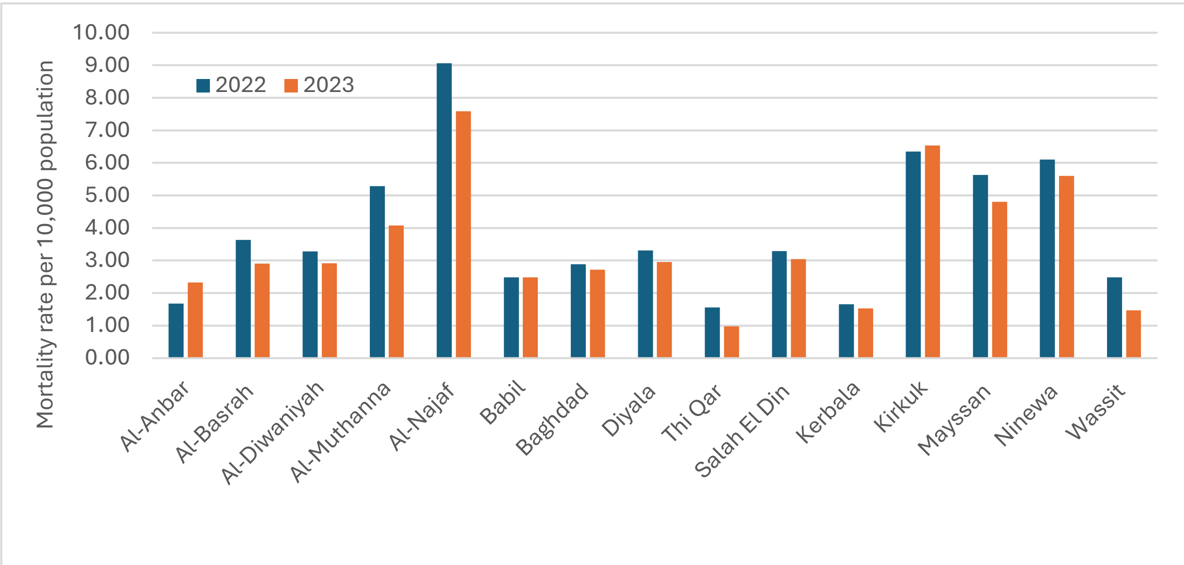

Figure 10 : Reported rates of Heart Disease Mortality in Iraq per 10,000 population in 2022 and 2023

As shown in the Figure 11 and Figure 12, there are also some governorates like Thi-Qar, Salah Al Din , Ninewa, and Al-Anbar that generally report lower rates of hospitalization and mortality for most of these diseases. A possible explanation is the disruption of health care system reporting during the years of war and conflict in these governorates. Tens of thousands of people relocated to other governates as a result of these conflicts. Thi-Qar was the focus for long months of demonstrations and clashes that might have impacted hospitalization and mortality records. This is important to note that conflicts, wars, and violence have a major complicating factor on climate change, health impacts in terms of poor monitoring, lack of health care access, lack of health care providers, as well as movement of people. Conflict and climate change multiply the adverse health impacts on the population who are most vulnerable, namely low-income population, older, and young and female, worsening their health outcomes compared to the general population.

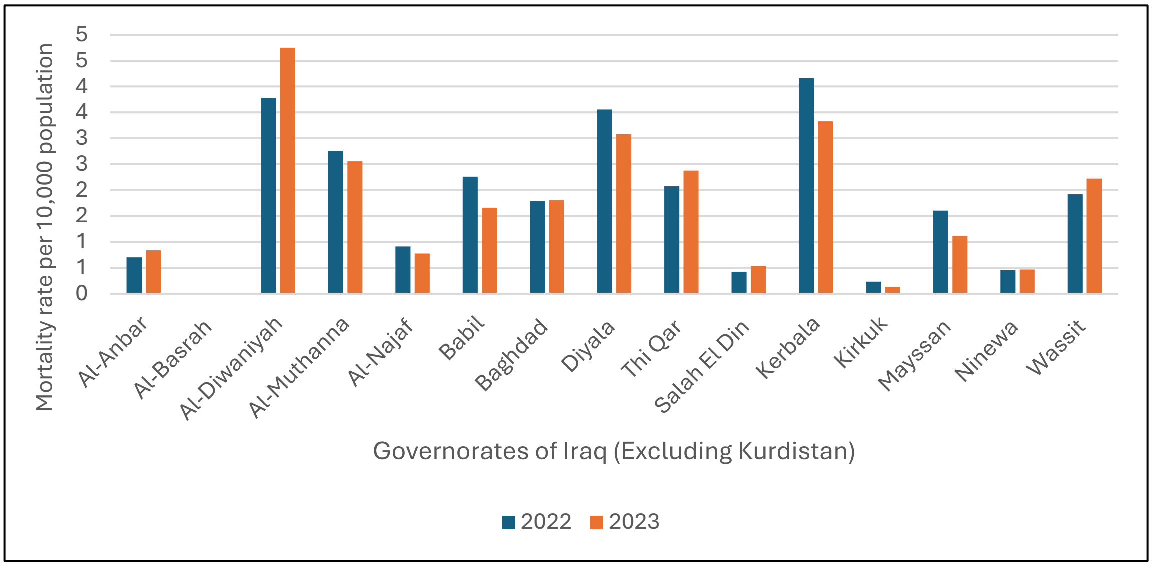

Figure 11: Reported rates of Essential Hypertension Hospitalizations in Iraq per 10,000 population between 2021-2023

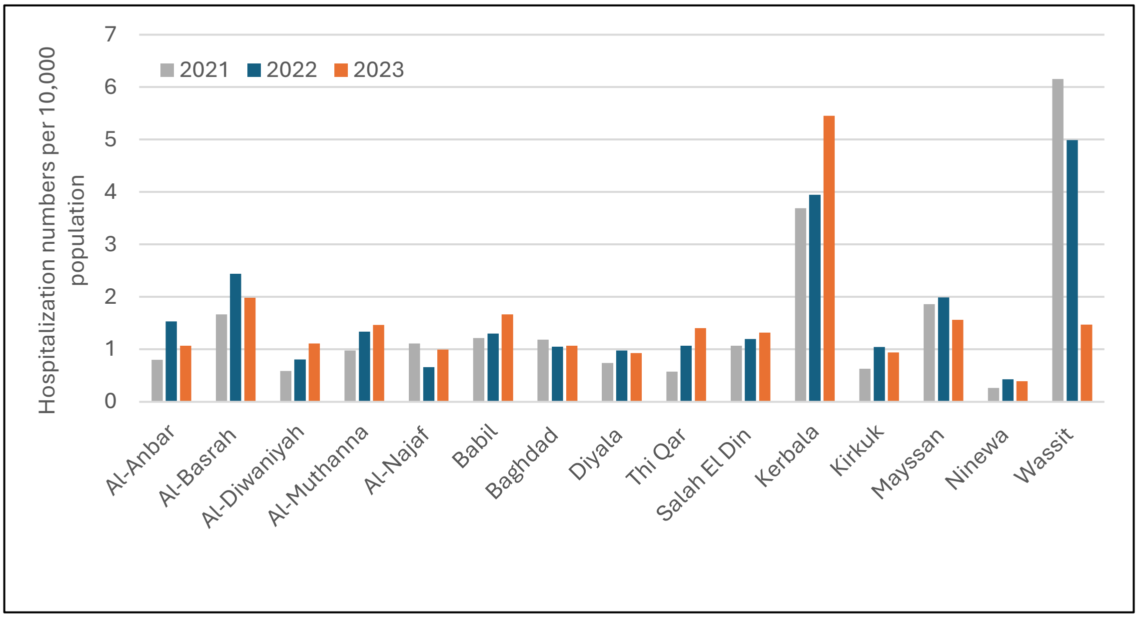

Figure 12 : Reported rates of Essential Hypertension Mortality in Iraq per 10,000 population in 2022 and 2023

Diabetes and insulin resistance are associated with heat and climate change, but not as direct as hypertension or cardiovascular diseases because diabetes is a multifactorial and complex disease. People with diabetes suffer disproportionate complications from cardiovascular diseases, which worsen during a heat wave, or when health care services are disrupted from other climate impacts such as flooding, dust storms, wildfires, and outbreaks of infectious diseases. These disruptions undermine access to health care for those with chronic diseases such as diabetes. Kidney diseases and impaired physiological response to these climate events are other complications for those with diabetes. The patients living with diabetes are more prone to infectious diseases as well, which can spread faster during warmer weather. All these conditions make the patients with diabetes at higher risk from climate change. As shown in Figure 13, hospitalization for diabetes is largely similar, with few exceptions of lower-than-average admissions in Ninewa, Salah Al Din and Al-Anbar for possible reasons mentioned earlier regarding disruption of the health care system and infrastructure. Maysan is also having a higher admission rate in each of the three years between 2021 to 2023. The mortality rates from diabetes more or less follow these patterns.

The Southern Governorates and Baghdad have similar higher mortality from diabetes (Figure 14). Given the potential for climate change and extreme temperatures during these events, as well as the disruption of health care services, diabetes is one of the diseases that require attention in relation to climate change impacts. Better data and monitoring are required to determine the levels of risk from extreme heat events on those with diabetes and the care they need to prevent complications for this vulnerable population in Iraq.

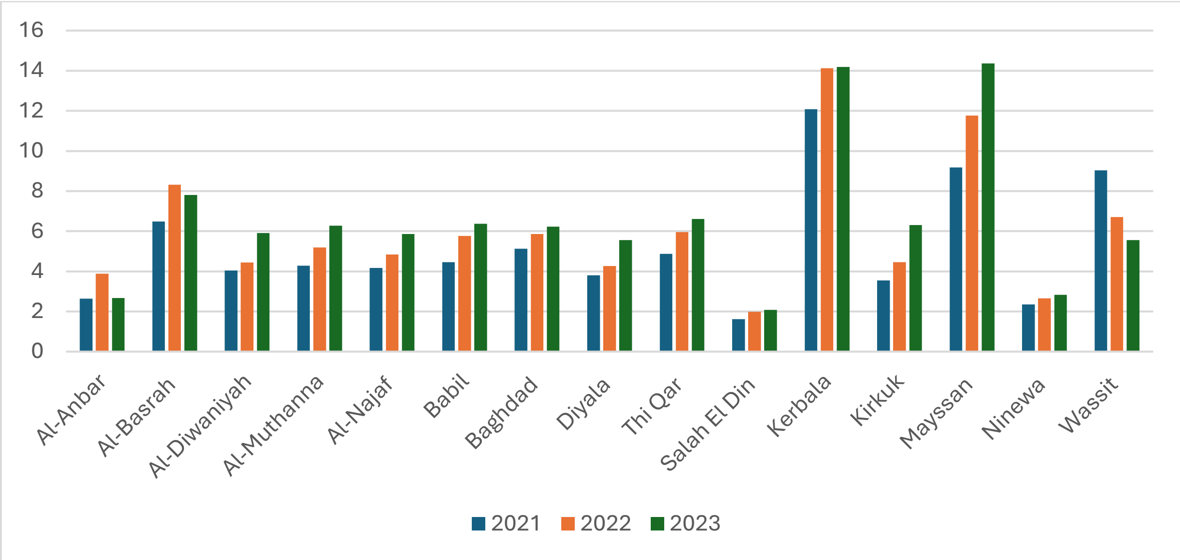

Figure 13 : Reported rates of Diabetes hospitalization in Iraq per 10,000 population between 2021-2023

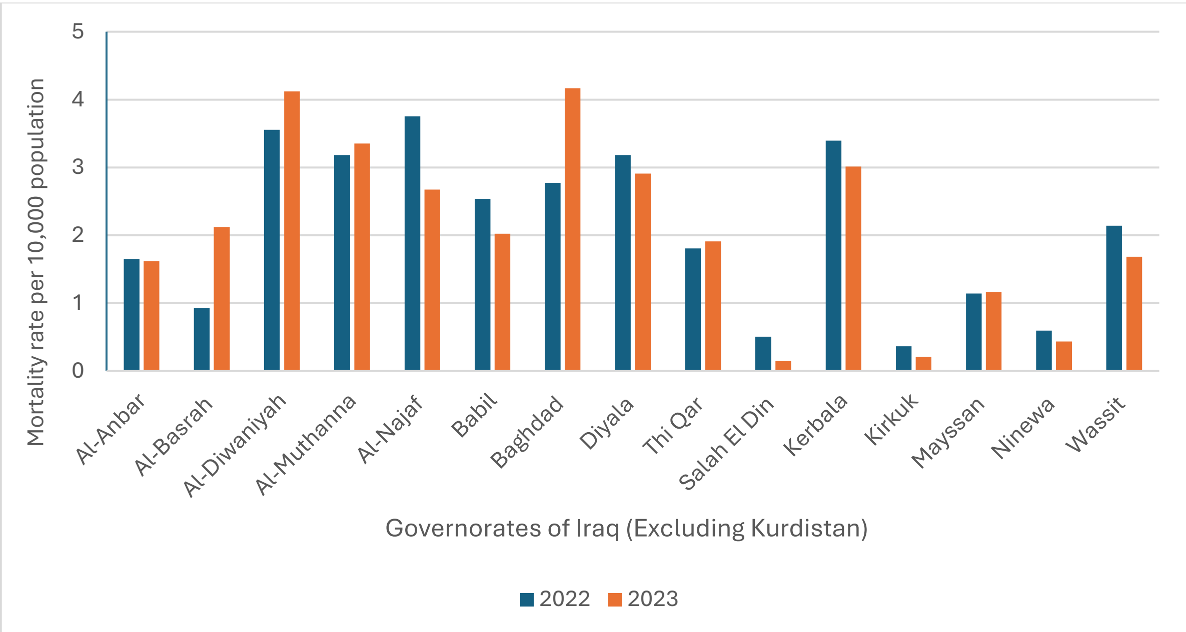

Figure 14 : Reported rates of Diabetes Mortality in Iraq per 10,000 population in 2022 and 2023

Recommendations for Improvements

The available data provides an insight on potential risks to hospitalization and death from climate sensitive diseases in Iraq. This data has to be interpreted with caution as suggestive and not definitive since there is no direct linkage with daily and annual temperature data to properly correlate the exposure with the outcome. Therefore, recommendations for improvement in understanding this correlation require the following:

- Despite the limitations of available data, some climate sensitive diseases seem to be predominant in certain governorates, especially in the South of Iraq, and these are the same governorates that are exposed to extreme heat events in the past decades. Most notable is Al-Basrah governorate that is vulnerable to infectious diseases, extreme temperatures, and weak health care systems. There should be special effort by the Iraqi government and National Health Plan to prioritize more vulnerable regions to these diseases.
- There is a need for several decades of health outcome data to be correlated with the increasing temperatures trends, as temperature is the main climate exposure in Iraq. Further analyses with longer-term health data trends in the future are needed. Modelling health and climate data to project future trends is possible, but it still requires enough data points beyond just two to three years. Daily data of health outcomes and temperatures is the gold standard in determining these associations.
- The data provided by the Iraqi MOH did not include the three Kurdistan Region Governorates of Al-Sulaymaniyah, Erbil, and Duhuk. This limits comparison between these governorates and the rest of Iraq, especially that temperature extremes vary between the North and the South which would have allowed comparison of the relevant health outcomes described above.
- The risk of climate change, especially extreme temperatures in Iraq on the spread of deadly infectious diseases, and the hospitalization and death from chronic diseases requires special attention and should become a priority in the Health National Adaption Plan for Iraq.
- To enable better planning, more data monitoring, multisectoral committees, and relevant prevention, many policies and interventions should be implemented to prepare Iraq for the coming decades. In the final section of this report several case studies are presented provide potential paths and scenarios for policy makers in Iraq to fully develop a plan to address climate change health impacts and identify the areas of most vulnerability in the health care system.

Pathways to Address Climate Change and Health

According to the WHO assessment of the Iraq National Health Response to climate change and adaptation, the health systems' capacity to withstand climate change extreme events through adaption is underdeveloped or nonexistent across different established indicators.[94] According to the 2021 report, there was National Planning for health and climate change and no assessment of vulnerability and adaptation of the health system. Although there are foodborne and waterborne disease monitoring in place, these are not geared towards climate change for early prevention strategies for vulnerable communities. There is no emergency preparation for extreme climate events. The human capacity to address these does exist from an older cadre of well-established career civil servants in the different sectors but with limited training due to the wars, sanctions, and civil strives for decades as well as limited resources for such capacity building.

Based on key stakeholder engagement during workshop organized by UNEP in July 23-26, 2024 case studies were developed based on input and descriptions from representatives from several ministries from Iraq who attended. Accordingly, four areas as opportunities for action are developed.

- Develop a Health National Adaptation Plan (HNAP) for Iraq
- Strengthen multisectoral collaboration on health and climate change
- Strengthen integrated risk surveillance and health early warning systems
- Build climate-resilient and environmentally sustainable health care facilities

Develop a Health National Adaptation Plan (HNAP) for Iraq

The presence of a Health National Adaptation Plan (HNAP) is critical for channeling resources, expertise, and building local capacity to address short and long-term impacts of climate change on

94 World Health Organization. (2022, June 1). Crimean-Congo hemorrhagic fever - Iraq. Disease Outbreak News. https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON386.

health. This encompasses all points of multisectoral collaboration, resilience health care facilities, and monitoring and early warning systems. It would focus on building and developing human capacity regarding health in all institutions not just the ministry of health. The environment, agriculture, water, and the work of other ministries in the area of climate change all have direct and indirect health impacts and should have an office or staff trained in understanding the connections to human health.

Another important component of the Health National Adaptation Plan (HNAP) is the provision of financing and support (federal budget, support and international cooperation). This should be distributed according to the vulnerability level at each geographical location, which would require spatial data driven policies and decisions.

An often-neglected component is the social norm and behavioral change needed by the populations at the local and national levels through well designed media campaigns and interventions. These changes could take the form of an environmental citizenship guide and focusing on the methodology for modifying population behavior towards the effects of climate change and adaptive capacity at the individual and family level, based on the population policy document in Iraq. Partnerships with academic research institutions and centers to lead the preparation of studies selected by the Ministry of Environment, Health, Agriculture, Water Resources, etc., will make it feasible to implement the Health National Adaptation Plan (HNAP) as part of government programs.

An Health National Adaptation Plan (HNAP) is considered a national priority for Iraq with regards to the health sector to move forward in limiting the effects of climate change. Iraq is currently in the process of preparing a national adaptation plan, which includes (14) sectors, including the health sector, which will present this plan by the end of 2024. Current work is also underway to prepare a local adaptation plan, which includes (6) priority governorates with regards to adaptation to climate change.

Below are case studies demonstrating how might Health National Adaptation Plan (HNAP) be activated in Iraq with specific examples. The case studies should be part of the Health National Adaptation Plan (HNAP) overall plan guidelines and would be used as a starting point and not exclusively focus on the mentioned health risk factor within the Health National Adaptation Plan (HNAP). It is similar to a proof of concept before fully implementing the Health National Adaptation Plan (HNAP) nationally and across all sectors.

Case 1: Targeting a specific governorate that is most vulnerable as an example for implementing the Health National Adaptation Plan (HNAP) for the health sector.

As Health National Adaptation Plan (HNAP) would include multisectoral collaboration, as well as monitoring and surveillance to identify vulnerable communities, and least resilient health care sectors, by default it should include all four components proposed by the WHO as actions to address the gap. It should start with the creation of a strategy plan for 2-5 years and start with initial steps by working through one or a few governorates and localities. The lead would be the Climate Adaption Office in the Ministry of Health that would form a task force committee from all stakeholders to identify the priorities of health impacts. Given the many climate-sensitive health risks among vulnerable communities, it is advisable to focus on the highest risk health conditions in the designated governorate to pilot and start the Health National Adaptation Plan (HNAP). This will require several steps to implement the adaptation intervention needed for this governorate as follows:

1. In consultation with the task force members and based on available data, choose the governorate that has the highest recorded temperatures in the summer and least access to electricity.
2. Focus on heat-related illnesses in that geographical location. If no data exists, develop a plan to collect data from major health facilities, such as emergency admissions for heat related illnesses or deaths.

3. Create a spatial map of all health care facilities in that region with details about the resources available in terms of the number of health care providers, number of beds, supplies relevant to emergency heat-related illnesses, and access to electricity generators. This can include a site visit and Vulnerability and Adaptation Assessment of the Health Care facilities.
4. Identify the most vulnerable communities by correlating risks from high temperatures with limited health care facilities accessible to these communities.
5. Prioritize the most urgent resources needed, such as new electricity generators to guarantee access to health care during extreme rise of temperatures, or essential cooling facilities.
6. Build the capacity of health care providers about early signs of heat stroke and heat related illnesses and state-of-art treatment and approaches through targeted virtual and in-person training workshops.
7. Plan community outreach and awareness campaigns to educate the most vulnerable communities about signs and symptoms of heat stroke.
8. Include the local and international metrological stations, the Ministry of Electricity, Ministry of Finance, and other relevant ministries to be part of this focused adaptation plan for this governorate and location.
9. Carry out monitoring, evaluation, and reporting by having baseline and follow up assessments of the vulnerability of the health care facilities using the WHO guidelines for this assessment. This should include building up a database of the data collected and impacts of the interventions on vulnerability and adaptation of the targeted health care facilities. This would benefit other health care facilities nationwide and expand it to other climate-sensitive health risks.

Case 2: A public-academic partnership in creating a national spatial climate vulnerability map as it relates to health.

The ultimate goal of the Health National Adaptation Plan (HNAP) is to be an evidence-based resource for climate-sensitive health risks to guide decisions, policies, interventions and resources. This will require the study of impacts of climate change on health through large scale research to determine impacts on current and future health from climate change. Analyses of health data and climate data from the past years and trends of the heatwaves and precipitation and extreme weather events at the national level are needed.

This requires data about the vulnerability of the different populations in terms of demographics for older adults, low-income communities, hotspots for vector borne diseases, urban heat islands, limited access to electricity, or primitive housing settlements in rural areas. It also requires data about climate exposure risks including higher seasonal temperatures, dust storms and air pollution, drought and water scarcity, or food insecurity, among others. Most relevant to health are climate-sensitive health risks such as heat stroke, hypertension, diabetes, renal disease, water-borne illnesses, vector borne illnesses, and mental illnesses. But these health outcomes are the most challenging to accurately document its spatial spread in Iraq given the limited digital records and the quality and availability of health records.

Nevertheless, there is a need to start this process to guide the plans for a national adaptation and vulnerability assessment using evidence through empirical data. The capacity to carry out such data collection requires expertise in demography, spatial analyses, epidemiology, big data expertise, meteorology, health services research, and other disciplines which might not be available to staff in relevant Iraqi ministries. That is why partnerships with academic experts, independent national consultants, and international UN and WHO organizations are needed. The following steps can be followed to reach the first phase of evidence-based Health National Adaptation Plan (HNAP) in Iraq.

1. Create a dashboard that includes all existing data for any of the vulnerabilities, exposures, or health risks by approaching the national statistical office in the Ministry of Planning, National Meteorological Administration, and Ministry of Health, respectively, to obtain such data.

2. Identify and recruit the experts from academia, industry, and international entities who are capable of carrying out the necessary collection, analyses, and interpretation of the different datasets at the national level.
3. Create easy-to-interpret spatial maps demonstrating the vulnerable areas across Iraq with a focus on climate relevant health risks in the most disadvantaged communities within each governorate in Iraq and creating a colored index according to the level of vulnerability.
4. Modify the Health National Adaptation Plan (HNAP) to be inclusive of the priority geographical locations with the least climate resilience in terms of health care access, income, infrastructure, and extreme climate events and conditions.
5. Roll out the interventions that are most cost-effective and within the limits of existing human capacity and financial resources.
6. Even if interventions will not target all risks in the first phase, the effort should be inclusive of all potential climate health risks of heat stress, food insecurity, water scarcity, polluted air from combustion of dust storms, risks for older population with chronic diseases, spread of vector borne diseases, and mental illnesses.
7. Relying on remote sensing and other modelling effort from international authorities in science and climate change when actual empirical data are difficult to obtain.
8. Planning on passive and active data collection to prospectively build the data and projections of risk in the future.
9. Consider the Health National Adaptation Plan (HNAP) a live document that is revised and changed annually according to the new developments from evidence collected from Iraq or regionally and globally.

Strengthen multisectoral collaboration on health and climate change

Climate change is the most diverse topic of our time and requires diverse approaches by multisectoral collaborations. Without the collaboration of every relevant public sector, as well as the private sector, and the population at large, the success of adaptation and mitigation of climate change impacts will be limited and unsustainable. For instance, health data is not sufficient without metrological data or land use and water data. The demographics of the populations, their access to energy and food, and the infrastructure and planning relevant to each geographical area require support from a multitude of sectors ranging from agriculture and water to meteorology and energy. Furthermore, this type of collaboration involves the distribution of institutional roles (legislative authority, executive authority, supervisory authority, judicial authority), according to relevant responsibilities as they relate to climate change and health. The Health National Adaptation Plan (HNAP) must be linked to the National Adaptation Plan to leverage mitigation efforts that will have health co-benefits. There is already a multisectoral effort regarding climate change in Iraq, which has to be evaluated to learn what is working and what is not. Revising the collaborators and extending the contributions to new entities, including the private sector, is one such strategy. The multisectoral committee can have specialized subcommittees to tackle specific problems and be more efficient as a process to tackle climate change health impacts. Exchange of data among the different stakeholders and their respective sectors is critical for success of Iraq's Health National Adaptation Plan (HNAP) and any other policy or intervention relevant to climate change. The following three case studies demonstrate this type of multisectoral collaboration.

Case 3: Health co-benefits of mitigation of climate change by urban and agricultural waste management

Although Health National Adaptation Plan (HNAP) strategies are focused on health systems and climate relevant health impacts, it can be linked to other climate mitigation efforts nationally.

The following steps can be taken to address this as part of multi-sector collaborations.

1. Include legislators and industry in the national committee to address waste management to enact clear and precise legislation that will enforce any laws and take into consideration the cooperation of major industries.
2. Management of the waste sites and landfills through recycling of waste and creating an industry with circular economy to support the sustainability of this recycling.
3. Ban agricultural and waste burning with severe financial penalties for industry and regular offenders.
4. Utilize landfill sites to generate energy without pollution.
5. Address environmental justice among neighborhoods and residents near the landfill sites and relocate the sites, residents, or create green zones around the landfills to limit pollution and put barriers to protect the soil and underground water from leaching contaminants.
6. Carry out an assessment of the damage generated by poor waste management through air, water, and soil analyses and monitoring.
7. Launch aggressive campaigns for education to address upstream sources of waste to limit the level of waste and prevent it from reaching landfills (for example creating composting solutions for industry and consumers).
8. Continuous monitoring of existing and new landfills to determine current human health and ecological damage and to generate data projections to enforce existing and future laws as well as use the data to provide evidence to enforce penalties on polluters.
9. Include water waste from industry, and the health sector within this effort given its impact on marine life and the food chain that would impact human health locally and globally.

Case 4: Transformation towards public transportation and electric vehicles (EV) to create a multisectoral win-win in support of climate change mitigation and adaptation.

A common transportation method in downtown Baghdad and many other areas in Iraq is the two-passenger scooter (known in Iraq as the tuk-tuk). This is a recent mode that resembles a very old and traditional transportation by horses up till the 80s in some areas in Iraq. These scooters can easily be converted from diesel and gas to electric with different battery capacities that can haul up to 4 passengers. Similarly, the main modes of public transportation in Iraq are private vans and minibuses that are polluting and uncomfortable. With proper incentives a rapid switching of owners to electric versions of these minibuses can be made possible. The transportation shift must be accompanied by urban planning and allowing bike paths and walking paths. The collaborative nature of ministries of urban planning, health, finance, and local policy makers with private industry, academia, and community is a must for success of transition of transportation. The health sector has a major role in leading by example and transforming their many fleets of vehicles to EV. Each ministry can install solar panels enough to charge their fleet cars on site and demonstrate a return in such investments within a few years. Below are some of the steps that can be followed in such scenario at a single city, governorate, or nationwide.

1. Develop the infrastructure for energy efficient transportation such as buses and cars EV charging units at the location of ministries.
2. Carry out cost-effectiveness analyses for switching to clean energy sources to charge EVs including health benefits from lower air pollution.
3. Require all new purchases of transportation by ministries to be electric cars
4. Incentivize citizens and especially private taxis to buy EV through waiving of taxes, replacing their current cars, and coordination with banks to provide them interest free government loans.
5. Long term planning for electric rail and buses to replace public transportation in urban areas and limit gas operated cars in such areas by requiring fees for cars entering these zones in the city, which is successfully practiced in many major cities around the world.

6. In low-income areas that cannot afford electric cars, or it is not possible to rebuild the urban infrastructure, provide electric bikes for rent or for purchase in small amounts over extended periods to make them affordable to everyone.
7. Develop a nationwide media campaign in cooperation with community leaders about the benefits of active transportation for health and chronic disease prevention and create a safe environment and pathways for walking, running, and biking.
8. Incentivize the private sector and national industry through joint investments and tax-free imports to produce low carbon emission transportation such as bikes, scooters, and EV car assembly.
9. Engage the academic and research community in documenting the physical and mental health benefits from active transportation through physical activity and access to green space and clean air.

Case 5: Ecological rehabilitation of the marshes in Southern Iraq in support of One Health.

The marshes area in Southern Iraq is a historical wetland ecosystem area and a UNESCO heritage site. It has been there for millennia and were essential for the survival of humans (known as the Marsh Arab) living there and a variety of animals such as local water buffalos, fish, local birds, and a variety of other animals that some have become extinct.[95] They also act as a natural flood management system during the Spring and overflow of the Tigris and Euphrates rivers that feed them. They are used to filter contaminants before water flows into the Arabian Gulf. It was for centuries a main source of rice growing lands and a major source of income in the agricultural sector. That is why it is a demonstration of the concept of One Health which is defined as: a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment.[96]

Even after it was drained for political reasons in the 1990s and re-flooded for restoration in the last 20 years, its decline is now a symptom of climate change impacts. Its delicate ecosystem between ecology, humans, and animals is severely undermined by drought, extreme heat, limited water flow in the Tigris and Euphrates, and the migration of the people who lived there. It has become an area with severe shortage of water resources and the deterioration of its quality, a declining standard of living for the Marsh Arabs, poverty, food insecurity and malnutrition, and regular migration to urban areas. As a result of the death of fish and the death of water buffaloes and its relationship to health of children and pregnant women, and sustainability of the lifestyle of the people, there is widespread malnutrition, deteriorating maternal health, and spread of diseases. Therefore, there is a direct impact of climate change on this area that requires a multisectoral collaboration by Iraq officials, which should include the Ministry of Health and a focus on the social and health wellbeing of the people who live there. The environmental refugees from the marshes are creating a humanitarian crisis from their displacement and burdening health care and other infrastructure and services elsewhere in Southern Iraq.

The steps that can be followed to address this include the following steps.

1. Create a specialized multisectoral permanent subcommittee to be part of the National Adaptation Plan and linked to the Health National Adaptation Plan (HNAP).
2. Review all existing data regarding water, temperature, fishery and wildlife, agriculture, demographic and health indicators for the marshes region.
3. Send a team of public health, water, and agricultural specialists to fill in the gaps of existing data to determine the main health risks and their sources from water, animals, and land contamination.

95 Richardson, C.J., Reiss, P., Hussain, N.A., Alwash, A.J., & Pool, D.J. (2005). The restoration potential of the Mesopotamian marshes of Iraq. Science, 307, 1307–1311.

96 Centers for Disease Control and Prevention. (2024). One Health. https://www.cdc.gov/one-health/about/index.html.

4. Develop spatial maps to determine the most vulnerable communities and areas within this fragile area, with a focus on infectious diseases, maternal health, child malnutrition, and chronic diseases among the elderly.
5. Develop immediate and long-term adaptation interventions to address the priorities of access to energy, water quality, and health care access that are most relevant to heat, drought, and sandstorms.
6. Carry out a national media campaign to raise awareness about climate change health impacts using the marshes as a prime example of immediate impacts and the need for action towards climate resilience and adaptation.
7. Develop solutions for the displaced populations in terms of housing and access to services and plan to resettle them back in the marshes or in areas that can ensure their support in the immediate future.
8. Seek local and international expertise, political support, and funding through the loss and damage funds for ecological restoration that starts to re-establish the damaged ecosystem based on scientifically known methods.
9. Create an annual international cross-sectoral conference that includes experts and scientists on climate, health, ecology, cultural and heritage, water, and agriculture with the participation of Iraqi officials and decision-makers to highlight the consequences of climate change on people, animals, and the planet.

Strengthen integrated risk surveillance and health early warning systems

The success of climate change adaptation depends on the collection of data. Without data for surveillance, risk, or early warning, there is limited understanding of the needs for interventions and their population impacts. Acquiring good quality data is what made the developed world realize the magnitude of the climate change problem. The assessment of health impacts from climate change is more recent compared to the ecological and planetary impact assessment of climate change, which explains the delay in addressing the health risks through adaptation. For example, most countries do not have early warning systems for heatwaves and at best depend on ad hoc meteorological communications about higher-than-average temperatures but without contingency plans on what to do to help the most vulnerable in society. Traditionally, at the global level, most of the data collection and analyses is done in collaboration with academic or research and surveillance entities as consultants to government entities and departments. The simple reason for this collaboration is the limited level of human capacity available to these government entities to carry out large scale and sophisticated assessment and data collection. To determine long term projections of climate change at a governorate or national level, a team of data and climate scientists need to work together to create these models to be specific to the government. Additionally, these models are always updated and require advanced skill sets that few people or groups have around the globe. If the association between these models with health risk (such as mortality or hospital admissions, or cost-benefit analyses) is needed then this introduces yet another layer of complexity and required skillsets and capacity. In such cases there might be a need to seek international experts as consultants to train local technical staff or those in academia to build local capacity for the sake of sustainability. Therefore, government multisectoral collaboration is needed for all work of climate change but this extends to outside the government to include academia and the private sector when it comes to data collection, monitoring, and surveillance. There is a long-term investment in capacity building at the national level which will require academic institution partnerships. In the following two case studies the steps needed to create a climate resilience index, and a surveillance and early warning system are described.

Case 6: Create a national climate resilience index to geographically focus the resources and effort for adaptation to climate change health impacts.

Prepare a complete database according to population demographic indicators and economic, social, and environmental indicators. This would include the design of survey forms that target the different sectors and include variables related to climate change, and health and medical sector, with the importance of adopting indicators according to a scientific approach that allows the government to measure the geographical gap in climate resilience at all levels. These levels include access to health care, income levels, employment status, percentage of elderly or those with chronic diseases sensitive to climate, localities with historically high temperatures, flooding risk, frequent sandstorms and high levels of PM2.5 pollution, and other indicators. The framework for monitoring and reporting and documenting health will cover all types of municipalities and geographical designation from the smallest town, municipality, city, and governorate levels with the priority for governorates with climate vulnerability. The adoption of a participatory action plan requires civil society organizations that can identify the targeted governorates and the most vulnerable communities in these governorates. The High Commission for Human Rights and relevant ministries, including the Ministry of Environment teams, can contribute to producing qualitative reports to measure indicators of progress and decline in environmental human rights work within the issue of adaptation in the health sector. The following steps are an example of how to proceed in creating the climate vulnerability index

1. Identify the national expertise needed to collect, analyze or interpret the data and monitoring system and build the capacity through international training opportunities.
2. Purchase the software and equipment needed to initiate the data collection and monitoring.
3. Collaborate across relevant government sectors and stakeholders to create databases from all areas which are shared and accessible within the standard international norms of protection of privacy.
4. Create a regular monitoring mechanism and update the collection process every 3-6 months for long-term prospective analyses.
5. Secure financial resources for academic partnerships for high level advanced analyses and evaluation of the monitoring and surveillance program, as well as peer reviewed publications, with special emphasis on spatial analyses for decision making.
6. Create a secure public facing platform and website to allow the public nationally and globally to access tables and results from this monitoring system.
7. Engage the community organizations and nongovernmental organizations from the identified lowest resilience geographical areas in decision making and general education and solutions to climate change related health impacts and resilience.
8. Transform the data on evidence-based policies and update the Health National Adaptation Plan (HNAP) to highlight the interventions needed to address the relevant climate vulnerabilities, for example creating cooling sites in neighborhoods with low-income populations identified in geographical areas with record summer temperatures.
9. Reach out to international organizations for collaboration and creating regional interest in sharing and aggregating data for regional approaches and solutions to climate change health impacts.

Case 7: Early warning system for dust storms

Dust storms (DS) are increasing in frequency at the global level and one of the main sites for generation of these DS is Southern Iraq desert areas. Although all desert is prone to become the source of DS, for reasons yet not fully understood, the certain geographical areas in the Sahara deserts in Mali and Chad deserts and in the Arabia Peninsula desert have been known to be a major source of DS. DS is directly related to ecological unbalance and disturbance of surface soil that leads to easier uplifting of the sand into the air based on certain weather conditions of pressure, temperature and wind combinations. It is therefore seasonal and most of the DS in Iraq happen during the Spring. The health consequences are well documented in terms of impact on those with existing chronic airway diseases such as asthma and chronic obstructive airway diseases[97], as well as high risks from traffic accidents due to limited visibility.

97 Kanatani, K.T., Ito, I., Al-Delaimy, W.K., Adachi, Y., Mathews, W.C., Ramsdell, J.W., & Toyama Asian Desert Dust and Asthma Study Team. (2010). Desert-dust exposure is associated with increased risk of asthma hospitalization in children. Am. J. Respir. Crit. Care Med., 182, 1475-1481.

In addition, it has been shown that dust particles in DS carry microorganisms that attach to the particles and move thousands of miles across the globe.[98] The impact of carrying these microorganisms on human health is still not fully understood. Pollen and allergens are also carried by dust particles and are additional risk factors. With dust storms increasing in frequency from 120 to 300 per year between 2010 and 2020, the impacts on health are going to be more significant and require proper monitoring, preparation, and adaptation of health care systems. Although the events of dust are being mitigated though restoration efforts in the desert by planting native plants that preserve the soil crust and minimize the uplifting of dust, this is a long-term and expensive strategy. Short-term solutions are needed to minimize the impacts of dust storms on health. The following steps are suggested to address this case study of DS and health impacts.

1. Identify and collect the historical records and trends of DS and methods of measuring these events in the past decade or more.
2. Collaborate with meteorologists from Iraq and internationally (such as World Meteorological Association) to create DS prediction models based on historical records with participation from nearby countries impacted by the DS such as Kuwait, Iran, Jordan, and Saudia Arabia.
3. Establish long-term DS and air pollution monitoring stations across Iraq by using advanced dust and particulate matter measuring equipment such as the LDAR to differentiate the type of air pollutants and identify DS more accurately.
4. Link the monitoring to an early warning system that is jointly run by the Iraqi Meteorological and Public Health sectors of the government to coordinate the health risks and how to reach the communities impacted from the DS.
5. Partner with academics and research institutions to scientifically utilize this data for the purpose of future planning, projections, and allocation of resources to adapt to DS that are expected to increase in frequency and intensity.
6. Carry out a planned health care emergency response to DS by supplying resources to health care facilities that are near a high concentration of people according to the regions with the highest frequency of DS.
7. Increasing the capacity and training skills of government staff in respective government units to be able to interpret and analyze data related to DS surveillance and creating live spatial maps to help the general public and decision makers be aware in real time about duration and intensity of DS and vulnerable communities.
8. Ensure financial sustainability and upgrade of the monitoring and surveillance systems by involving the private sector, international organizations, and government allocated funds.
9. Build on the DS focus to be inclusive of other combustion fossil fuel particulate matter for climate mitigation purposes by identifying their sources outside DS events.

Build climate-resilient and environmentally sustainable health care facilities

The health care sector and staff are at the forefront of climate change impacts on societies across the globe. Climate resilient health care facilities are identified as facilities that can adapt to the climate change impacts and overcome the challenges to continue to serve their patients at times of climate crises such as flooding, electricity outage, extreme heat, hurricanes, or other severe weather events. Environmental sustainability of these health care facilities is another component of the resilience of these facilities but also a long-term mitigation intervention to limit the contributions of the health sector to global warming and climate change.

Climate resilience requires rapid action and steps to reduce the negative effects of climate changes on the environment, society, health and economy. The rise in temperatures, the decrease in rainfall, and the

98 World Bank. (2019). SAND AND DUST STORMS IN THE MIDDLE EAST AND NORTH AFRICA (MENA) REGION. Sources, Costs, and Solutions. https://documents1.worldbank.org/curated/en/483941576489819272/pdf/SAND-AND-DUST-STORMS-IN-THE-MIDDLE-EAST-AND-NORTH-AFRICA-MENA-REGION-SOURCES-COSTS-AND-SOLUTIONS.pdf.

increase in dust and dust storms, are all incentives to start Time to Action, as launched by the Climate Change Secretariat during COP26 in Glasgow. The health care facilities have to have flexibility in responding to expected and likely climate changes as a result of extreme events and natural disasters. The units and wards can be converted to make-shift emergency wards in such emergencies, or the outbreak of cholera and other highly transmissible diseases means more quarantine measures should be implemented into existing non-quarantine hospitals. Displacement from flooding means that shelters are needed for families and large storage facilities or indoor garage space in health care facilities can be converted into temporary shelters with proper sanitation, water, and electricity. In the example of the COVID pandemic, storage of bodies of those who died from the pandemic overwhelmed mortuaries and created a health risk of transmission of improperly stored corpses.

The WHO Framework for Building Climate-Resilient and Environmentally Sustainable Health Care Facilities is a valuable resource for Iraq's Ministry of Health to help assess, monitor, and plan the health care facilities' resilience and sustainability to climate change in Iraq. The Framework is detailed in a step-by-step guideline to link the exposures from climate change with health risks and how to adapt the health care facilities through four major components as discussed earlier in the background section on vulnerability of health care facilities: 1) The health workforce capacity building through support of human resources and training to increase awareness and communication of the cadre and health leadership. 2) Water sanitation and health care waste monitoring, assessment, management, and support for health and safety regulations. 3) Energy assessment, management, and support for health care activities. 4) Adaptation of current and new infrastructure, technologies and products to be sustainable for health care facilities' operations. The Framework has many case studies from around the globe that serve as examples for countries like Iraq to develop a climate resilient and sustainable health care facilities and system that will address the specific climate change hazards to Iraq.

Case 8: Visit health care facilities to determine through climate vulnerability and adaptation assessment the climate resilient health care facilities

Iraq's infrastructure has been degraded systematically over decades of war, sanctions, civil unrest, and poor management and corruption by successive governments. Therefore, it requires an overhaul and serious attempt at addressing its capacity to withstand the insult of extreme weather events from climate change. Given the existing electricity and energy shortage all over the country, this would be the most vulnerable sector to outage from heatwaves for example. Electric generators have limited capacities and in heatwaves the increasing demands of air conditioning and extreme outdoor temperatures can lead to failure of the energy provision for these facilities that are critical to preservation of vaccines, operation room capacities, neonatal intensive care units, and many other facilities needed for a functioning healthcare system. This is why there is an urgent and immediate need for assessment of the most vulnerable facilities, as well as the weakest sectors within each facility across the nation. The following steps can highlight an approach that is to be led by the Ministry of Health, but requires the support of energy, planning, waste management, water, and other sectors to support health care facilities to withstand extreme climate events that can disrupt health care access to thousands or millions at times of crises.

1. Conducting a field survey of health centers and hospitals using the Vulnerability and Adaptation Assessment of health care facilities through adaptation of the climate resilience and sustainability framework described above.
2. Mapping the spatial data for all of Iraq and identifying the immediate needs, medium-, and long-term strategies to overhaul the health care facilities based on available resources.
3. Based on the mapping and joint multisectoral consultations, prioritize the purchase of sustainable and environmentally friendly equipment and technologies to limit greenhouse gas emissions but also increase climate resilience and sustainability.

4. Taking into account the conditions of sustainable and environmentally friendly green buildings when investing into new buildings and infrastructure.
5. Focus on emergency backup of energy and water that can support the health care facilities for several days to maintain the functionality of the hospitals and health care facilities during these emergency periods.
6. Training and preparing medical personnel and health care workers on potential risks and disasters, which must include mental health support for staff and patients.
7. Engage local neighboring communities in the training, planning, and provision of support as volunteers in cases of emergencies and disasters by having their representation in the committees and earlier planning phases.
8. Create a new and reliable emergency communication and monitoring system and mechanism to alert staff and health care providers to return to work from their time off or vacation to serve in emergencies.
9. Assign hospital administration and collaborating sectors from engineering, planning, water, and energy to be able to independently create makeshift shelters at the hospital as well as conversion of general wards to emergency or quarantine wards.

Case 9: Mapping health care facilities to be responsive to climate-sensitive infectious diseases outbreak surveillance and treatment

To increase the resilience of the health care system to address climate change sensitive infections, an assessment is needed of the current endemic and future epidemic spread of diseases in Iraq caused or exacerbated by climate change. Well-known diseases of dengue fever, malaria, West Nile, or Leishmaniases diseases are spread by mosquitoes and sandflies, while tick born deadly diseases such as hemorrhagic fever is related to sheep and other farm animals. Cholera is water-born and can spread through poor sanitation and contaminated water which becomes more common during higher temperatures. Increasing temperatures causes the spread of the insects that spread these diseases. Iraq has all of these diseases, and they are spreading into new areas as a result of hotter and longer summers. Although these are notifiable diseases and there is appropriate monitoring and planning for these conditions by the Ministry of Health, there is lack of understanding of future risks based on climate projections. The role of climate is usually neglected when trying to pinpoint the risk factors and causes of spread for these diseases. There is a need for a comprehensive assessment of these conditions with spatial maps and climate relevant hotspots. Health care facilities, staff, and infrastructure are needed to support the national responses for these conditions at the local level. The following steps describe the approach that needs to be taken to plan a response within the Health National Adaptation Plan (HNAP).

1. Spatial mapping of the above-mentioned infectious diseases, or at least the top three in terms of number of cases and risk, to enable this data with climate and access to healthcare facilities.
2. Link spatial maps of the diseases to the heat maps in terms of average temperatures to identify geographical areas that are most vulnerable to spread of these climate-sensitive conditions.
3. A full assessment of primary, secondary, and tertiary referral health care facilities that are closest to the hotspots and epicenter for these infectious diseases in each governorate.
4. Provide rotating infectious diseases specialists to visit and train the local staff along with climate scientists about the association of these diseases with climate as well as measures for prevention and education.
5. Provide workshops and training for local communities and their leaders in the form of townhall meetings to discuss the diseases and their risk and prevention measures, such as wearing double gloves when cutting animals and reporting early signs of hemorrhagic fever disease.
6. Engage the research community to carry out population studies to determine additional risk factors and interventions for prevention of the spread of these diseases in the communities.
7. Risk reduction of vector borne diseases through collaboration with other sectors in waste management and sanitation as well as local municipalities develop long-term sustainable plans to undermine these vectors' breading grounds.
8. Provide medications, testing kits, intravenous fluids, and other resources at every health level in the areas of recurrent reporting of these climate sensitive diseases.

9. Evaluate the economic and health benefits of these early interventions in terms of the number of prevented diseases, hospitalization, and mortality reduction, with the help of external evaluators, epidemiologists, and economists, to encourage further investment in these actions for these vulnerable communities and regions.