MONGOLIA'S

FIRST BIENNIAL TRANSPARENCY REPORT

Under the United Nations Framework Convention on Climate Change and the Paris Agreement

CCRCC

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Publication Title:

Mongolia's First Biennial Transparency Report under the Paris Agreement submitted to the United Nations Framework Convention on Climate Change

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- Ministry of Environment and Climate Change
- Climate Change Research and Cooperation Centre (CCRCC)

In Collaboration With:

- Ministry of Foreign Affairs
- Ministry of Energy
- Ministry of Food, Agriculture, and Light Industry
- Ministry of Road and Transport Development
- Ministry of Construction and Urban Development
- National Statistics Office
- National Climate Change Committee
- National Agency for Meteorology and Environmental Monitoring (NAMEM)
- Information and Research Institute of Meteorology, Hydrology and Environment (IRIMHE)
- General Authority for Land Administration Geodesy and Cartography (GALAGC)
- National University of Mongolia
- Mongolian University of Life Sciences

Notes on Using This Document:

As a developing country Party to the United Nations Framework Convention on Climate Change (UNFCCC), Mongolia is obliged to submit its Biennial Transparency Report (BTR) every two years, with the first submission to the UNFCCC by 31 December 2024.

The BTR presents Mongolia's Greenhouse Gas (GHG) Inventory from 1990 to 2022, projections of GHG emissions and removals up to 2030, and planned, adopted, and implemented mitigation actions till 2030.

This document was prepared in accordance with the UNFCCC modalities, procedures, and guidelines (MPGs) for the Enhanced Transparency Framework (annex to decision 18/CMA.1).

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ABBREVIATIONS

AD	Activity Data
AR5	Fifth Assessment Report
BAU	Business as Usual
BTR	Biennial Transparency Report
BUR	Biennial Update Report
CAAM	Civil Aviation Authority of Mongolia
CCD	Climate Change Department
CCRCC	Climate Change Research and Communication Center
CCPIU	Climate Change Project Implementation Unit
CF	Carbon Fraction
CRT	Common Reporting Table
DOC	Degradable Organic Carbon
DOCf	Fraction of Degradable Organic Carbon
DRI	Direct Reduced Iron
DCCIC	Department of Climate Change and International Cooperation
EBTs	Energy Balance Tables
EF	Emission Factor
ERT	Review Team
ES	Executive Summary
EAFs	Electric Arc Furnaces
F-gases	Fluorinated Gases
FOD	First Order Decay
FRDC	Forest Research and Development Center
FRL	Forest Reference Level
GALAGC	General Authority for Land Administration Geodesy and Cartography
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GLs	Guidelines
GWP	Global Warming Potential
HWP	Harvested Wood Products
iBUR	Initial Biennial Report
IE	Included Elsewhere
IEA	International Energy Agency

INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
JICA	Japan International Cooperation Agency
LEAP	The Low Emissions Analysis Platform
LEP	Linear Error Propagation
LULUCF	Land Use, Land-Use Change and Forestry
MDIs	Metered Dose Inhalers
MECC	Ministry of Environment and Climate Change
MEL	Monitoring, Evaluation and Learning
MOE	Ministry of Energy of Mongolia
MSW	Municipal Solid Waste
NAMEM	National Agency for Meteorology and Environmental Monitoring
NA	Not Applicable
NAP	National Adaptation Plan
NE	Not Estimated
NO	Not Occurring
NDC	National Determined Contribution
NGDP	National Green Development Policy
NID	National Inventory Document
NIR	National Inventory Report
MECC	Ministry of Environment and Climate Change
NOA	National Ozone Authority
NSO	National Statistical Office
ODS	Ozone Depleting Substances
QA	Quality Assurance
QC	Quality Control
RA	Reference Approach
RCP	Representative Concentration Pathways
SA	Sectoral Approach
SDGs	Sustainable Development Goals
SWDS	Solid Waste Disposal Site
TACCC	Transparency, Accuracy, Consistency, Comparability, Completeness,
UNFCCC	United Nations Framework Convention on Climate Change
UNCOMTRADE	United Nations Commodity Trade Statistics Database
XPS	Extruded polystyrene
CFCs	Chlorofluorocarbons
CH_4	Methane
CO_2	Carbon Dioxide
CO_2-eq	CO_2-equivalents

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HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
NF_3	Nitrogen Trifluoride
N_2O	Nitrous Oxide
PFCs	Perfluorocarbons
SF_6	Sulphur Hexafluoride

EXECUTIVE SUMMARY

Introduction

This report is Mongolia's First Biennial Transparency Report (BTR1) under the Paris Agreement (PA)[1]. The BTR1 is prepared in accordance with the Modalities, Procedures and Guidelines (MPGs) adopted with Decision 18/CMA.1[2], under the Enhanced Transparency Framework established by Article 13 of the PA, in accordance with the Guidance (Outlines and Tables) adopted with Decision 5/CMA.3 for operationalizing the MPGs for the enhanced transparency framework[3]. This BTR1 provides an information of climate change action in the light of the objective of the Convention and enhanced implementation thereof as set out in Article 2 of the Paris Agreement. The BTR1 also provides information on progress made by Mongolia towards the target for 2030 included in the National Determined Contribution (NDCs)[4] under Article 4, provision of financial, technological and capacity building support received. This report has included information related to climate change impacts and adaptation under Article 7 of the Paris Agreement.

National GHG Inventory on anthropogenic emissions by sources and removals by sinks of greenhouse gases

The GHGI has been compiled in line with the 2006 Guidelines of the Intergovernmental Panel on Climate Change (IPCC). To ensure the latest UNFCCC reporting requirements under the Paris Agreement, this national inventory compilation used the most recent version of the GHG Inventory Software, accompanied by the common reporting tables (CRT) in line with Decision 5/CMA.3. The inventories track four greenhouse gases: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and hydrofluorocarbons (HFCs), using Global Warming Potential (GWP) values for a 100-year period, based on the IPCC Fifth Assessment Report.

This Chapter provides inventory of greenhouse gas (GHG) emissions and removals over the period from 1990 to 2022, along with detailed descriptions of the data, methodologies and procedures used in calculating these estimates, sectors covered, and source categories included in the inventory. Activity data are mainly based on official statistics; international sources are used as needed. Line ministries and agencies are provided data when data are not in national statistics. The emission factors are mostly default factors from the IPCC guidelines with some country-specific values. Recalculations are carried out to maintain time series consistency. The national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases presented as part of this BTR1 and the annual greenhouse gas inventory information 1990-2022 in the Common Reporting Tables (CRT).

In 2022, national total GHG emissions were 48,509.11 Gg CO2-eq without LULUCF and increased by 102.12% since 1990 (23,999.56 Gg CO2-eq) and 16,603.67 Gg CO2-eq with LULUCF and increased by 305.42% compared to base year 1990 (-8,082.88 Gg CO2-eq).

1 The Paris Agreement: https://unfccc.int/documents/
2 The MPGs: https://unfccc.int/documents/
3 Outlines and tables: https://unfccc.int/documents/
4 The Government of Mongolia, 2019. Nationally Determined Contribution (NDC). Government Decree No.407. Ulaanbaatar

The agriculture sector is the highest contributor (55.2%) to the national GHG emissions, followed by energy (42.0%), IPPU (1.5%) and waste (1.3%).

In 2022 carbon dioxide (CO2) remained the largest contributor to national greenhouse gas emissions contributing 42.88% (20,487.43 Gg CO2-eq) to the national total in CO2 equivalents.

Fuel combustion activities in the energy sector accounted for the largest sources of CO_2 emissions, highlighting the sector's significant role in Mongolia.

Methane (CH_4) emissions represented 41.4% (20,078.08 Gg CO_2-eq) driven largely by activities within enteric fermentation and manure management in the agriculture sector.

Nitrous oxide (N_2O) emission comprised 16.4% (7,821.42 Gg CO_2-eq) with mostly agricultural soil in the agricultural sector. Hydrofluorocarbons (HFCs) represents 0.25% (122.17 Gg CO_2-eq) driven by IPPU sector.

CO_2 emissions increased by 42.88%, with LULUCF (from -19,990.59 Gg CO_2 to -11,418.00 Gg CO_2) and by 69.4% without LULUCF (from 12,091.85 Gg CO_2 to 20,487.43 Gg CO_2) during 1990-2022. GHG CH_4 and N_2O, increased by 127.12% and 154.99%, respectively. HFC gases are estimated from 2007 due to data availability, and it is increased from 0.25 to 122.17 Gg CO_2-eq during 2007-2022.

Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

Mongolia's updated NDC approved by the Government in 2019[5] and submitted to UNFCCC. The NDC outlined a series of policies and measures that the country commits to implement up to 2030, in the energy, industry, agriculture and waste sectors. The mitigation target of Mongolia's NDC will be a 22.7% reduction in total national greenhouse gas (GHG) emissions by 2030, compared to the projected emissions under a business-as-usual scenario for 2010. In addition, if conditional mitigation measures such as carbon capture and storage and waste-to-energy technology are implemented, then Mongolia could achieve a 27.2% reduction in total national GHG emissions. Along with that, actions and measures to remove GHG emissions by forest are determined, which set the total mitigation target of Mongolia as 44.9% of GHG emission reduction by 2030[6].

Development banks, international partners, and global climate finance mechanisms particularly the Green Climate Fund (GCF)—have played a critical role in supporting Mongolia's climate agenda across multiple sectors. Major areas of intervention include the development of solar and wind energy infrastructure, retrofitting public and private buildings with energy-efficient technologies, promoting climate-smart agriculture and sustainable livestock management, advancing afforestation, reforestation, and forest management initiatives, encouraging the uptake of electric vehicles (EVs), improving public transportation systems, and enhancing institutional capacities and community-based adaptation measures.

Despite these advancements, Mongolia's overarching climate policy framework remains fragmented and lacks a cohesive,

5 The Government of Mongolia, 2019. Nationally Determined Contribution (NDC). Government Decree No.407. Ulaanbaatar

6 First Submission of Mongolia's NDC.pdf. https://unfccc.int/sites/default/files/NDC/2022-06/First%20Submission%20of%20Mongolia%27s%20NDC.pdf

interdisciplinary implementation approach. Furthermore, infrastructure limitations continue to hinder the effective delivery of climate services and resources to rural and pastoral communities, particularly herders, who are among the most vulnerable to climate impacts.

Like many other developing countries, Mongolia has divided these NDCs into those commitments it will do independent of external assistance ("unconditional" commitments) and those they will do with external support ("conditional" commitments). These conditional commitments thus depend on funding by bilateral and multilateral donor partners and financial institutions (IFIs). The current financing gap to reach the NDCs in Mongolia is estimated at 11.7 billion USD (approximately 85% of GDP).

Information related to climate change impacts and adaptation under Article 7 of the Paris Agreement

Chapter 3 compiles Mongolia's progress in assessing and responding to climate change impacts in accordance with Article 7 of the Paris Agreement, focusing on observed climate trends, projected risks, adaptation measures, and institutional frameworks.

The country has already experienced significant climate impacts: since 1940, Mongolia's average temperature has increased by 2.52°C, exacerbating dzuds, droughts, permafrost degradation, and desertification, which in turn threaten food security, pastoral livelihoods, and water availability. The melting of permafrost and glaciers, surface water shortages, and soil and pasture degradation have been identified as particular challenges faced by Mongolia as a result of climate change. A substantial number of hazardous events, such as floods, dzud, and extreme weather, occurred in Mongolia in 2021 and 2022, resulting in widespread destruction and hundreds of fatalities. Approximately 22 deaths were caused by climate-related catastrophes in 2021, and 4 in 2022. The damages accounted about 2.5 billion USD in 2021 and 0.7 billion USD in 2021.[7] Future climate scenarios under SSP5-8.5 project a further increase of air temperature by 6.1°C by 2080, with extreme hot days and intense precipitation patterns, posing risks to population, ecosystems and infrastructure.

Due to a high degree of vulnerability to climate change, adaptation is particularly important for Mongolia. Therefore, the Action Plan for implementation of Nationally Determined Contribution (APNDC) was developed and adopted in July 06 2021 by the Resolution No.01/2021 of the National Climate Committee (NCC)[8]. The APNDC outlines a comprehensive, science-based strategy to strengthen national resilience to climate change in alignment with Article 7 of the Paris Agreement. The plan identifies 28 sectoral adaptation actions under 8 adaptation goals, with a strong focus on climate-vulnerable sectors such as water, agriculture, livestock, infrastructure, health, and disaster risk reduction. The APNDC aligns with Vision-2050, Mongolia's long-term development agenda and supports achievement of the SDGs through integrated and inclusive policy frameworks.

Mongolia is undertaking efforts to establish a Monitoring, Evaluation, and Learning (MEL) system under the National Climate Committee (NCC) to systematically track progress on climate change adaptation. To support

[7] Ministry oof Environment and Tourism (MET). (2024). Mongolia's State of the Environment Report 2021–2023. Ulaanbaatar

[8] Action Plan for implementation of Nationally Determined Contribution (APNDC) was developed and adopted in July 06 2021 by the Resolution No.01/2021 of the National Climate Committee (NCC)

the MEL framework, focal points for the Nationally Determined Contribution (NDC) were designated at both local and sectoral levels, with responsibilities including the coordination and compilation of adaptation-related outcomes.

To further support MEL implementation, the NDC Partnership, in collaboration with UNDP and FAO, deployed technical officers tasked with compiling progress updates and supporting periodic review reporting on the implementation of the NDC, including adaptation measures at the national level. However, due to disaggregated funding sources and fragmented institutional responsibilities, a comprehensive accounting of all adaptation measures has not yet been fully integrated into the MEL system. This gap limits the completeness and comparability of adaptation progress data and underscores the need for stronger coordination and standardized reporting mechanisms across sectors and stakeholders.

At the local level, climate adaptation is not yet systematically integrated into development planning through Local Climate Change Strategies, despite the availability of site-specific risk assessments. Nonetheless, development partners such as the Green Climate Fund (GCF), United Nations Environment Programme (UNEP), and Asian Development Bank (ADB) have supported initiatives in climate-resilient infrastructure, agriculture, and ecosystem restoration.

Despite progress, Mongolia continues to face challenges, including institutional fragmentation, limited adaptation finance, and data gaps, particularly in rural areas. To address these, the government is working to integrate adaptation into the Medium-Term Expenditure Framework (MTEF) and promote innovative financing mechanisms.

Mongolia initiated its National Adaptation Plan (NAP) in 2021, establishing a strategic framework to safeguard climate-sensitive livelihoods, preserve critical ecosystem services, and strengthen national and local resilience through inclusive, participatory, and locally driven adaptation measures.

Information on financial, technology development and transfer and capacity building support provided and mobilized under Articles 9-11 of the Paris Agreement

Chapter 4 addressed Mongolia's progress in mobilizing and utilizing financial, technological, and capacity-building support in accordance with Articles 9–11 of the Paris Agreement. Between 2010 and 2022, Mongolia mobilized approximately USD 2.5 billion in international climate finance to support mitigation, adaptation, and sustainable development objectives. In the period 2021–2022, USD 301.96 million was commited USD 116.8 million in grants, USD 179 million in loans, and USD 6.2 million in technical assistance with major contributions from multilateral and bilateral partners including ADB, GCF, Japan, and the World Bank. These resources supported key sectors such as energy, agriculture, water, and infrastructure.

In the area of technology development and transfer, Mongolia has prioritized low-carbon technologies in the energy, water, agriculture, and mining sectors. Initiatives include grid modernization, geothermal heating, solar and wind energy, smart irrigation, and clean mining technologies. Feasibility studies are ongoing to assess cost-effectiveness and applicability, with further support needed for scaling.

Between 2021 and 2022, Mongolia received an estimated USD 5.5–5.7 million in international climate capacity-building support. UNEP provided USD 2.64 million through the GCF Readiness Programme to strengthen NAP development, MRV systems, and institutional coordination.[9] FAO contributed USD 1.25 million via the CBIT project to improve transparency in the agriculture and land-use sectors.[10] UNDP, ADB, GIZ, and GGGI collectively supported NDC implementation, gender-responsive planning, and subnational climate action, while the NDC Partnership provided in-kind coordination support.[11,12,13] These efforts, led by former MET, enhanced Mongolia's institutional systems for transparency and climate action.

Despite progress, challenges remain, including financing gaps, limited data infrastructure, and institutional fragmentation. To address these, Mongolia is advancing innovative finance tools (e.g., green bonds, Article 6 carbon markets), improving policy coherence, and enhancing public–private collaboration.

Mongolia's efforts underscore its commitment to an integrated and climate-resilient development pathway, supported by robust international partnerships and forward-looking national policy reforms.

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9 UNEP (2022). GCF Readiness Progress Report – Mongolia (Jan–Jun 2022). https://open.unep.org/docs/gcf/MNG-RS-004-Mongolia-Jan-Jun%202022.pdf

10 FAO (2022). *Mongolia CBIT Agriculture and Land Use Transparency Project.* https://www.thegef.org/project/mongolia-cbit-agriculture

11 GGGI (2022). *Advancing Climate Resilience through Local Planning in Mongolia.* https://gggi.org/advancing-climate-resilience-through-local-planning-gggi-mongolia-hosts-climate-change-and-local-planning-forum

12 ADB (2022). *TA 6883: Accelerating Gender Equality in East Asia for an Inclusive and Green Recovery.* https://www.adb.org/projects/55023-001/main

13 NDC Partnership (2022). Country Engagement Support – Mongolia. https://ndcpartnership.org/country/mongolia

CHAPTER ONE: NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

1.1 SUMMARY

1.1.1. Background Information on GHG Inventories

In accordance with the Enhanced Transparency Framework (ETF) established under Article 13 of the Paris Agreement, all Parties are required to submit a Biennial Transparency Report (BTR) every two years, with the initial report due by 31 December 2024. Due to procedural delays associated with national internal review and validation processes, Mongolia submitted its First BTR on 10 August 2025.

Pursuant to Decision 18/CMA.1, the preparation of Mongolia's national greenhouse gas (GHG) inventory follows the MPGs, utilizing the 2006 IPCC Guidelines for National GHG Inventories.

The inventory includes estimates of emissions by sources and removals by sinks for four direct greenhouse gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFCs)—and two indirect gases: nitrogen oxides (NO_X) and carbon monoxide (CO). Perfluorocarbons (PFCs) were not included in this reporting cycle due to the unavailability of reliable national data and emission factors.

Table S 1. GHGs covered under each category in the national GHG.

№	Sector/GHG	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3
1	Energy	X	X	X				
2	IPPU	X			X			
3	Agriculture	X	X	X				
4	LULUCF	X	X	X				
5	Waste		X	X				

The inventory covers the time series 1990–2022 for CO_2, CH_4, and N_2O, and 2007–2022 for HFCs, based on the best available national data and Tier 1 and Tier 2 methodologies. Emission estimates are presented across the five key IPCC sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Land Use, Land-Use Change and Forestry (LULUCF); and Waste. Detailed information on methodologies, emission factors, activity data sources, and recalculations is provided in Table S.1 and the respective sectoral chapters.

This report presents comprehensive information on national greenhouse gas (GHG) emissions, including historical emission trends, detailed descriptions of source and sink categories, uncertainty estimates, recalculations, planned methodological improvements, and the quality assurance/quality control (QA/QC) procedures applied. Emission trends are reported by individual IPCC sector as well as for total national GHG emissions, expressed in carbon dioxide equivalents (CO_2-eq). Global Warming Potential (GWP) values with a 100-year time horizon, consistent with the IPCC Fifth Assessment Report (AR5), were used to convert non-CO_2 gases into CO_2-equivalent terms, as shown in the accompanying table.

Table S 2. Global Warming Potential (GWP)

№	GHG	GWP (CO_2 equivalents)
1	CO_2	1
2	CH_4	28
3	N_2O	265
4	HFC134a	1300
	HFC125	3170
	HFC143a	4800
	HFC32	677

1.1.2. Trends in total greenhouse gas emissions

The total GHG emissions in 2022 were 48,509.11 Gg CO_2 eq. without Land Use, Land-use Change and Forestry (LULUCF) and 16,603.67 Gg CO_2-eq with LULUCF. As shown in Figure S.1, emission with LULUCF is increased by 102.12%, without -305.42% compared to the emissions in 1990.

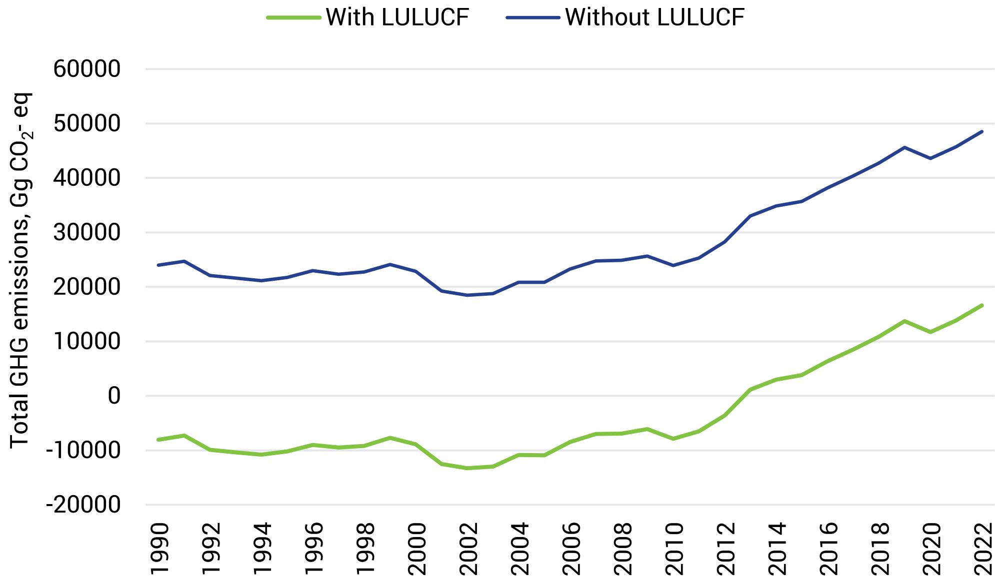


Figure S 1. Total GHG emissions trends in Gg CO2 eq (1990 to 2022)

The recalculated emissions due to use of GWP-AR5 resulted in increase of national total emissions without LULUCF in CO2-eq by1.2% in base year 1990 and 1.4% in 2020 (Figure S.1).

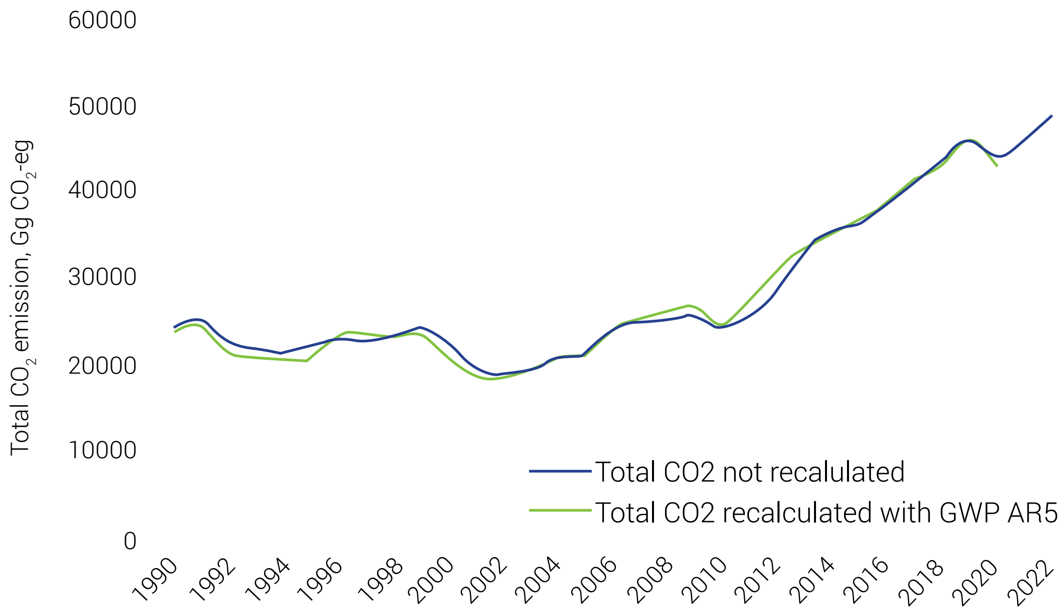


Figure S 2. Comparison of National total GHG emission with and without recalculations.

Carbon dioxide (CO_2) remains the largest contributor to Mongolia's total greenhouse gas (GHG) emissions, accounting for 42.88% of total emissions in CO_2 -equivalent terms, as shown in **Figure S.3.** It is followed by methane (CH_4) at 41.4%, nitrous oxide (N_2O) at 16.4%, and hydrofluorocarbons (HFCs) at 0.25%.

Between 1990 and 2022, CO_2 emissions increased by 42.88% when including removals from the LULUCF sector (from –19,990.59 Gg CO_2 to –11,418.00 Gg CO_2), and by 69.4% when excluding LULUCF (from 12,091.85 Gg CO_2 to 20,487.43 Gg CO_2). Over the same period, CH_4 emissions increased by 127.12%, and N_2O emissions by 154.99%.

HFC emissions, available from 2007 onward due to data limitations, increased significantly from 0.25 Gg CO_2-eq in 2007 to 122.17 Gg CO_2-eq in 2022.

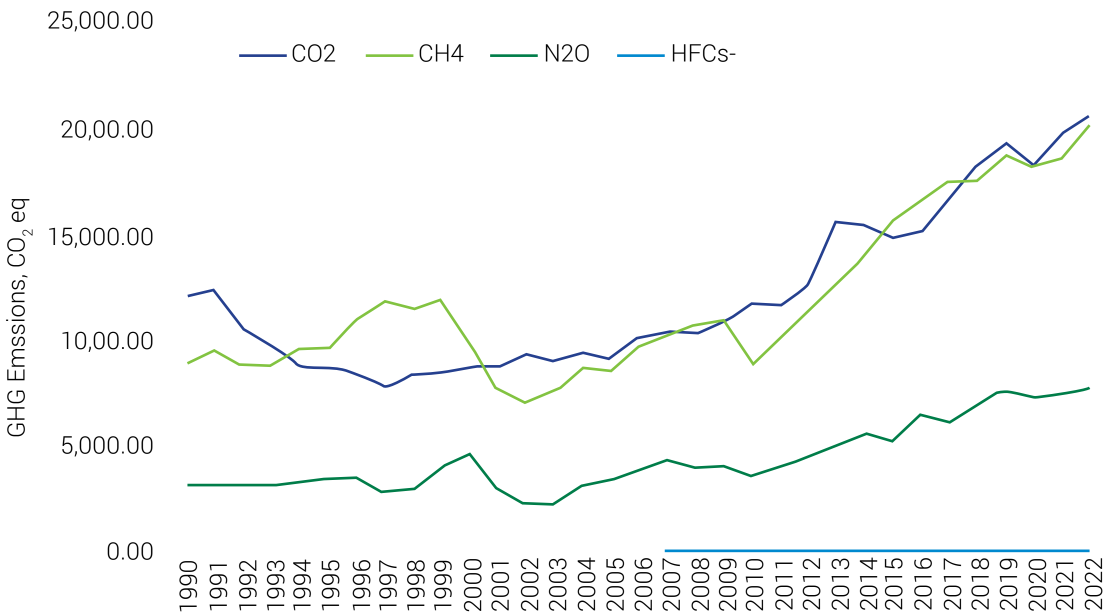


Figure S 3. Total GHG emissions by GHG type of gases, 1990–2022, in Gg CO2-eq

1.1.3. Emission trends by sector

In 2022, the agriculture sector remains the largest contributor to Mongolia's total greenhouse gas (GHG) emissions, with its share increasing from 47.9% in 1990 to 55.2%. The energy sector is the second-largest emitter, with emissions increasing by 68.52% over the same period. In 2022, GHG emissions from the Industrial Processes and Product Use (IPPU) sector reached 709.94 Gg CO_2 -eq, up from 262.12 Gg CO_2 -eq in 1990. Emissions from the waste sector also rose substantially, from 59.35 Gg CO_2 -eq in 1990 to 642.12 Gg CO_2 -eq in 2022. The Land Use, Land-Use Change and Forestry (LULUCF) sector continues to serve as the primary carbon sink, with net removals amounting to –31,905.43 Gg CO_2 -eq in 2022. Sector-specific emission and removal trends in Gg CO_2 -eq are illustrated in Figure S4.

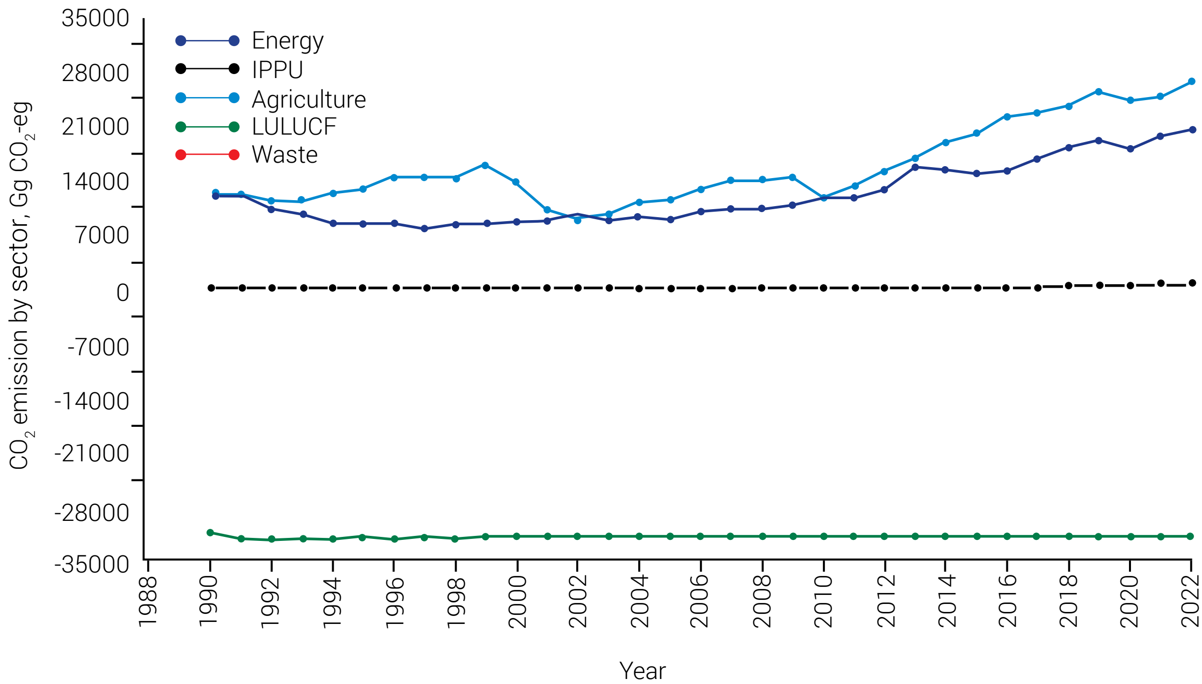


Figure S 4. Emission trends of all sectors of Mongolia, Gg CO2-eq, 1990-2022

1.1.4. Trend of gases

In 2022, carbon dioxide (CO_2) emissions predominantly originate from the energy sector, underscoring its central role in fossil fuel combustion and energy transformation processes. In contrast, methane (CH_4) and nitrous oxide (N_2O) emissions are primarily associated with the agriculture sector, largely driven by enteric fermentation, manure management, and agricultural soil activities (see Figure 3). Emissions of hydrofluorocarbons (HFCs) mainly arise from the Industrial Processes and Product Use (IPPU) sector, particularly from the use of fluorinated gases in refrigeration, air conditioning, and industrial applications.

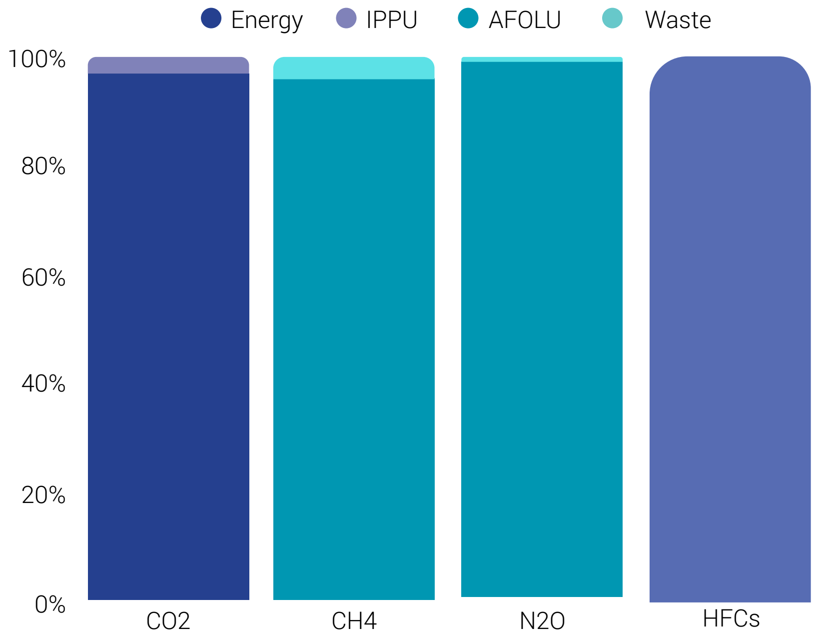


Figure S 5. Contributions of the individual sectors to GHG emissions in 2022

In 2022, carbon dioxide (CO_2) remained the principal greenhouse gas emitted in Mongolia, contributing 42.88% of total national emissions—equivalent to 20,487.43 Gg CO_2-eq. The predominant source of CO_2 emissions was fuel combustion within the energy sector, underscoring its structural significance in the national emissions profile.

Methane (CH_4) accounted for 41.40% of total GHG emissions (20,078.08 Gg CO_2-eq), with the majority arising from the agriculture sector. Enteric fermentation and manure management were the dominant emission categories, reflecting the centrality of livestock systems in the national economy and emissions landscape.

Nitrous oxide (N_4O) represented 16.40% of total emissions (7,821.42 Gg CO_2 -eq), primarily associated with agricultural soil management practices, including the application of synthetic and organic fertilizers, as well as crop residue decomposition.

Hydrofluorocarbons (HFCs), reported under the Industrial Processes and Product Use (IPPU) sector, contributed a relatively minor share—0.25% of total emissions, equivalent to 122.17 Gg CO_2-eq. These emissions were predominantly linked to refrigeration and air conditioning systems, with estimates available from 2007 onwards due to improved data accessibility.

1.2. NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

1.2.1. Overall responsibility for the national inventory

The National Climate Committee (NCC) was formally re-established by Government Resolution No. 350 dated 22 September 2022 as Mongolia's highest inter-sectoral and inter-ministerial coordination mechanism for climate policy. Chaired by the Deputy Prime Minister, the NCC provides strategic direction and oversight on national climate change mitigation and adaptation actions. It ensures the integration of climate objectives into national development policies and decision-making processes. Its composition includes sectoral Ministers, State Secretaries, and relevant Director-Generals from all key ministries and agencies, ensuring whole-of-government alignment with the country's commitments under the Paris Agreement.

The Ministry of Environment and Climate Change (MECC) serves as the national competent authority responsible for climate policy development, implementation, and coordination. It is the lead ministry for preparing and submitting official reports to the UNFCCC, including the National Communication, Biennial Transparency Report, and Nationally Determined Contributions. As per Article 24, Clause 2 of the Law on Air, the MECC is legally mandated to oversee the national GHG inventory system and reporting processes, and to appoint the national focal point to the UNFCCC.

At the operational level, the Climate Change Research and Cooperation Center (CCRCC), established under Government Resolution No. 181 of 20 May 2020, is responsible for the technical implementation of the national GHG inventory system. The CCRCC coordinates inventory compilation, methodological updates, capacity development, and QA/QC implementation in accordance with the IPCC Guidelines and the Modalities, Procedures and Guidelines (MPGs) under the Enhanced Transparency Framework. It operates under the oversight of the Division of Climate Change within the Department of Comprehensive Policy and Planning at the MECC and is functionally supervised by the national focal point for the UNFCCC. The institutional arrangement is presented in Figure I.1.

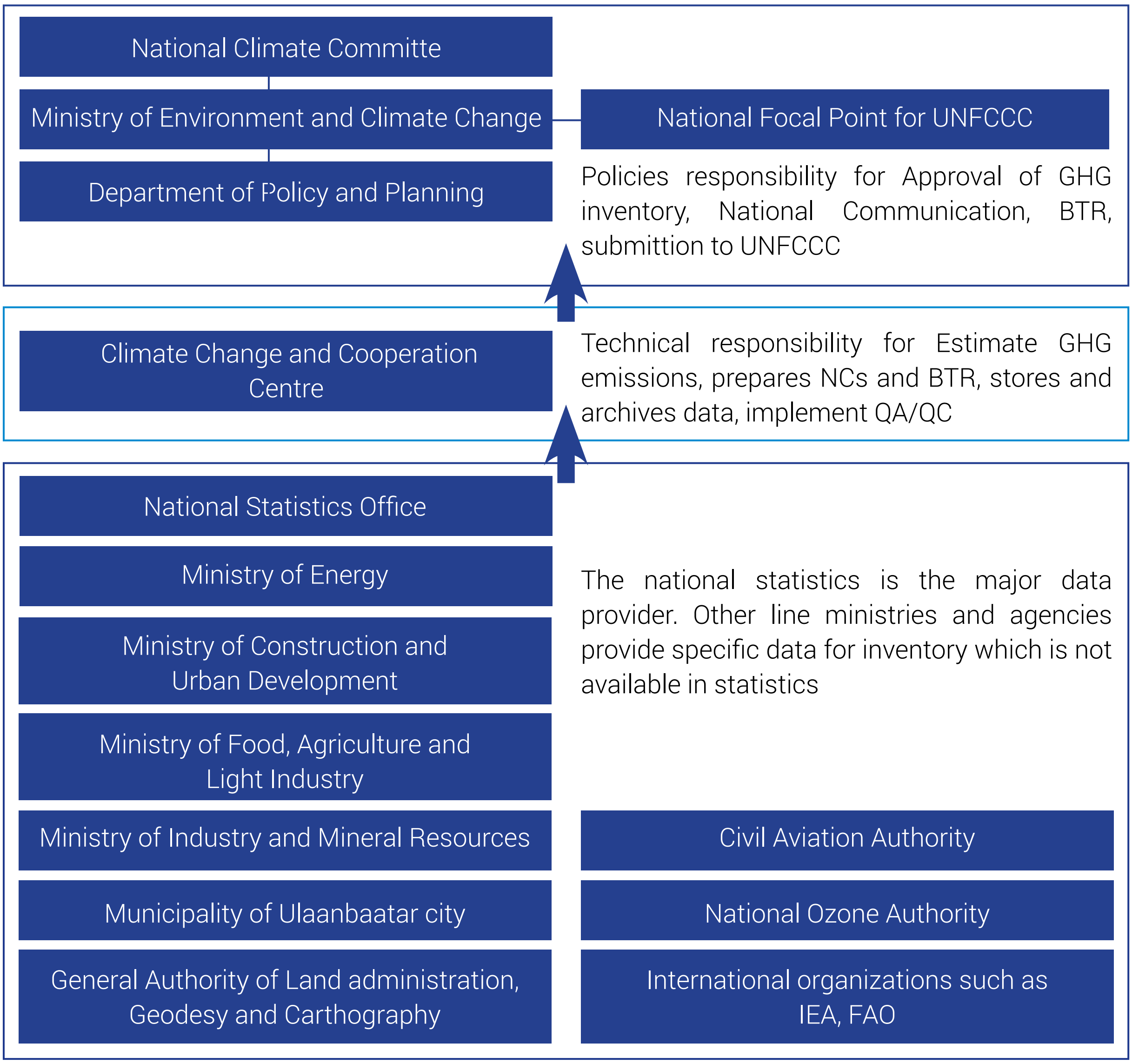


Figure I. 1. The institutional arrangements for compiling the BTR.

The National Statistics Office (NSO) serves as the primary provider of official data used in the development of Mongolia's national greenhouse gas (GHG) inventory. Supplementary sector-specific data required for GHG estimation—beyond the scope of NSO—are sourced from various governmental entities, including the Ministry of Energy; Ministry of Industry and Mineral Resources; Ministry of Food, Agriculture and Light Industry; General Authority for Land Administration and Cartography; National Ozone Authority; and the Civil Aviation Authority. These institutions provide activity data essential for estimating emissions and removals across sectors. In light of limited national budgetary allocations for climate reporting, the preparation of Mongolia's climate-related reports, including the GHG inventory, is supported through Enabling Activities financed by the Global Environment Facility (GEF) and administered by the United Nations Environment Programme (UNEP). Within this framework, the Ministry of Environment and Climate Change (MECC) designates a National Project Director to oversee overall project implementation and appoints a Project Coordinator to manage day-to-day operational and technical execution. A range of national institutions and expert teams contributed to the preparation of the First Biennial Transparency Report (BTR1). These efforts included conducting technical studies to identify sectoral constraints, gaps, and associated financial, technological, and capacity-building needs. The report also documents the support received and outlines additional resource requirements. Consultants and sectoral experts were selected through a competitive procurement process in accordance with the Law on Public Procurement[14], ensuring transparency, quality, and compliance with applicable regulatory standards.

The experts responsible for the sectoral inventories and the corresponding chapters and annexes in this report are provided in the table below.

Project Director: Department of Comprehensive Policy and Planning, MECC	
Project coordinator: Choikhand J (Ph.D), CCRCC.	
Sectors	Responsible expert(s)
Energy	Baljinnyam Sereeter (Ph.D)
IPPU	Jambajamts Lkhamjav (Ph.D) and Buyangerel Bodigerel
Agriculture	Munkhtsetseg Zorigt
LULUCF	Nandin-Erdene Geserbaatar
Waste	Enkhdul Tuuguu (Ph.D) and Buyangerel Bodigerel

1.2.2. Preparation of Inventory

The Climate Change Research and Cooperation Center (CCRCC) is the designated technical entity responsible for the full cycle of Mongolia's national greenhouse gas (GHG) inventory preparation and reporting. This includes establishing institutional arrangements, defining roles and responsibilities, and coordinating the systematic collection, validation, and analysis of activity data across all key sectors. CCRCC also leads the implementation and maintenance of the national Quality Assurance/Quality Control (QA/QC) plan, ensuring that inventory development adheres to the 2006 IPCC Guidelines, UNFCCC reporting requirements, and the Enhanced Transparency Framework (ETF).

[14] The Government of Mongolia. Law on Procurement of Goods, Works, and Services with State and Local Property Assets. Last amended in 2023

Sectoral inventories are compiled by qualified experts in energy, industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste. These experts validate data, apply and refine emission factors, and implement methodologies consistent with the IPCC's tiered approach.

The inventory process is cyclical and iterative, comprising five key stages: (i) planning and methodological improvement, (ii) data collection and estimation, (iii) report preparation and documentation, (iv) internal review and government approval, and (v) submission to the UNFCCC. These stages, shown in Figure I.2, support continuous improvement in transparency, accuracy, completeness, consistency, and comparability (TACCC).

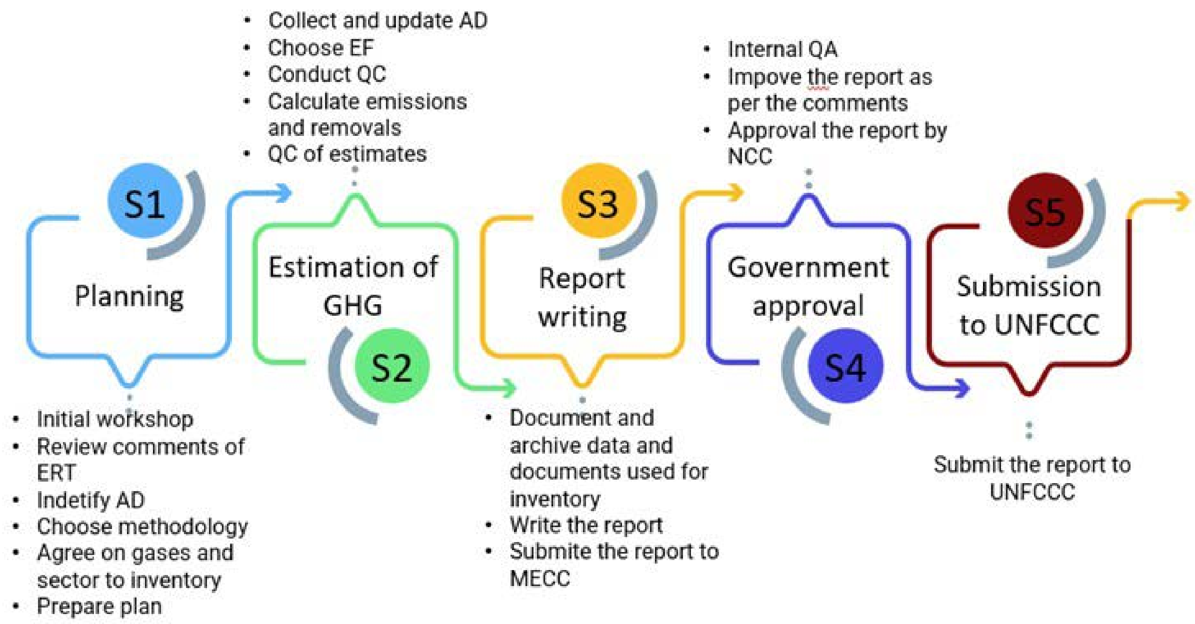


Figure I. 2. Schematic diagram of inventory cycle

Prior to the initiation of the national greenhouse gas (GHG) inventory cycle, CCRCC convenes sectoral working groups comprising technical experts from relevant government agencies, the private sector, academic and scientific institutions, independent consultants, and accredited non-governmental organizations (NGOs). These experts play a key role in supporting the preparation of the GHG inventory in accordance with IPCC guidelines. Additional specialists are engaged, as needed, to address sector-specific data limitations or methodological requirements.

The working groups are also responsible for reviewing and addressing technical recommendations from prior reporting cycles, particularly those provided through the Quality Assurance processes of the National Greenhouse Gas Inventory Management System and by the GHG Support Unit of the Transparency Division under the UNFCCC Secretariat. Each sectoral lead, in collaboration with the working group, prepares the emissions estimates and formulates an inventory improvement plan, which serves as the foundation for subsequent data collection, calculation, and documentation[15].

For this inventory cycle, the latest version of the IPCC Inventory Software was employed, in line with recommendations from the Expert Review Team (ERT) during the technical analysis of Mongolia's Second Biennial Update

15 UNFCCC Transparency Review is conducted in August 25-29, 2024.

Report (BUR2). Annual emission estimates were developed for the full time series from 1990 to 2022, ensuring consistency, transparency, and completeness. The Common Reporting Format (CRF) spreadsheets contain activity data, implied emission factors, and re-calculated emissions for each year. Emission trends are reported for individual GHGs and for total national emissions expressed in carbon dioxide equivalent (CO e), following the global warming potential values in line with Decision 18/CMA.1.

1.2.3. Archiving System

Archiving plays a fundamental role in maintaining the transparency, accuracy, and institutional continuity of the national greenhouse gas (GHG) inventory system, and is essential for enabling the development of subsequent inventories. The First Biennial Transparency Report (BTR1), along with its associated Common Reporting Tables (CRTs) and all supporting documentation, is systematically archived by the CCRCC.

All inventory-related files are stored on a centralized master computer in a dedicated directory titled "GHG Inventory," which is organized by inventory year and subfolders corresponding to relevant sectors and technical components. This structured digital repository ensures accessibility for authorized staff involved in the inventory process while facilitating institutional knowledge transfer and time-series consistency. The archive includes methodological documentation, sectoral activity data, emission factor references, calculation spreadsheets, QA/QC records, verification reports, internal reviews, and literature cited in inventory documentation.

To ensure data integrity and protect against unintended modification or loss, selected files are password-protected, and standard metadata and file naming conventions are applied. This archiving protocol is consistent with the Intergovernmental Panel on Climate Change (IPCC) good practice guidance and the requirements of the Enhanced Transparency Framework (ETF) under the Paris Agreement, thereby strengthening the credibility and reproducibility of Mongolia's national GHG inventory system.

1.2.4. Official Consideration and Approval of the Inventory

The Biennial Transparency Report (BTR1) and the associated national greenhouse gas (GHG) inventory are subject to formal approval by the National Climate Committee (NCC) prior to submission to the UNFCCC. The complete inventory datasets and supporting documentation are compiled by the CCRCC and submitted to the NCC alongside the BTR documentation for endorsement.

As per the original timeline, the national GHG inventory was scheduled to be finalized by 31 December 2024, allowing for approval and timely submission in accordance with the UNFCCC reporting deadlines. However, delays in completing the internal review and national approval process have led to the rescheduling of the submission date to 31 December 2025.

Prior to NCC endorsement, the draft BTR1 were submitted to the Ministry of Environment and Tourism (MET) for technical review. MET established a review working group composed of experts from various relevant sectors to assess the draft report. During the initial meeting, working group members were assigned specific chapters of the BTR1 for review and were requested to provide technical comments and suggestions for improvement. Subsequent meetings were held to evaluate whether the comments had been adequately addressed. Upon confirmation, the revised BTR1 was submitted to the MET in December 30 2025 for final approval.

1.3. METHOD AND CROSS-CUTTING ELEMENTS

1.3.1. Methodologies, Parameters and Data Sources

The inventory was prepared in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006)[16]. The inventory calculated by the most recent version of the GHG Inventory Software. Results are reported in CRT in line with Decision 5/CMA.3. Global Warming Potential (GWP) values are taken from the IPCC Fifth Assessment Report (AR5). These methodological choices ensure that national submissions meet the latest UNFCCC reporting requirements[17]. For the estimation of Mongolia's GHG inventory used mostly Tier 1 and used Tier 2 where possible. An overview of the methods and EFs applied for the calculations of the emissions is presented in the table below.

Table I. 1. Methods and emission factors used.

Source and Sink Categories		CO_2		CH_4		N_2O		HFCs	
		Method	EF	Method	EF	Method	EF	Method	EF
1.	Energy								
1.A	Fuel Combustion	T1, T2	D, CS	T1	D	T1	D	-	-
1.A.1	Energy Industries	T1, T2	D, CS	T1	D	T1	D	-	-
1.A.2	Manufacturing Industries and Construction	T1, T2	D, CS	T1	D	T1	D	-	-
1.A.3	Transport	T1	D	T1	D	T1	D	-	-
1.A.4	Other Sectors	T1	D	T1	D	T1	D	-	-
1.A.5	Non-Specified	T1	D	T1	D	T1	D	-	-
1.B	Fugitive emissions	-	-	T1	D	-	-	-	-
1.B.1	Solid Fuels	-	-	T1, T2	D, CS	-	-	-	-
1.B.2	Oil and Natural Gas	-	-	T1	D	-	-	-	-
1.B.3	Other emissions from Energy Production	NO	NO	NO	NO	NO	NO	-	-
2.	Industrial Processes and Product Use								
2.A	Mineral Industry	T1	D	-	-	-	-	-	-
2.A.1	Cement production	T1	D	-	-	-	-	-	-
2.A.2	Lime production	T1	D	-	-	-	-	-	-
2.C	Metal Industry	T1	D	-	-	-	-	-	-
2.B	Chemical Industry	NO	NO	NO	NO	NO	NO	-	-
2.C	Metal Industry	T1	D	NO	NO	NO	NO	-	-
2.C.1	Iron and Steel Production	T1	D	-	-	-	-	-	-
2.D	Non-Energy Products from Fuels and Solvents	T1	D	-	-	-	-	-	-
2.D	Lubricant use	T1	D						
2.E	Electronic Industry	NO	NO	NO	NO	NO	NO	-	-
2.F	Product Uses as Substitutes for Ozone Depleting Substances	-	-	-	-	-	-	T1	D

[16] https://www.ipcc-nggip.iges.or.jp/public/2006gl/

[17] The MPGs: https://unfccc.int/documents/

2.F.1.	Refrigeration and air conditioning	-	-	T1	D	-	-	-	-
2.F.1.a.	Commercial refrigeration	-	-	T1	D	-	-	-	-
2.F.1.e.	Mobile air conditioning	-	-	T1	D	-	-	-	-
2.F.2.	Foam blowing agents	-	-	T1	D	-	-	-	-
2.F.3.	Fire protection	-	-	T1	D	-	-	-	-
2.F.4.	Aerosols	-	-	T1	D	-	-	-	-
2.F.1.a.	Commercial refrigeration	-	-	T1	D	-	-	-	-
2.G	Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	-	-
2.H	Other	NO	NO	NO	NO	NO	NO	-	-
3.	Agriculture	-	-	T1	D	-	-	-	-
3.A	Livestock	-	-	T1	D	-	-	-	-
3.A.1	Enteric Fermentation	-	-	T1	D	-	-	-	-
3.B	Manure Management	-	-	T1	D	-	-	-	-
3.C	Rice cultivation	NO	NO	NO	NO	NO	NO	-	-
3.D	Direct and indirect N2O								
3.D.1.	Direct N_2O emissions from managed soils	T1	D	-	-	-	-	-	-
3.C.1	Burning	NO	NO	NO	NO	-	-	-	-
3.F	Field burning of agricultural residues	NO	NO	NO	NO	-	-	-	-
3.G	CO2 emissions from liming, urea application and other carbon-containing fertilizers	NO	NO	NE	NE	NE	NE	-	-
4	LULUCF	T1	D	T1	D	NE	NE	-	-
4.A	Forest land								
4.A.1	Forest land remaining forest land	T1	D	-	-	-	-	-	-
4.B	Total cropland	NE	NE	-	-	-	-	-	-
4.B.1	Cropland remaining cropland	NE	NE	-	-	-	-	-	-
4.C	Grassland	NE	NE	-	-	-	-	-	-
4.C.1	Grassland remaining grassland	NE	NE	-	-	-	-	-	-
4.C.2	Land converted to grassland	NE	NE	-	-	-	-	-	-
4.D	Total wetlands	NE	NE	-	-	-	-	-	-
4.D.1	Wetlands remaining wetlands	NE	NE	-	-	-	-	-	-
4.D.2	Land converted to wetlands	NE	NE	-	-	-	-	-	-
4.E	Settlement	NE	NE	-	-	-	-	-	-
4.F	Other land	NE	NE	-	-	-	-	-	-
4.G	Harvested wood products (HWP)	T1	D	-	-	-	-	-	-
5.	Waste	-	-	T1	D	-	-	-	-

5.A	Solid waste disposal						
5.A.1	Managed waste disposal sites			T1/T2	D		
5.A.2	Unmanaged waste disposal sites			T1/T2	D		
5.A.3	Uncategorized waste disposal sites						
5.B	Biological treatment of solid waste						
5.B.1	Composting	-	-	NO	NO	NO	NO
5.B.2	Anaerobic digestion at biogas facilities						
5.C	Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO
5.C.1	Waste incineration	NO	NO	NO	NO	NO	NO
5.C.1	Waste incineration	NO	NO	NO	NO	NO	NO
5.D	Wastewater Treatment and Discharge	-	-				
5.D.1	Domestic wastewater	-	-	T1	D	T1	
5.D.2	Industrial wastewater			T1	D	T1	
5.E	Other						

1.3.1.1. Activity Data

Mongolia's national GHG inventory utilizes activity data from both national and international sources. The primary source of national data is the National Statistics Office of Mongolia, consistent with the 2006 IPCC Guidelines, which recommend prioritizing nationally reported statistics where available[18]. In instances where national data were incomplete or unavailable, supplementary data were sourced from reputable international databases, including the International Energy Agency (IEA)[19], Food and Agriculture Organization (FAO)[20], and World Bank (WB)[21], alongside sector-specific assumptions as necessary. A detailed list of key data sources by sector is provided in Table I.2.

Table I. 2. Sources of sectoral activity data.

Sectors	Activity data sources
1. Energy	National statistics office (NSO)-statistical yearbook, www.1212.mn, International energy agency (IEA) statistics, Mongolian Civil Aviation Authority (MCAA),
2. Industrial processes and product use	NSO-statistical yearbook, www.1212.mn, National Ozone Authority, www.ozone.mn.
3. Agriculture	NSO-statistical yearbook, www.1212.mn, MOFALI – Statistical yearbook of agriculture,

18 National statistics office (NSO)-statistical yearbook from 1990 to 2022.
19 www.iea.org
20 www.fao.org/faostat/en/
21 https://data.worldbank.org

4. LULUCF	NSO-statistical yearbook, www.1212.mn, General Authority for Land Administration Geodesy and Cartography (GALAGC), Report on land, food and agriculture organization (FAO) – www.fao.org/faostat/en/
5. Waste	NSO-statistical yearbook, www.1212.mn, World Bank, Ulaanbaatar city major's office, Forest Research and Development Center, MOFALI, Ulaanbaatar water supply and sewerage authority

1.3.2. Brief description of key categories

The key categories in GHG emissions and removals are estimated in accordance with the 2006 IPCC Guidelines and used Tier 1[22]. The key categories evaluated emissions trends from 1990 to 2022, for with LULUCF) and without LULUCF, emissions in base and inventory years. The key categories are chosen using a predetermined cumulative emissions category that contributes at least 95% of national emissions in the current GHG inventory.

The analysis identifies key categories by level and trend assessments. The level assessment determines which categories contribute the most to total emissions, while the trend assessment identifies categories with the highest impact on emission trends.

Table I.3 provides key categories identified by the level and trend assessments for 1990 and 2022 emissions (with/without LULUCF). In 2022, 18 key categories were identified based on level and trend assessments, excluding LULUCF. When LULUCF is included, the number of identified key categories decreased to 12 due to the massive contribution of the LULUCF sector. In 2022, nine additional key categories were identified compared to 1990 (excluding LULUCF).

Table I. 3. Key categories identified by the Approach 1 level and trend assessments for 1990 and 2022 emissions.

Category code	Source category	Gas	Without LULUCF		With LULUCF	
			1990	2022	1990	2022
1.A.1	Energy Industries - Solid Fuels	CO_2	L	L, T	L	L, T
1.A.1	Energy Industries - Liquid Fuels	CO_2	L	T		
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	L	T	L	T
1.A.3.a	Civil Aviation - Liquid Fuels	CO_2		T		
1.A.3.b	Road Transportation - Liquid Fuels	CO_2	L	L	L	L, T
1.A.3.c	Railways - Solid Fuels	CO_2		T		
1.A.3.c	Railways - Liquid Fuels	CO_2		L		
1.A.3.e	Other Transportation - Liquid Fuels	CO_2	L	L, T		L
1.A.4	Other Sectors - Solid Fuels	CO_2	L	L, T	L	L, T
1.A.5	Non-Specified - Solid Fuels	CO_2	L	L, T	L	T
2.A.1	Cement production	CO_2		L, T		L
2.A.2	Lime production	CO_2		T		
2.F.1	Refrigeration and Air Conditioning	HFCs		T		
3.A	Enteric Fermentation	CH_4	L	L, T	L	L, T

[22] IPCC Good Practice (Chapter 7); IPCC 2006 GL (Vol. 1, Ch. 4)

3.B.	Manure Management	CH_4	L		
3.D.1	Direct N_2O emissions from managed soils	N_2O			L, T
3.D.2	Indirect N_2O Emissions from managed soils	N_2O		L, T	L, T
4.A.1.	Forest land Remaining Forest land	CO_2		L	L, T
Key: L=Level, T=Trend					

Detailed results of the key category analysis in both level and trend assessments, with and without LULUCF provided in Table I.3 of this report.

1.3.3. Brief description of QA/QC plan including verification

The Quality Assurance (QA) and Quality Control (QC) procedures in National Greenhouse Gas Inventory Report are structured into framework to ensure accuracy, transparency, and continuous improvement. The system follows the 2006 IPCC Guidelines[23] and serves to enhance the credibility of greenhouse gas emissions and removals data.

(QA/QC and verification activities include routine checks, independent reviews, and verification steps to uphold data integrity. Documentation and archiving play a crucial role in maintaining detailed records of processes, data sources, and methodologies, supported by an effective archiving system to ensure transparency and facilitate future reference.

The National Greenhouse Gas (GHG) Inventory Procedure, including the Quality Control/Quality Assurance (QC/QA) Plan, was developed prior to the commencement of the current inventory cycle and submitted to the Ministry of Environment and Tourism (MET) for approval in November 2024. Although the plan is still pending formal approval, it has been applied in the preparation of this inventory to ensure methodological consistency and adherence to good practice. The plan, drafted in the Mongolian language, is publicly available in its current form on the CCRCC website[24].

The procedure provides an institutional and technical framework for compiling GHG inventories across all IPCC sectors—energy, IPPU, AFOLU, and waste—and outlines responsibilities for relevant ministries and data providers. It sets standardized requirements for data submission, validation, and archiving, with CCRCC designated as the national entity responsible for inventory coordination under Government Resolution No. 181 (2020).

Quality control is conducted at two levels. Sectoral focal points conduct initial checks on activity data, subcategory classification, use of IPCC notation keys, and completeness of Common Reporting Tables (CRTs). CCRCC then performs a secondary review to ensure methodological integrity, time series consistency, and transparency in recalculations. All data are cross-checked against original sources, and emission factors and calculations are reviewed for accuracy and traceability.

Quality assurance measures include structured internal reviews, technical consultations, and sector-specific workshops. In accordance with the procedure, CCRCC conducts internal QA reviews, while certified external experts perform independent evaluations of methodologies, sectoral assumptions, and uncertainty estimates. These QA processes support continuous improvement and are fully documented.

Uncertainty is addressed at every stage of the inventory cycle. CCRCC identifies key categories and quantifies uncertainty using IPCC-recommended methods. Uncertainty estimates are periodically revised based on new data or updated methodologies, with expert input obtained through peer review and technical consultations.

[23] IPCC Good Practice (Chapter 6); IPCC 2006 GL(Vol. 1, Ch.6)
[24] https://www.ccrcc.mn/

All inventory-related materials—including CRTs, calculation files, QC/QA records, methodological notes, and raw data—are stored in CCRCC's centralized digital inventory system, as required under the procedure. This ensures transparency, data security, and full traceability, contributing to a robust and credible national GHG inventory in line with UNFCCC reporting obligations.

1.3.4. Recalculations

Recalculations are carried for the reason of are updated use of GWP from AR5. In order to ensure consistent emission inventories, recalculations carried out for the whole time series following the guidance in the IPCC guidelines.

1.3.5. Uncertainty Analysis

The uncertainty values for activity data (AD) and emission factors (EF) have not been developed in this report. The default uncertainty values for AD and EF from the 2006 IPCC Guidelines are used[25]. Furthermore, the IPCC Approach 1, known as the Linear Error Propagation (LEP) methodology, has been used to assess the 2022 GHG inventory uncertainty estimates with the base year 1990. The default uncertainty range represents a 95% confidence interval. In cases where asymmetric uncertainty ranges were assumed, the larger percentage was used for the calculations.

The national total GHG inventory uncertainty for the year 2022 is estimated at 196.395%, with a trend uncertainty of 1,607.600% over the time series from 1990 to 2022. The ten source categories contributing most significantly to trend uncertainty in 2022 are presented in Table I.4, while Table I.5 provides a comparative overview of sectoral contributions to trend uncertainty in national total emissions for the same year. Detailed results of the uncertainty analysis are provided in Table I.4.

Table I. 4. Ten sources contributing most to trend uncertainty in the national total in 2022 emissions.

IPPC category code	IPPC category	Gas	Uncertainty introduced into the trend in total national emissions (%)
3.B.1.a	Forest land Remaining Forest land	CO_2	171425008.45
3.C.4	Direct N2O Emissions from managed soils	N_2O	37620609.43
3.C.5	Indirect N2O Emissions from managed soils	N_2O	15900208.20
3.A.1.a. ii	Other Cattle	CH_4	538553.45
3.B.3.a	Grassland Remaining Grassland	CO_2	442303.75
3.A.1.c	Sheep	CH_4	329776.26
1.A.1.a. ii	Combined Heat and Power Generation (CHP) - Solid Fuels	CO_2	267181.52
3.A.1.d	Goats	CH_4	108285.19
3.A.1.f	Horses	CH_4	94248.84
3.A.1.e	Camels	CH_4	18572.81

[25] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Chapter 3: Uncertainties

Table I. 5. Contribution of sectors to trend uncertainty in the national total in 2022 emissions

IPCC category	CO_2	CH_4	N_2O	HFCs
Energy	2780.987	0.072318	0.002267	-
IPPU	69.88758	0	0	0.949065
Agriculture	0	10905.16512772	535208.2	-
LULUCF	1718673.112005	0	0	-
Waste	0	72.95188	2.001179	-

1.3.6. Assessment of Completeness

In this BTR1, the sources/removals of direct and indirect GHGs associated with activities occurring in Mongolia in which data and emissions factors were available estimated. Mongolia has updated the national GHG inventory from 1990 to 2022 for all five sectors, such as Energy, IPPU, Agriculture, LULUCF, and Waste. Direct gases, namely CO_2, CH_4, N_2O, HFCs and indirect gases (NOx, CO) have been covered under this inventory. PFCs have not been considered in this inventory due to data unavailability.

The source categories which refers to emissions or removals from sources that are not present in the country or have no occurrence (NO) within the reporting period and source-specific emissions and removals that are not estimated because they are deemed irrelevant to the national context or due to the lack of available, reliable data, are presented in Table I.6, Table I.7, Table I.8, Table I.9, and Table I.10.

Table I. 6. Sources and sinks from the energy sector not included in the national inventory.

1	ENERGY	Gases		
		CO_2	CH_4	N_2O
1.A.1.	ENERGY INDUSTRIES			
1.A.1.a.iii.	Heat plants	NA	NA	NA
1.A.1.b.	Petroleum refining	NO	NO	NO
1.A.1.c.i.	Manufacture of solid fuels	NA	NA	NA
1.A.3.	TRANSPORT			
1.A.3.d.	Water-borne navigation	NA	NA	NA
1.A.3.e.i.	Pipeline transport	NO	NO	NO
1.A.4.	OTHER SECTORS			
1.A.4.c.iii.	Fishing (mobile combustion)	NE	NE	NE
1.A.5.	NON-SPECIFIED			
1.A.5.b	Mobile	NE	NE	NE
1.A.5.c	Multilateral operations	NA	NA	NA
1.B.1.	SOLID FUELS			
1.B.1.a.i	Underground mines	-	NA	-
1.B.1.b.	Uncontrolled combustion and burning coal dumps	-	NO	-

1.B.1.c	Solid fuel transformation	-	NA	-
1.B.2.	OIL AND NATURAL GAS			
1.B.2.a.i	Venting	NA	NA	NA
1.B.2.b.	Natural gas	NO	NO	NO
1.B.3.	Other emissions from energy production	NE	NE	NE
1.C.	CARBON DIOXIDE TRANSPORT AND STORAGE	NO		

Table I. 7. Sources and sinks from the IPPU sector not considered in the national inventory.

2	IPPU	CO_2	HFCS
2.A.	MINERAL INDUSTRY		-
2.A.1.	Cement production	-	-
2.A.2.	Lime production	-	-
2.A.3.	Glass production	NA	-
2.A.4.	Other process uses of carbonates	NE	-
2.A.5.	Other	NO	
2.B.	CHEMICAL INDUSTRY		
2.B.1.	Ammonia production	NE	-
2.B.2.	Adipic Acid Production	-	-
2.B.3.	Caprolactam, Glyoxylic and Glyoxylic Acid Production	-	-
2.B.5.	Carbide Production	NE	-
2.B.6.	Titanium Dioxide Production	NE	-
2.B.7.	Soda Ash Production	NE	NO
2.B.8.	Petrochemical and Carbon Black Production	-	-
2.B.9.	Fluorochemical and Carbon black Production	-	-
2.B.10.	Other (Please specify)	NO	NO
2.C.	METAL INDUSTRY		
2.C.1.	Iron and Steel production	-	-
2.C.2.	Ferroalloys production	NE	-
2.C.3.	Aluminum production	NE	-
2.C.4.	Magnesium production	NE	-
2.C.5.	Lead production	NE	-
2.C.6.	Zinc production	NE	NO
2.C.7.	Other (Please specify)	NO	NO
2.D.	NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE		
2.D.1.	Lubricant Use	-	-
2.D.2.	Paraffin Wax Use	NE	-
2.D.3.	Solvent Use	-	-

2.D.4.	Other (asphalt production and use	NO	NO
2.E.	ELECTRONICS INDUSTRY		
2.E.1.	Integrated Circuit or Semiconductor	-	NO
2.E.2.	TFT Flat Panel Display	-	-
2.E.3.	Photovoltaics	-	-
2.E.4.	Heat Transfer Fluid	-	-
2.E.5.	Other (Please Specify)	NO	NO
2.F.	PRODUCT USES AS SUBSTITUTES FOR OZONE DEPLETING SUBSTANCES		
2.F.1.	Refrigeration and Air Conditioning	-	-
2.F.2.	Foam Blowing Agent	-	-
2.F.3.	Fire Protection	-	-
2.F.4	Aerosols	-	-

Table I. 8. Sources and sinks from the agriculture sector not considered in the national inventory.

3	AGRICULTURE	Gas			
		CH_4	N_20	NO_x	CO
3.A.	LIVESTOCK				
3.A.	ENTERIC FERMENTATION	-	-	-	-
3.A.1.b.	Other cattle	-	-	-	-
3.A.2.	Sheep	-	-	-	-
3.A.3.	Swine	-	-	-	-
3.A.4.b.	Camels				
3.A.1.d.	Goats	-	-	-	-
3.A.1.e.	Horses	-	-	-	-
3.A.1.g.	Poultry	-	-	-	-
3.B.	MANURE MANAGEMENT				
3.B.1.	Cattle		NO	-	-
3.B.1.b.	Other cattle		NO	-	-
3.B.2.	Sheep		NO	-	-
3.B.3.	Swine		NO	-	-
3.B.4.b.	Camels		NO	-	-
3.B.4.d.	Goats		NO	-	-
3.B.4.e.	Horses		NO	-	-
3.B.4.g.	Poultry		NO	-	-
3.C.1	Burning				
3.C.1.a	Forestland	NE	NE	NE	NE
3.C.1.c	Grassland	NE	NE	NE	NE
3.G.	Liming	-	NO	NO	NO
3.H.	Urea application	-	NO	NO	NO

3.D.1.	Direct N_2O emissions from managed soils	-	-	NO	NO
3.D.2.	Indirect N_2O emissions from managed soils	-	-	NO	NO
3.B.5.	Indirect N_2O emissions from manure management	-	NO	NO	NO
3.C.	Rice cultivation	NO	-	-	-
3.J.	Other (please specify)	NO	-	NO	NO

Table I. 9. Sources and sinks from the LULUCF sector not considered in the national inventory.

4	LAND	Gas		
		CO_2	CH_4	N_2O
4.A.	Forest land			
4.A.1.	Forest land remaining forest land	E, NA	IE, NE	IE, NE
4.A.2.	Land converted to forest land	NE	IE, NE	IE, NE
4.B.	Cropland			
4.B.1.	Cropland remaining cropland	NE	NE	NE
4.B.2.	Land converted to cropland	NE	NE	NE
4.C.	Grassland			
4.C.1.	Grassland remaining grassland	NE	IE, NO	IE, NO
4.C.2.	Land converted to grassland	NE	IE, NO	IE, NO
4.D.	Wetlands			
4.D.1.	Wetlands remaining wetlands	NE	-	-
4.D.2.	Land converted to wetlands	NE	-	-
4.D.2.c.	Land converted to other wetlands	NE	-	-
4.E.	Settlements			
4.E.1.	Settlements remaining settlements	NE	-	-
4.E.2.	Land converted to settlements	NE	-	-
4.F.	Other land			
4.F.1.	Other land remaining other land	NE	-	-
4.F.1.	Land converted to other land	NE	-	-
4.G.	Harvested wood products	-	-	-

Table I. 10. Sources and sinks from the waste sector not considered in the national inventory.

5	Waste	Gas		
		CO_2	CH_4	N_2O
5.A.	SOLID WASTE DISPOSAL			
5.A.3.	Uncategorized Waste Disposal Sites	-	NE	-
5.B.	**Biological Treatment of Solid Waste**	-	NE	NE
5.C.	INCINERATION AND OPEN BURNING OF WASTE			
5.C.1.	**Waste Incineration**	NE	NE	NE

5.C.2.	Open Burning of Waste	NE	NE	NE
5.D.	WASTEWATER TREATMENT AND DISCHARGE			
5.D.2.	Industrial Wastewater Treatment and Discharge	-	NE	NE
5.E.	OTHER	NE	NE	NE

The inventory covered greenhouse gas emissions and removals from anthropogenic sources, including direct GHGs—carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N^2O)—as well as indirect GHGs such as nitrogen oxides (NO_x), carbon monoxide (CO), and hydrofluorocarbons (HFCs). Emissions and removals are reported in terms of carbon dioxide equivalents (CO_2-eq), using 100-year global warming potentials (GWPs).

1.4. METRIC

Mongolia's national GHG inventory employed the most recent GWPs from the IPCC Fifth Assessment Report (AR5) 100-year time horizon GWPs, as illustrated in Table I.11.

Table I. 11. GWPs in outlined in AR5.

№	GHG	GWP (CO_2 equivalents)
1	CO_2	1
2	CH_4	28
3	N_2O	265
4	HFC134a	1300
	HFC125	3170
	HFC143a	4800
	HFC32	677
5	PFCs	6330-17400
6	SF_6	23500
7	NF_3	16100

1.5. FLEXIBILITY APPLIED

In accordance with Article 13 of the Paris Agreement and Decision 18/CMA.1, Mongolia has applied flexibility provisions available to developing country Parties in light of national capacity constraints. Flexibility was applied in limited areas of this Biennial Transparency Report due to data availability, methodological, and institutional capacity limitations. Mongolia is implementing improvement plans to progressively reduce the need for flexibility in future BTR submissions.

1.6. BRIEF DESCRIPTIONS OF GREENHOUSE GAS EMISSIONS AND REMOVALS

Total GHG emissions in Mongolia in 2022 were 48,509.10 Gg CO_2-eq without LULUCF and 16,603.67 Gg CO_2-eq with LULUCF and increased by 305.42% (Figure I. 3). From 1990 to 2022, the emissions steadily increased while the removals remained constant. The variations over time of GHG emissions is due to Mongolia's economic and population growth since 1990.

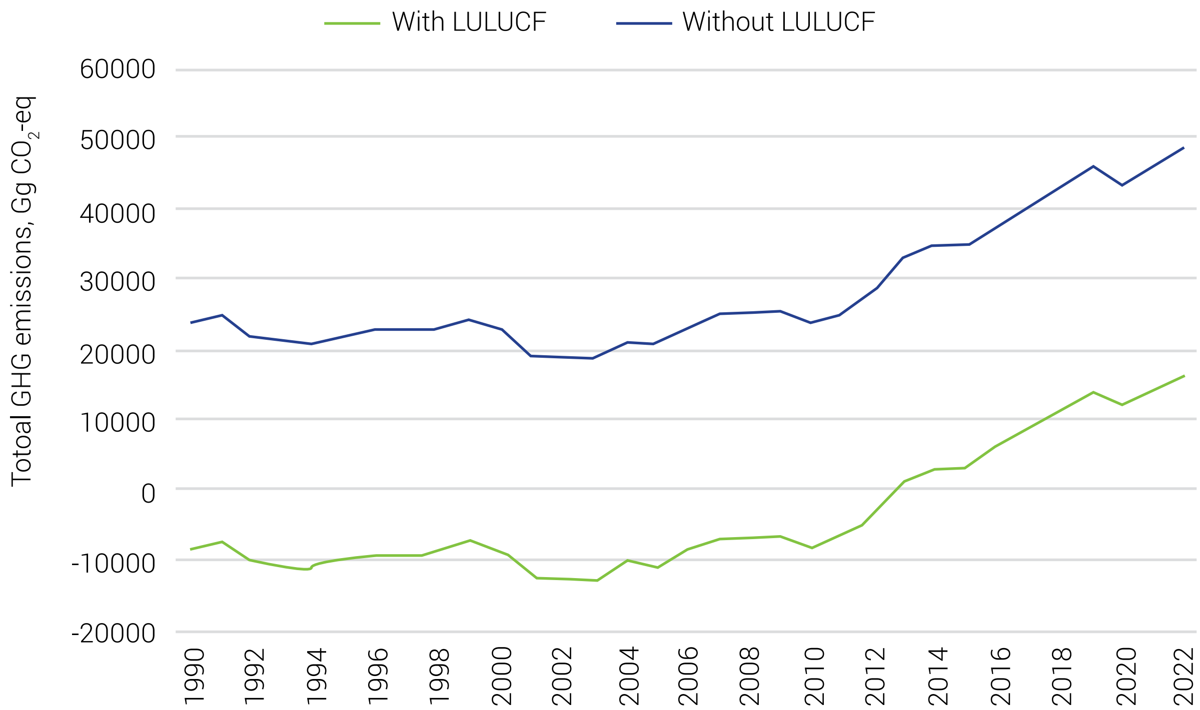


Figure I. 3. National GHG emission trends

1.6.1. Brief descriptions of emission and removal trends by gas

Carbon dioxide (CO_2) and methane have always been the dominant contributor to national greenhouse gas emissions. However, the share of CO has decreased from 50.38% (1990) to 42.23% (2022). While the share of the other three gases has increased from 1990 to 2022 (Figure I. 4). The emission trend of gases is presented in Figure I. 5.

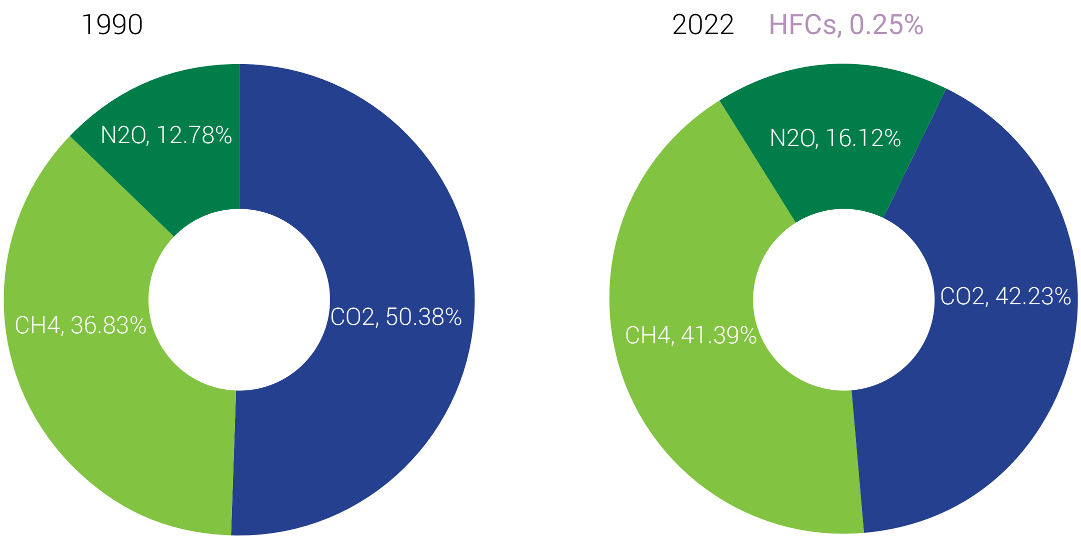


Figure I. 4. The share of gases in national total emissions in 2022

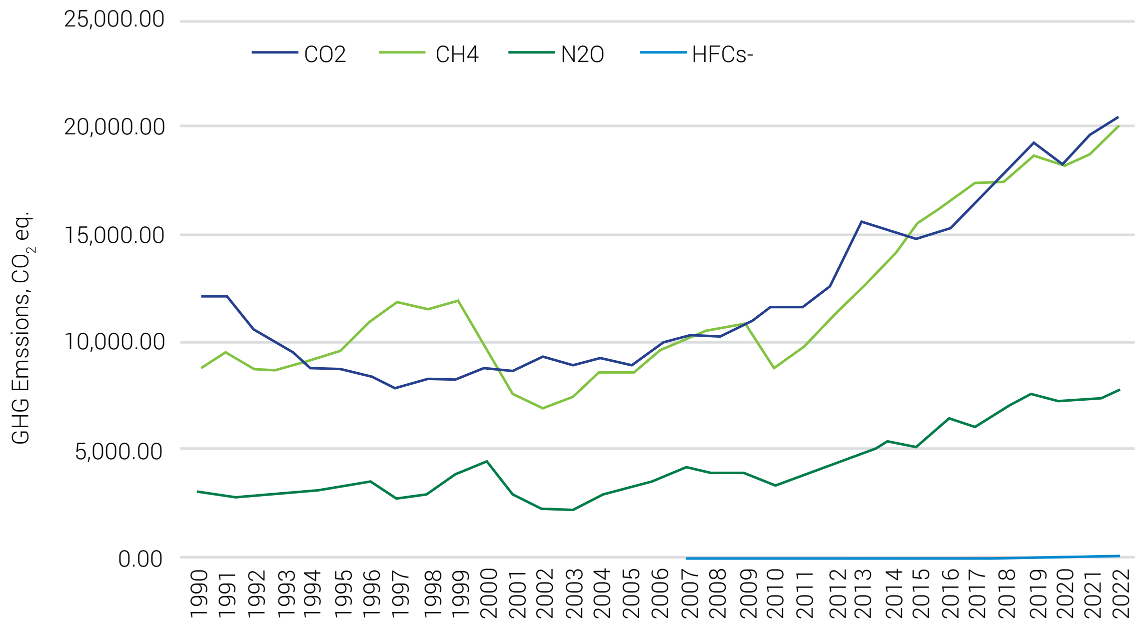


Figure I. 5. Emission trends by gases in Gg CO2-eq, 1990-2022.

1.6.1.1. Carbon dioxide

National total Carbon dioxide (CO_2) emissions without LULUCF increased by 69.43% from 1990 (12,09.85 Gg CO_2-eq) to 2022 (20,487.43 Gg CO_2-eq) and with LULUCF increased by 42.88% from 1990 (-19,990.59 Gg CO_2-eq) to 2022 (-11,418.00 Gg CO_2-eq) mainly due to increased fuel combustion and fugitive emissions (See Figure I. 6.).

The energy and IPPU are the sectors that contribute to CO2 emissions. CO_2 emissions from energy sector was 19,899.67 Gg CO2 and increased by 68.22% compared to the base year 1990. CO2 emissions from IPPU sector was 587.76 Gg CO2 and increased by 124.23% compared to the base year 1990.

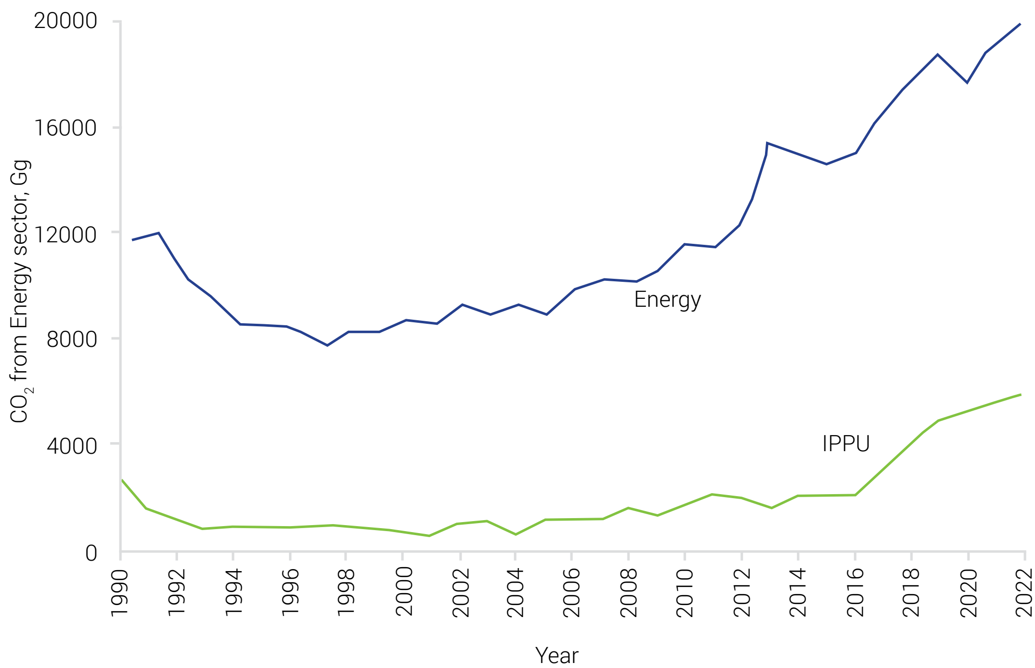


Figure I. 6. Emission trends of carbon dioxide by sectors for the period of 1990-2022, Gg CO2

1.6.1.2. Methane

The methane (CH_4) is the second largest GHG gas in Mongolia. The main sources of CH_4 emissions are enteric fermentation and manure management in the agriculture sector and solid waste disposal in the waste sector. CH_4 emissions increased from 315.73 to 717.07 Gg-CH_4 with a growth of 65.03% from 1990 to 2022 (Figure I. 7).

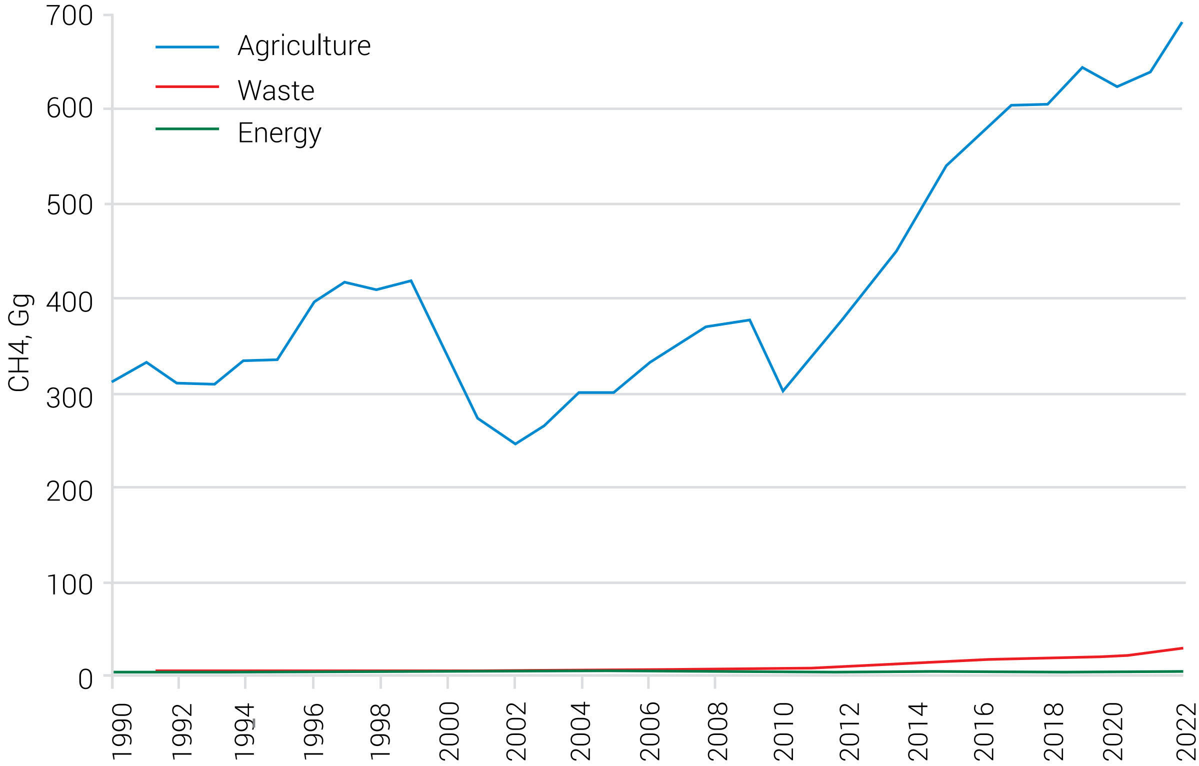


Figure I. 7. Emission trend of methane by sectors for the period of 1990-2022, Gg CH_4

1.6.1.3. Nitrous oxide

The agriculture sector is the main source for Nitrous oxide (N_2O) emissions. N_2O emissions from agriculture soil increased from 11.57 to 29.51 Gg-N_2O for the period 1990-2022, which is 154.99% increase over the period 1990-2022 (Figure I. 8). N2O emissions from energy sector is estimated 1.46 Gg- N2O and from wastewater treatment and discharge in waste sector was 0.12 Gg-N2O (Figure I. 8).

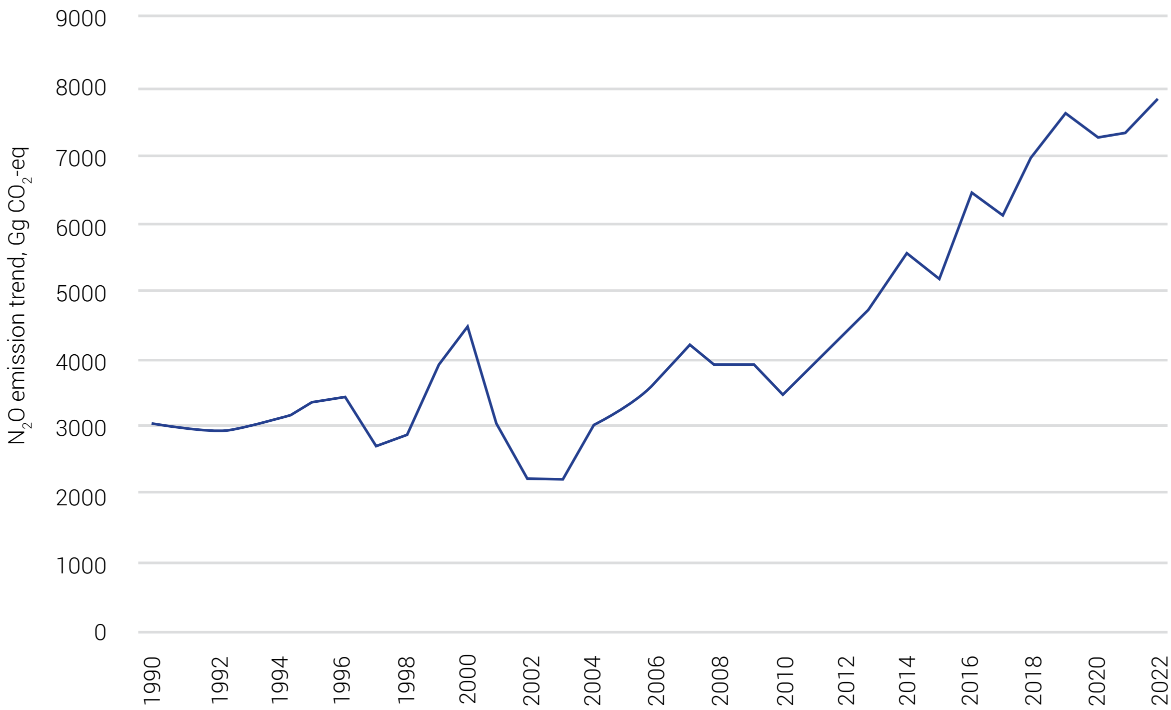


Figure I. 8. Emission trend of nitrous oxide by sectors for the period of 1990-2022, Gg N2O

1.6.1.4. Hydrofluorocarbons (HFCs)

Hydrofluorocarbons (HFCs) emissions are directly related to the consumption of applications which include fluorinated substitutes, the emissions increasing with the growing use of refrigerators, air conditioners, fire protectors, and foam-blowing equipment in the IPPU sector. The emission increased from 0.25 Gg-CO2-eq (2007) to 122.17 in Gg-CO2-eq in 2022 (Table I. 12).

Table I. 12. Emission trends by gas type in Gg, 1990-2022

Year	CO_2 without LULUCF	CH_4	N_2O	HFCs, CO_2-eq
1990	12,091.85	315.73	11.57	-
1995	8,691.27	344.97	12.69	-
2000	8,713.40	344.71	17.02	-
2005	9,013.80	306.13	12.31	-
2010	11,687.59	311.19	13.32	2.10
2015	14,976.72	555.88	19.66	99.67
2020	18,157.40	645.65	27.36	119.89
2022	20,487.43	717.07	29.51	122.17

1.6.2. Brief descriptions of national total emissions and removal trend by sector

The agriculture sector is the key sector that accounts for 55.2% of the national total in 2022. The second highest emitter sector is the energy sector, accounting for 42.0% of total national emissions. Emissions from IPPU and Waste sector contributed 1.5 and 1.3% respectively to the national total in 2022 (Figure I. 9.). GHG emissions from all sectors have increased from 1990 to 2022.

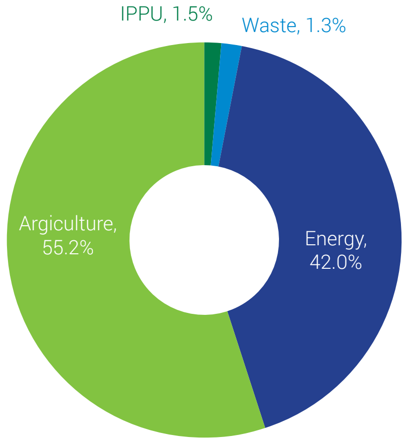


Figure I. 9. Contribution of the sectors in the national GHG emissions (excluding LULUCF) in 2022

1.6.2.1. Energy sector

In 2022 GHG emissions in the energy sector estimated 20,394.81 Gg CO2-eq increased by 68.53% since 1990 (Error! Reference source not found.). A large part of emissions in the energy sector come from energy industries (electricity generation, electricity and heat production) source category.

1.6.2.2. Agriculture sector

The agriculture sector is the key sector in national ghg emissions. In 2022 the emission estimation is 26,762.24 Gg CO2-eq increased by 131.19% since 1990 (Figure I. 10). The main contributor to the emissions from the agriculture sector is enteric fermentation and manure management.

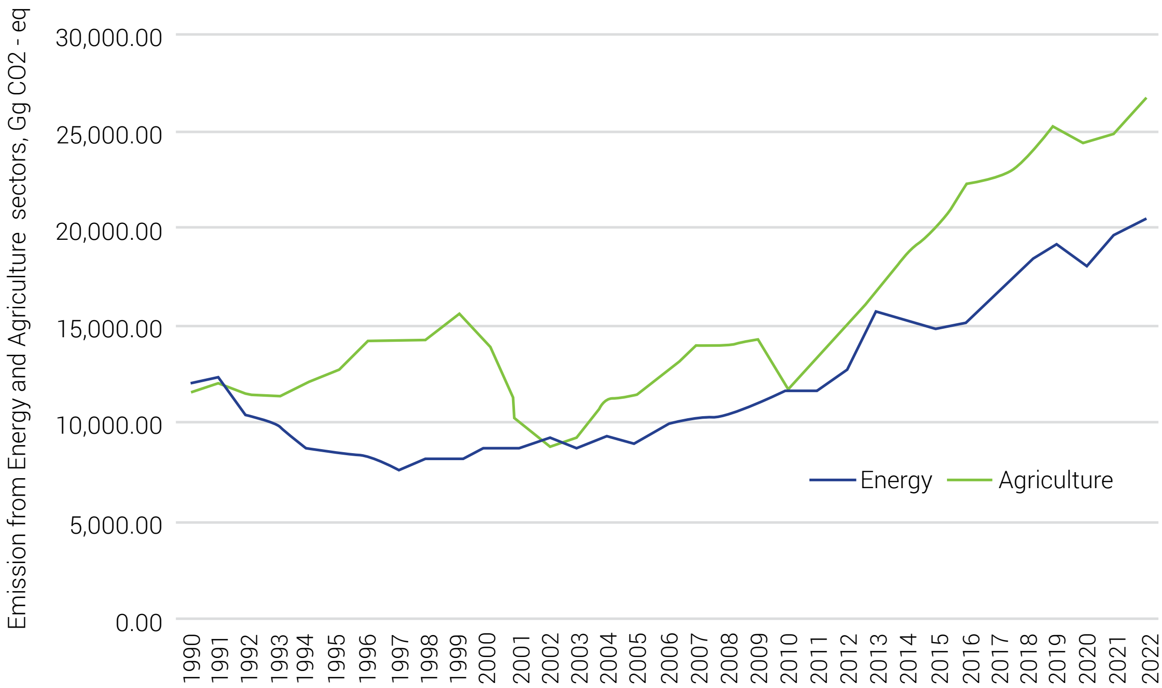


Figure I. 10. GHG emission trends in Energy and Agriculture sectors

1.6.2.3. Industrial Processes and Product Use Sector

Contribution of the IPPU sector to national GHG emissions is small. In 2022 GHG emissions in the IPPU sector estimated 709.94 Gg CO_2-eq increased by 170.84% since 1990 (See Figure I. 11). The main contributor to the emissions from IPPU sector is the mineral industry (cement and lime production. The cement and lime are the important ingredients for the building materials in Mongolia.

1.6.2.4. Waste sector

The waste sector is the insignificant source of GHG emissions, which contributes only 1.3% to national total. However, GHG emissions is increasing since 1990 with population growth especially in urban areas. Total aggregated emissions from the Waste sector have increased by by 981.92% in 2022 from 59.35 Gg CO_2-eq to 642.12 Gg CO_2-eq (Figure I. 11).

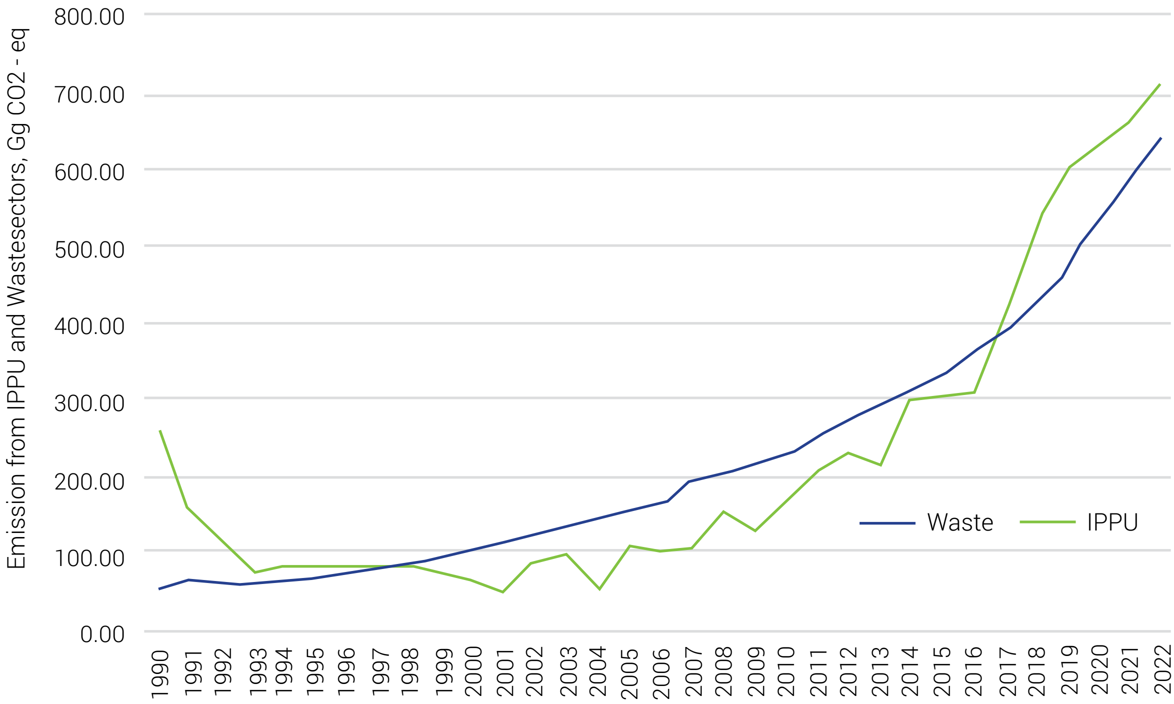


Figure I. 11. GHG emission trends in IPPU and Waste sectors

1.6.2.5. Land use, land use change and forestry

LULUCF is a net sink in Mongolia accounted more than 50% of net removal of the country's direct GHG emission. Total removals were – 31,905.43 GgCO2-eq in 2022 (Figure I. 12). The availability of data for LULUCF inventory is still lacking. It should be noted that only the forest land remaining forest land category is reported under Land category for this submission.

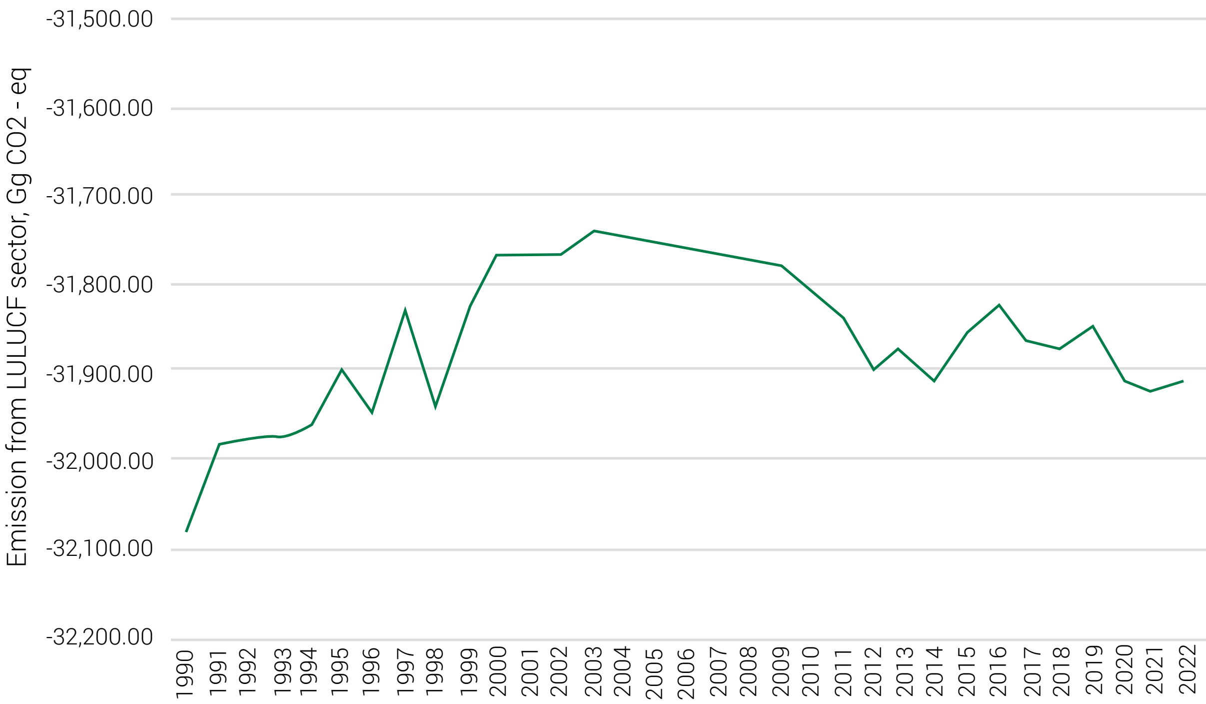


Figure I. 12. GHG emission trends in LULUCF sector

1.7. TRENDS IN GREENHOUSE GAS EMISSIONS AND REMOVALS

1.7.1. Energy sector

1.7.1.1. Sector general information

In Mongolia, total primary energy supplies continue to be dominated by coal, and electricity generation is largely provided by coal-fired power plants, particularly combined heat and power plants. About 93% of all electricity and 98% of all district heat was provided by coal-fired systems. Mongolia's renewable energy resources, including wind, solar, geothermal, and hydro, are estimated to be able about 1 GW.

The share of energy consumption growth in the oil and gas industry, other manufacturing industries, public utilities, and households was the largest. However, the energy consumption of the agricultural industry, metallurgical and non-mineral food industry, and light industry sub-sectors decreased significantly. Total domestic energy consumption increased by 92.3 percent. During these periods, the electricity and heat production industries, public utilities, households, mining, and extraction industries were the largest energy consumers.

The electricity and heat production industries, public utilities, households, mining, and extraction industries were the largest energy consumers.

The energy sector of GHG inventory in Mongolia covers two main source categories, namely fuel combustion (CRF 1.A) and fugitive emissions (CRF 1.B). In Mongolia fossil fuels are used to produce energy for mostly electricity and heat generation in combined heat and power generation). Figure I. 13 represents the source of categories covered in the Mongolian energy sector inventory. Other sources of categories have not been covered in this inventory because they are not relevant to the national context or due to the lack of available data.

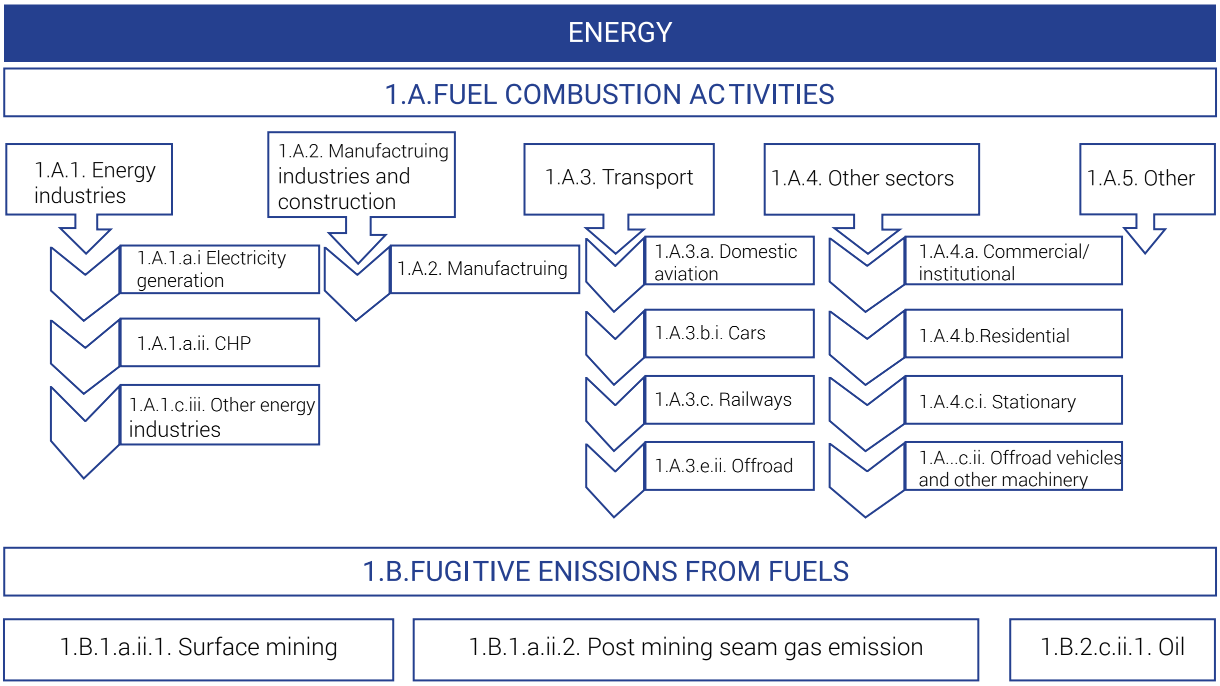


Figure I. 13. Emission source categories covered in the energy sector in Mongolia.

The GHG estimated are CO_2, CH_4, N_2O and indirect such as NOx, CO and CO_2 and CH_4 from fugitive emissions from coal and oil production.

Aggregated GHG emissions in Fuel Combustion (1.A) and Fugitive emissions from fuels (1.B) in 2022 in the energy sector presented in Table I.13. Emissions estimates of all source categories included in this inventory provided in table I.6. and CRT. The trends of GHG emissions by source categories shown in Figure I.13

CO_2 emissions from energy industries (1.A.1) is highest in the energy sector followed by Transport (1.A.3) and Manufacturing Industries and Construction (1.A.2).

N_2O emissions from 1.B Fugitive Emissions from Fuels are not estimated due to limited data availability and methodological constraints. Flexibility is applied in accordance with the ETF MPGs.

Table I. 13. Overview of emissions in the energy sector in the base year and in the last year of inventory, in Gg

Category	Gas	1990 (Base year)	2022 (Latest year)	Difference in 1990 and 2022, %	Contribution to total emission in 2022, %		
					Total CO_2-eq	Sector	Gas
1A	CO_2	11,823.46	19,850.02	68.22%	40.92%	97.33%	96.89%
	CH_4	3.83	3.91	2.1%	0.23%	0.54%	0.55%
	N_2O	0.62	1.46	133.16%	0.79%	1.89%	4.93%
1B	CO_2	6.27	49.65	692.15%	0.10%	0.24%	0.24%
Total					42.04%	100%	

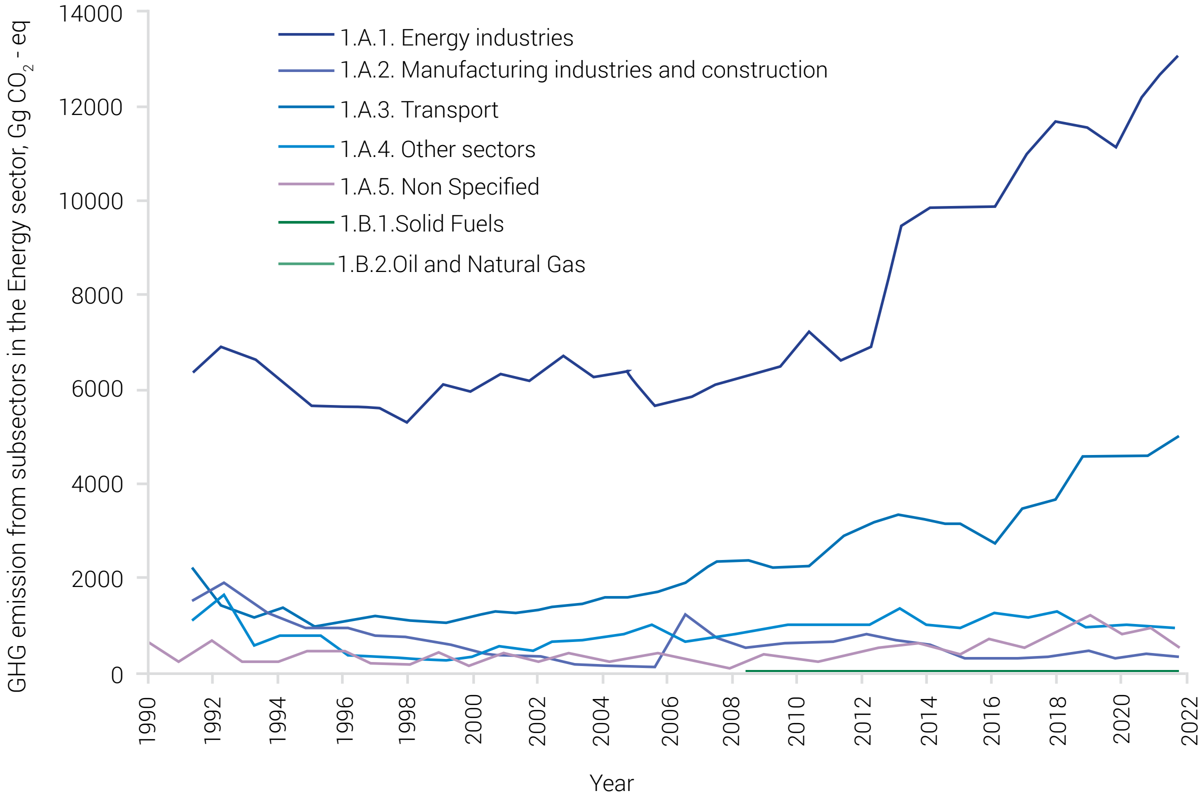


Figure I. 14. Contribution of subsectors to GHG emissions in the energy sector

1.7.1.2. Key categories

The CO_2 emissions from all fuel types in the energy industries (1.A.1), and CO_2 emissions from solid fuels in manufacturing industries and construction (1.A.2). In the transport sub-sector, key sources are civil aviation (1.A.3.a) and road transportation (1.A.3.b), both using liquid fuels, as well as railway transportation (1.A.3.c), which uses both solid and liquid fuels. Other transportation activities (1.A.3.e) also contribute through the use of liquid fuels, the use of solid fuels in other sectors (1.A.4), and from non-specified energy activities (1.A.5) that also rely on solid fuels are identified key categories without LULUCF (see Figure I. 14). The categories represent the primary contributors to CO_2 emissions in the energy sector.

1.7.1.3. Methodology

The emissions from the energy sector were calculated using the 2006 IPCC Guidelines[26]. The choice of the method was made in accordance with the decision tree of the 2006 IPCC Guidelines. The Tier 1 method was applied for emission estimation from combustion of oil products such as diesel oil, motor gasoline, jet fuel, residual fuel oil, lubricants. The Tier 2 method, i.e., the country-specific net calorific values (NCVs) and CS EFs for CO_2 emissions were applied for the emission estimation from coal combustion such as other bituminous coal and lignite (Namkhainyam 2014)[27]. IPCC default EF used for CH_4 and N_2O estimates.

[26] 2006 IPCC Guidelines for National Greenhouse Gas Inventories (the 2006 IPCC GLs) Volume 2

[27] Namkhainyam B. et al., 2014. Studies on country specific GHG emission and removal factors for Mongolia. Ulaanbaatar.

Table I.14. Methods and EFs applied in Energy sector.

ENERGY		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
1.A.1.	Energy industries	T1, T2	D, CS	T1	D	T1	D
1.A.2.	Manufacture of solid fuels and other energy industries	T1, T2	D, CS	T1	D	T1	D
1.A.3.	Transport	T1	D	T1	D	T1	D
1.A.4.	Other sectors	T1, T2	D, CS	T1	D	T1	D
1.A.5.	Non-specified	T1, T2	D, CS	T1	D	T1	D
1.B.1.	Fugitive emissions from fuels (solid fuels)	-	-	T1	D	-	-
1.B.2.	Oil and natural gas and other emissions from energy production	T1	D	T1	D	T1	D

IPCC default and CS NCVs used for the emission exrtimated in energy sector is provided in below table.

Table I.15. The CS NCVs and EFs which are used in GHG inventory estimation.

1	ENERGY	NCVs, (TJ/Gg)	Carbon content, (kg/GJ)	CO_2 EFs, (kg CO_2/TJ)	CH_4 EFs, (kg CH_4/TJ)	N_2O EFs, (kg N_2O/TJ)
1.A.1.	ENERGY INDUSTRIES					
	Gas Diesel/oil	43	20.2	74,100	3	0.6
	Residual fuel oil	40.4	21.1	77,400	3	0.6
	Lignite	14.4*	27*	97,100*	1	1.5
	Other bituminous coal	18.1*	24.5*	88,300*	1	1.5
	Coke oven gas	38.7	12.1	44,400	1	0.1
	Other primary solid biomass	11.6	27.3	100,000	30	4
* Source for country-specific NCVs and CO_2 EFs: ERC report "Develop a national methodology for determining GHG emissions in the energy sector", 2021 (the report is in Mongolian), Table 3-7, p.37. Sources for the IPCC defaults: NCVs and CCs - 2006 IPCC GLs, Vol. 2, Ch. 1, Table 1.2, p. 1.18, Table 1.3 and 1.4, pp. 1.21, 1.23. Default CO_2, CH_4 and N_2O EFs – 2006 IPCC GLs, Vol. 2, Ch. 2, Table 2.2, p. 2.16.						
1.A.2.	MANUFACTURE OF SOLID FUELS AND OTHER ENERGY INDUSTRIES					
	Other bituminous coal	18.1*	24.5*	86,700*	1	1.5
	Lignite	14.4*	27*	95,400*	1	1.5
	Coke oven gas	28.2	29.2	107,000	1	1.5
* Country-specific values from ERC report "Develop a national methodology for determining GHG emissions in the energy sector", 2021 (the report is in Mongolian), Table 3-7, p.37. All others are IPCC defaults.						
1.A.3.	TRANSPORT					
1.A.3.a.	Civil aviation					
	Jet kerosene	44.1	19.5	71,500	0.5	2

1.A.3.b.	Road transportation					
	Gas/diesel oil	43	20.2	74,100	3.9*	3.9*
	Motor gasoline	44.3	18.9	69,300	25*	8*
1.A.3.c.	Railways					
	Gas/diesel oil	43	20.2	74,100	4.15***	28.6***
	Other bituminous coal	18.1**	24.5**	86,700**	2***	1.5***
	Lignite	14.4**	27**	95,500**	2***	1.5***
1.A.3.e.	Other transportation					
	Gas/diesel oil	43.0	20.2	74,100	4.15***	28.6***
*Default values from the 2006 IPCC GLs, Vol. 2, Ch. 3, Table 3.2.2, p. 3.21. ** Country-specific values from ERC report “Develop a national methodology for determining GHG emissions in the energy sector”, 2021 (the report is in Mongolian). ***Default values from the 2006 IPCC GLs, Vol. 2, Ch. 3, Table 3.4.1, p. 3.43. ****Default values from the 2006 IPCC GLs, Vol. 2, Ch. 3, Table 3.3.1, p. 3.36.						
1.A.4	OTHER SECTORS					
1.A.4.a.	Commercial and institutional					
	Lignite	14.4*	27*	95,400*	10*	1.5**
	Other bituminous coal	18.1*	24.5*	86,700*	10*	1.5**
1.A.4.b-c	Residential and Agriculture					
	Lignite	14.4*	27.0*	95,400*	300***	1.5***
	Other bituminous coal	18.1*	24.5*	86,700*	300***	1.5***
	Other primary solid Biomass	11.6****	27.3****	100,000***	300***	1.5***
	Gas/diesel oil	43.0****	20.2****	74,100***	10.0***	0.6***
*Country-specific values from ERC report “Develop a national methodology for determining GHG emissions in the energy sector”, 2021 (the report is in Mongolian). **Default values from the 2006 IPCC GLs, Vol.2, Ch. 2, Table 2.4, p. 2.20. ***Default values from the 2006 IPCC GLs, Vol. 2, Ch. 2, Table 2.5, p. 2.24. ****Default values from the 2006 IPCC GLs, Vol. 2, Ch. 1, Table 1.2, 1.3, pp. 1.18, 1.21.						
1.A.5	NON-SPECIFIED					
	Lignite	14.4*	27.0*	95,400*	1**	1.5**
	Other bituminous coal	18.1*	24.5*	86,700*	1**	1.5**
	Other primary solid Biomass	11.6***	27.3***	100,000**	1**	1.5**
*Country-specific values from ERC report “Develop a national methodology for determining GHG emissions in the energy sector”, 2021 (the report is in Mongolian). **Default values from the 2006 IPCC GLs, Vol.2, Ch. 2, Table 2.2, p. 2.16. ***Default values from the 2006 IPCC GLs, Vol. 2, Ch. 1, Table 1.2, 1.3, pp. 1.18, 1.21.						
1.B.1	SOLID FUELS					
	Average mining depth	$0.67*10^{-6}$ Gg/m^3			$1.2\ m^3/t$	
	Post mining	$0.67*10^{-6}$ Gg/m^3			$0.1\ m^3/t$	

1.7.1.4. Data source

The major data sources are the National statistics office (NSO) of Mongolia, relevant line ministries and agencies such as Ministry of energy, Ministry of road and transport development, Ministry of mining and heavy industry, Mongolian civil aviation authority and Mineral Resources and Petroleum Authority of Mongolia. Both "Sectoral approach" and "Reference analysis" were used in the Energy sector.

Aggregated data of fuel consumption in the manufacturing industries and construction (CRF 1.A.2) category the liquid (diesel oil) and solid fuel (coal) consumption for different industries are used due to unavailability of the disaggregated data. Fuel combustion (CRT 1.A): Within the transport subcategory (CRT 1.A.3), disaggregated fuel consumption data by vehicle type for road transport were not available at the national level. As a result, aggregate activity data—representing the combined consumption of motor gasoline and diesel oil—were used for emissions estimation. For domestic aviation, jet fuel consumption was estimated based on the number of domestic flights and international take-offs and landings, as reported in national statistical datasets. Railway activity data were sourced from the Ministry of Road and Transport Development (MRTD) and disaggregated into diesel oil consumption for locomotives and coal consumption—primarily sub-bituminous coal—for heating passenger wagons. Fuel use for heating was included only for the heating season, which typically lasts approximately seven months per year.

Other sectors (CRT 1.A.4) include the fuel consumption in commercial and institutional, residential and agriculture/forestry/fishing subcategories. In the agriculture (CRT 1.A.4.c) subcategory the coal, diesel oil and other primary solid biomass were consumed by stationary appliances and diesel oil by off-road vehicles and other machineries.

1.7.1.5. Energy industries (1.A.1)

The Energy Industries category (1.A.1) in Mongolia's greenhouse gas inventory encompasses emissions from several key sub-sectors, including electricity generation (1.A.1.a.i) primarily from diesel generators; combined heat and power generation (1.A.1.a.ii), which involves coal-fired and residual fuel oil-fired plants; and other energy industries (1.A.1.c.ii), which account for emissions from the transformation of coke oven gas and the utilization of primary solid biomass. Regarding other subcategories within the Energy Industries category (1.A.1), emissions from heat-only plants (1.A.1.a.iii) have not been estimated in the current inventory due to insufficient activity data. However, these emissions are recognized as a relevant source and are planned to be addressed and include next inventory submission once the necessary data becomes available.

Combustion of coke oven coke used for electricity and heat generation for internal consumption has been reported under the 'Manufacturing Industries and Construction' category (1.A.2).

In 2022, Mongolia's electricity production reached 8,035 million kWh, while electricity import was 2,107.4 million kWh. In 2022, electricity generation, combined heat and power generation, and other energy industries covered 2.66%, 97.23%, and 0.1% of total GHG emissions for energy industries (1.A.1), respectively (Figure 15). GHG emissions from energy industries are gradually increasing due to the growing electricity and heat demand.

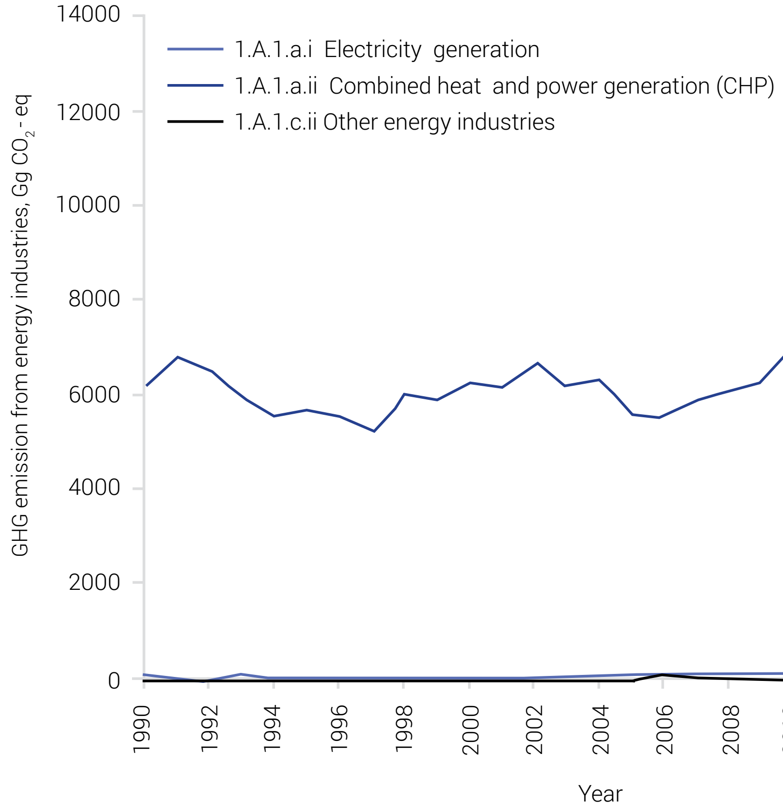


Figure I. 15. GHG emissions from energy industries (1.A.1) by source categories

Interannual fluctuations in emissions from energy industries (1.A.1) across the time series are primarily attributable to changes in thermal power generation and broader economic conditions. Between 2005 and 2010, the production of energy products increased fourfold. Coal remains the dominant primary energy source, accounting for an average of 93.5% of total energy production from 1990 to 2016. Since the commencement of crude oil exports in 1998, total energy production volumes have shown a steady upward trend. Notably, coal production experienced a sharp increase in 2010, with an annual growth rate of 74.2%, while the highest recorded growth in petroleum production occurred in 2007, reaching 2.2 times the previous year's output.

In contrast, the share of manufacturing industries and construction (1.A.2) decreased from 12.4% in 1990 to 1.81% in 2022. Two categories, Other Sectors (1.A.4) and non-specified (1.A.5), have seen a decrease in GHG emissions from 1990 to 2022. The emissions from the manufacturing and construction sectors, particularly coal consumption in this category, are declining. This reduction is attributed to the connection of construction facilities to central heating systems and electricity grids, technological advancements and innovation. Appendix table 6 summarizes emission trends in the energy sector by categories from 1990-201.7.1.6. Manufacturing industries and construction (1.A.2).

Mongolia's manufacturing industries and construction (1.A.2) category includes emissions from fuel combustion in industry sectors. According to the 2006 IPCC GLs, category 1.A.2 includes many sectors from 1.A.2.a (Iron and Steel) to 1.A.2.m (Non-specified industry).

In 2022, GHG emissions in this category were estimated 367.52 Gg CO_2-eq and decreased almost four times than emissions (1,494.99 Gg CO_2-eq) in 1990 (Figure I. 16). The significant decline in emissions in this sector resulted from the collapse of the socialist system and the fundamental changes in the country's economy.

Considerable increase in 2006 compared to 2005 is due to construction sector boom. The emissions start to decrease because of adoption of new methods and technologies in construction and industry which use less raw coal.

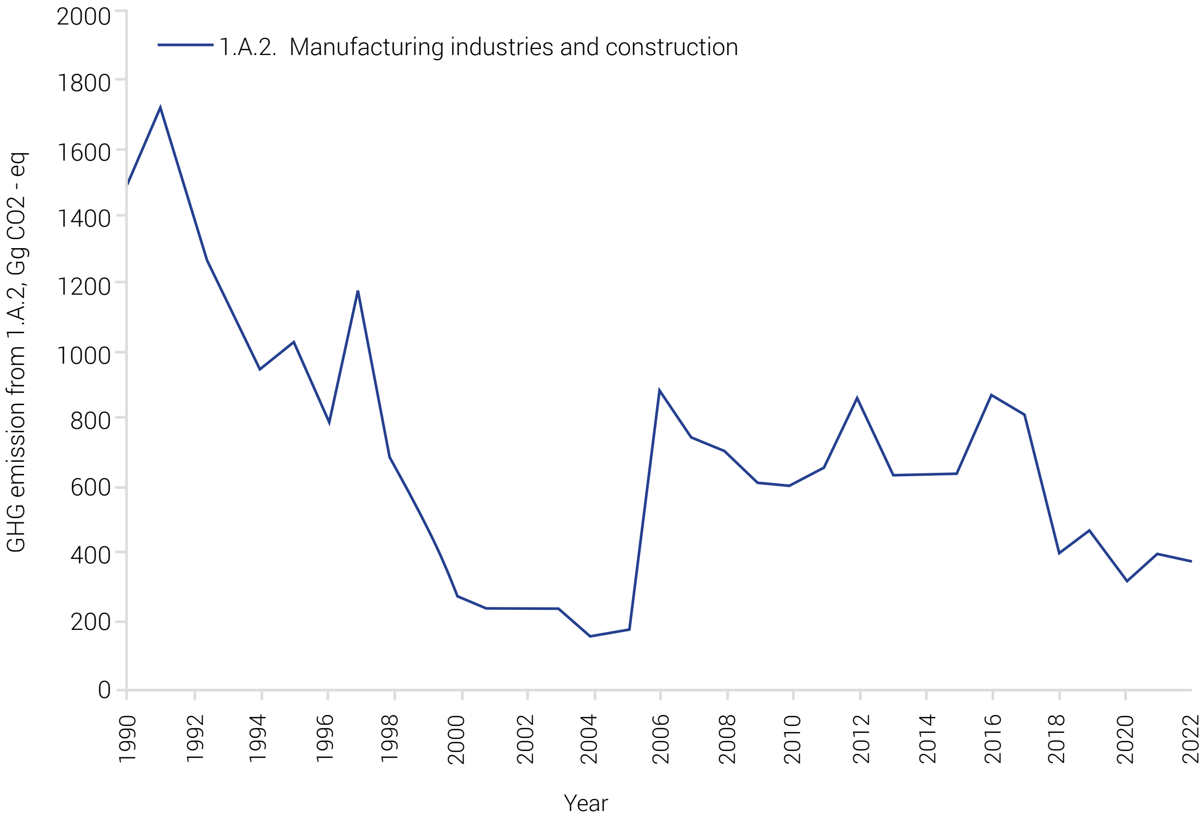


Figure I. 16. GHG emissions from manufacturing industries and construction (1.A.2)

The transport sector (1.A.3) in Mongolia comprises several subcategories that contribute to national greenhouse gas (GHG) emissions. The estimation in this subcategory is based on the consumption of jet kerosene for domestic aviation activities, as other aviation fuels such as aviation gasoline are not reported or are used insignificantly. In the case of road transportation (1.A.3.b), emissions are estimated by aggregating data across all vehicle types due to limited availability of disaggregated fuel consumption statistics. This includes light-duty vehicles such as passenger cars and light trucks, heavy-duty vehicles including buses and long-haul trucks, and two- and three-wheeled vehicles such as motorcycles, mopeds, and scooters. As there is no comprehensive data source categorizing fuel use by vehicle class or type, emissions are calculated using national totals for liquid fuels, primarily diesel and gasoline.

Although Liquefied Petroleum Gas (LPG) is known to be used in the transportation sector, its consumption is not included in the GHG emission estimates due to a lack of reliable data on usage and distribution by vehicle type or region. Railway emissions (1.A.3.c) are based on the use of diesel-powered locomotives, as there is no electric trains in Mongolia. These locomotives typically use diesel engines that are mechanically connected to generators or alternators, which in turn supply electric power to the traction motors that drive the train. Fuel consumption data for the railway sector is obtained from national energy statistics, and emissions are estimated using IPCC default emission factors for diesel combustion in rail transport. The subcategory off-road transportation (1.A.3.e.ii) covers fuel combustion in vehicles and equipment not used on public roads, particularly within the mining industry, which is a major sector in Mongolia's economy. Due to the lack of direct fuel consumption records for off-road equipment, the Mineral Resources and Petroleum Authority of Mongolia (MRPAM) conducted a study analyzing wholesale and retail diesel sales across multiple economic subsectors, including mining, oil production, railways, agriculture, and on-road transportation. From this analysis, the average share of diesel fuel used by each subsector was calculated. These percentages were then applied to national fuel consumption data to derive historical estimates of diesel usage for off-road transportation from 1990 to 2022. This method ensures a more accurate estimation of emissions from off-road sources, particularly where official statistics are lacking or incomplete.

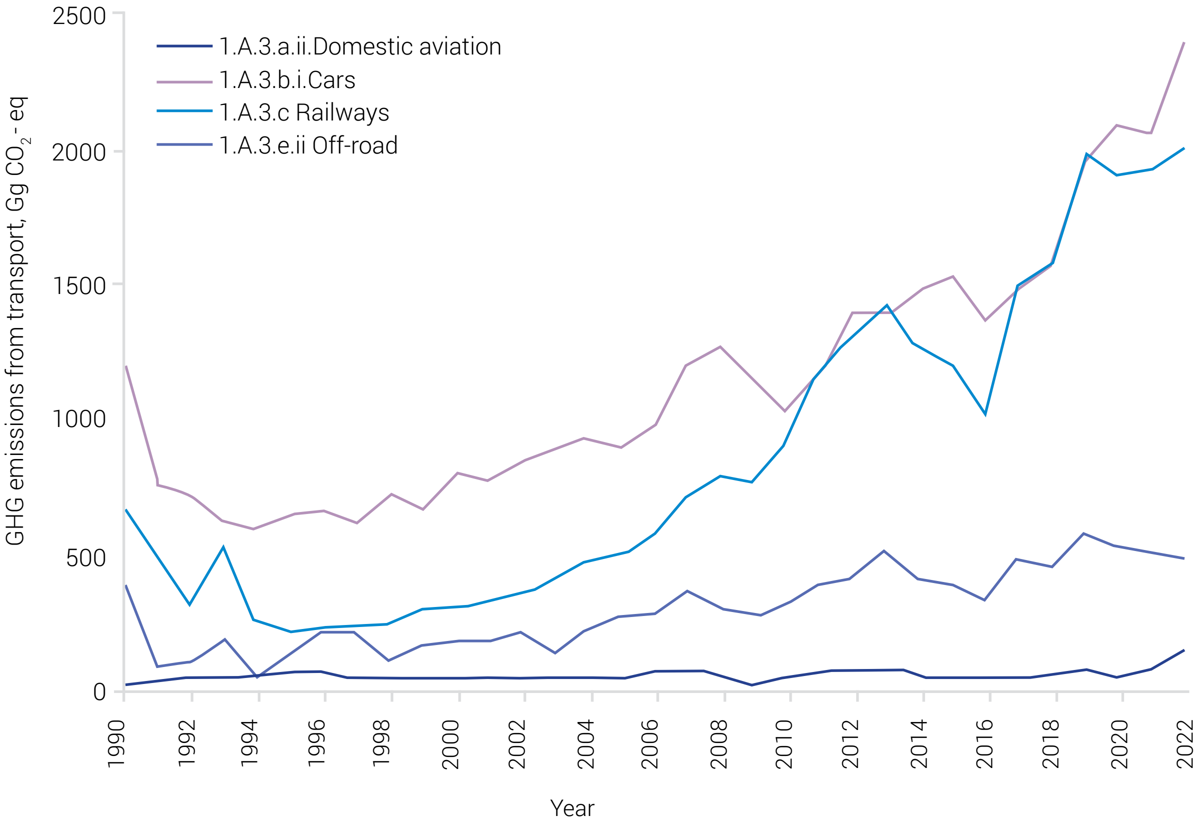


Figure I. 17. GHG emissions from transport (1.A.3) by source categories

In 2022, road transportation was the largest source of emissions within the transport category (1.A.3), accounting for 47.59% of the total. The other significant sources include off-road transportation and railways, which contribute 39.85% and 9.69%, respectively. Domestic aviation has a minimal share of 2.87% (Figure I.17 and Table I. 17.). In 2022, emissions from all source categories increased compared to 1990, primarily due to population growth and economic development.

Table I. 16. Transport category's GHG emissions in 1990 and 2022, CO2-eq

№	Source	1990	2022	Changes
1	1.A.3.a: Domestic aviation	10.48	145.83	135.35 (1291.5%)
2	1.A.3.b: Road transportation	1,227.62	2,490.91	1,263.29 (102.91%)
3	1.A.3.c: Railways	412.33	536.03	123.7 (30.01%)
4	1.A.3.e.ii: Off-road	669.12	2,007.37	1338.25 (200%)

1.7.1.6. Other sectors (1.A.4)

The 'Other Sectors' (1.A.4) category of Mongolia includes greenhouse gas emissions from various non-industrial and non-energy-producing sectors. This includes emissions from commercial and institutional buildings (1.A.4.a), such as restaurants, office complexes, schools, kindergartens, hotels, and other establishments where stationary fuel combustion occurs. These buildings usually use solid fuels like coal and biomass, as well as liquid fuels, especially in areas without access to centralized heating systems. The residential sector (1.A.4.b) accounts for emissions from fuel combustion in private households. A large portion of Mongolia's population lives in detached houses and gers (traditional dwellings) which are typically not connected to centralized heating system/networks. Consequently, raw coal, wood, and other solid fuels are used for space heating and cooking, making this sector a significant contributor to national emissions. In the agricultural sector, emissions from stationary fuel combustion (1.A.4.c.i) are associated with operations such as water pumping, grain drying, and the use of energy in horticultural greenhouses and other agricultural processes. According to the 2006 IPCC Guidelines include emissions from forestry and fishing activities.

However, due to a lack of available data, only emissions from the agriculture sector were estimated and included in the current inventory. Additionally, emissions from off-road vehicles and machinery used in agriculture (1.A.4.c.ii) are considered under this category. These include fuel combustion from tractors, harvesters, and irrigation equipment operating on farmlands. These mobile sources are particularly relevant in areas where mechanized farming practices are employed and contribute significantly to the overall energy-related emissions from agriculture.

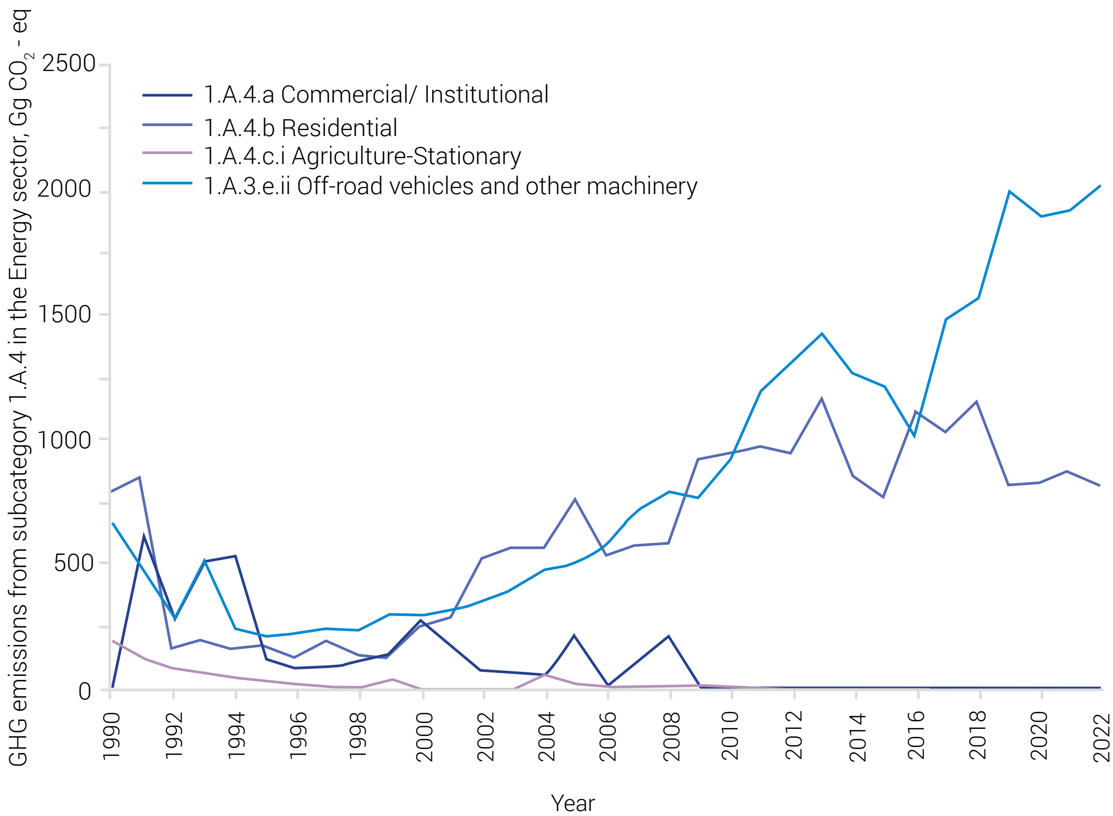


Figure I. 18. GHG emissions from other sectors (1.A.4) by source categories

In 2022, the residential category accounted for the largest share within the other sectors (1.A.4) at 94.61%. This was followed by agriculture (1.A.4.c.i and 1.A.4.c.ii) at 5.39%. The residential category covers a substantial area where many citizens live in small houses and gers near the city center. These households are not connected to a centralized heating system accounted for more than 50% and often rely on coal briquettes or raw coal for heating.

1.7.1.7. Non-specified (1.A.5)

According to the 2006 IPCC Guidelines, this source category includes all emissions from fuel combustion not specified elsewhere, covering fuel supplied to the military domestically and to foreign militaries not involved in multilateral operations. Due to the lack of information on military activities in Mongolia, GHG emissions for military fuel combustion have not been calculated. Therefore, the non-specified (1.A.5) category of Mongolia includes all remaining emissions from stationary fuel combustion that are not specified elsewhere. The data on consumption for this subcategory were sourced from the coal balance tables of IEA statistics and verified against national statistics. The emissions are represented in Figure I. 19.

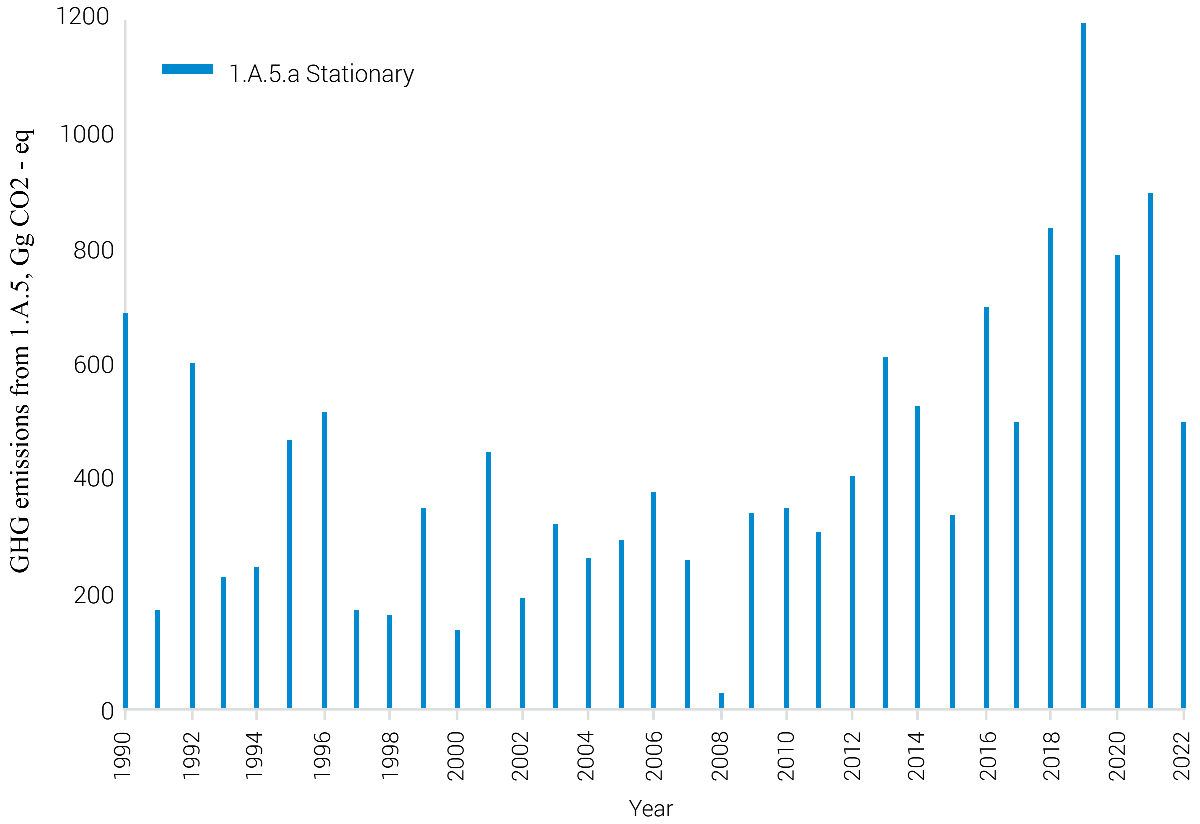


Figure I. 19. GHG emissions from non-specified (1.A.5)

1.7.1.8. Solid fuels (1.B.1)

In Mongolia, fugitive emissions from fuels are produced primarily in the coal mining, handling, and oil industries. Currently, the country does not have any petroleum refining industries. The methane CH_4 emissions from solid fuels (1.B.1) category of Mongolia includes emissions primarily from coal mining and handling (1.B.1.a). In Mongolia, only surface mining operations are conducted, as there are no underground coal mines. Therefore, emissions are estimated solely from surface mining activities. The total national coal production is used as the activity data for this category. Fugitive emissions from other fuel-related activities, including oil exploration, transportation, refining, and distribution, were not estimated due to either the unavailability of relevant data or the absence of these activities within the country. The overview of total fugitive emissions from surface mining has been presented in Figure I. 20.

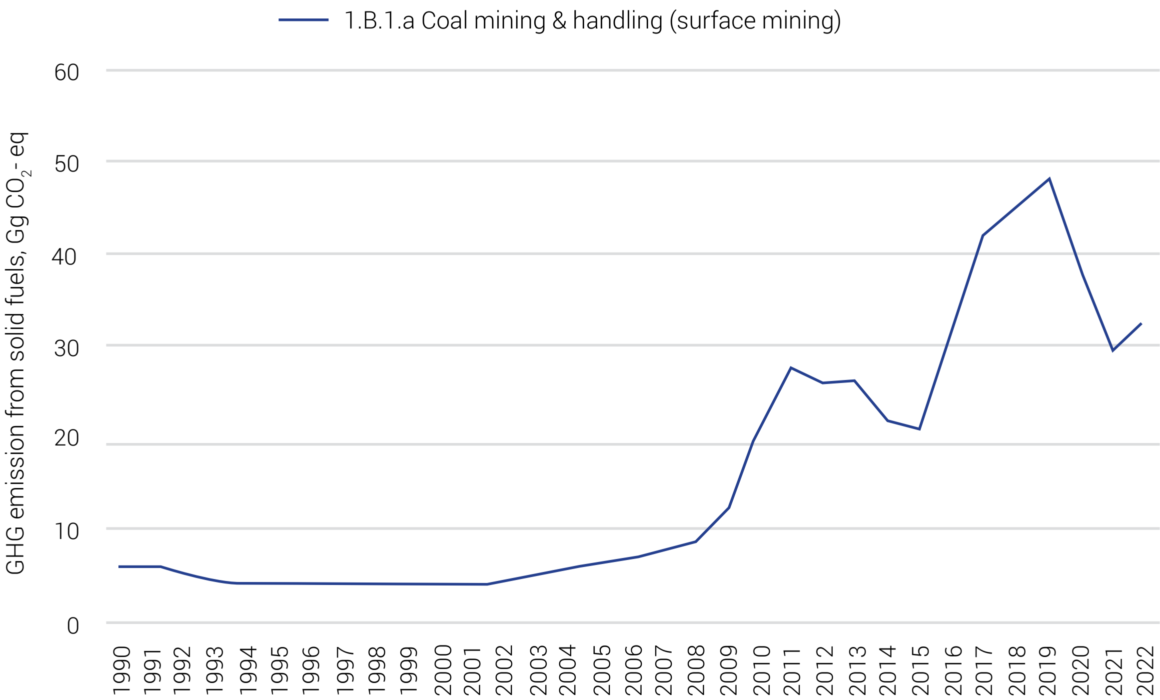


Figure I. 20. GHG CH4 emissions from solid fuels (1.B.1)

1.7.1.9. Oil and natural gas (1.B.2.a.ii)

Crude oil production in Mongolia began in 1996, with an initial exploration of around 2,000 cubic meters of oil. By 2020, this figure had increased to 1.2 million cubic meters. The crude oil extracted is exported directly to China. Between 1996 and 2016, approximately 5.9 million tons of oil were explored in the country. The oil and natural gas (1.B.2) category of Mongolia includes emissions from oil flaring (1.B.2.a.ii), which accounts for the flaring of natural gas and waste gas or vapor streams at oil production facilities. Additionally, this category covers oil production and upgrading (1.B.2.a.iii.2), specifically considering emissions associated with the extraction and processing of coal and crude oil in Mongolia. These activities are significant contributors to fugitive emissions in the energy sector, although the scope is limited by the availability of infrastructure and production scale. Regarding Venting (1.B.2.a.i), the GHG emissions were not estimated due to lack of data collections.

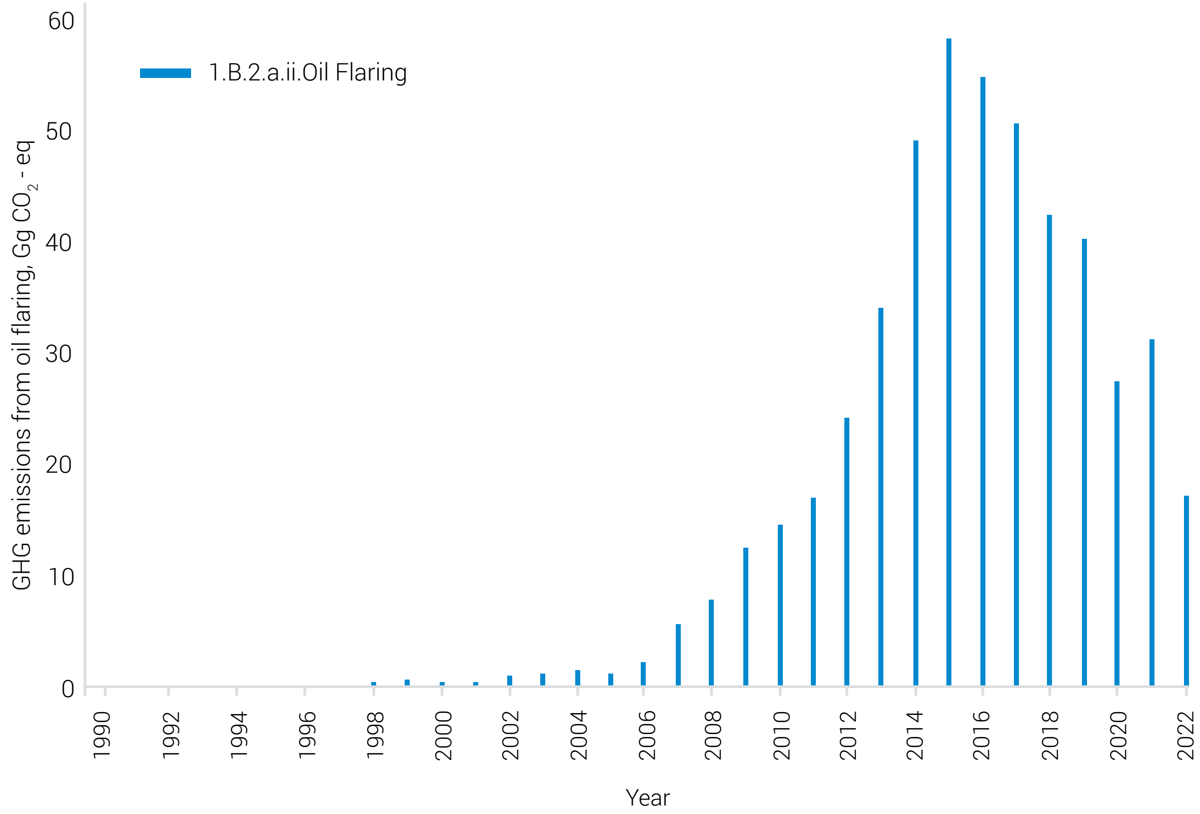


Figure I. 21. GHG emissions from oil and natural gas (1.B.2.a.ii)

Since 1998, the production amount of crude oil has started registered in the national statistics. Therefore, figures from 1990 until 1998 were reported as not occurring (NO). The inter annual changes depends on oil production. Crude oil production in Mongolia rose sharply until 2015 but declined gradually until 2022 (Figure I.21). This drop was due to fewer oil exploration license holders, as well as reduced demand and lower global prices.

1.7.1.10. Comparison of the sectoral approach with the reference approach

GHG emissions from fuel combustion are estimated using the Sectoral Approach (SA), which is based on actual fuel demand statistics, and the Reference Approach (RA), which relies on fuel supply statistics. The RA calculates CO_2 emissions from fuel combustion using high-level energy supply data. It assumes that carbon is conserved, meaning the carbon in crude oil matches the total carbon in its derived products. The RA does not differentiate between source categories in the energy sector and only addresses total CO_2 emissions from fuel combustion in source category 1.A (IPCC, 2006, p. 6.5). This section compares the results of SA and RA (Table I.17.).

Table I. 17. Comparison of CO2 emissions between RA and SA for the period 1990-2022

Year	SA Gg CO_2-eq	RA Gg CO_2-eq	Difference %
1990	10728.51	11782.23	-10.5
1991	11197.88	11932.08	-7.3
1992	11192.79	10269.81	9.2

1993	10338.57	9597.96	7.4
1994	8974.25	8468.661	5.1
1995	8947.25	8548.9	4.0
1996	7428.75	8321.18	-8.9
1997	7275.35	7625.964	-3.5
1998	7451.44	8170.7	-7.2
1999	7382.6	8192.572	-8.1
2000	8203.01	8566.12	-3.6
2001	7673.12	8627.627	-9.5
2002	8260.85	9153.238	-8.9
2003	8110.03	8820.79	-7.1
2004	8350.75	9166.655	-8.2
2005	9659	8819.978	8.4
2006	10596.98	9811.489	7.9
2007	11088.55	10163.53	9.3
2008	11222.82	10016.08	12.1
2009	11824.67	10560.8	12.6
2010	12749.36	11464.99	12.8
2011	14029	11306.39	27.2
2012	13803	12347.46	14.6
2013	16297.27	15325.57	9.7
2014	16317.2	15032.74	12.8
2015	14961.9	14500.18	4.6
2016	16228.68	14829.79	14.0
2017	17573.71	16323.09	12.5
2018	19093.78	17717.94	13.8
2019	21721.38	18629.93	30.9
2020	19428.93	17568.59	18.6
2021	15339.05	19082.58	-37.4
2022	18504.08	19846.26	-13.4

1.7.1.11. Sector specific recalculations

All GHG estimates have been recalculated for entire time series due to updated AD covering the period of 1990-2022 and use of 100-year GWPs from the IPCC Fifth Assessment Report as referenced in Table I.17.

1.7.1.12. Sector specific QA/QC and verification

QA/QC described in 1.3.3 are applied in energy sector. All information and activity data used for estimation of emissions have been double-checked by sectoral experts and cross-checked experts from other sectors. The data from IEA cross-checked with national statistics. IPPU sector experts cross-checked the data for this waste sector AD, calculations and consistencies between BTR1 and CRT. The AD and methods used to estimate GHG emissions under this sector were documented by the expert sector and archived both in hard copies and electronically. Sector specific improvement and planned improvements.

1.7.1.13. Sector specific planned improvements

The time series of the activity data was covered for the period of 1990-2022 for this inventory. The IPCC inventory software was firstly used for tthe estimation. Sector specific planned improvements is provided in Table I.33 under 1.8 data gaps and improvement plans.

1.7.2. INDUSTRIAL PROCESSES AND PRODUCT USE (IPPU)

1.7.2.1. Overview

The IPPU sector accounts for 709.94 Gg CO2-eq in 2022, which is 1.5% of national GHG emissions (Figure I.23).

The GHG emissions of the IPPU sector in Mongolia are estimated from only four source caegories out of IPCC eight subsectors. The subsectors covered in current inventory presented in Figure I.22. The remaining activities under the IPPU sector were excluded from the inventory because they either did not take place in Mongolia or lacked sufficient data for use. In Mongolia, the category "Other Product Manufacture and Use" (2.G) includes several subcategories with varying data availability and relevance. SF_6 gas-insulated electrical equipment is installed at the 4th Thermal Power Plant, and these units are sealed for life, preventing emissions under normal operating conditions except in the event of accidents. Consequently, the subcategory for manufacture (2.G.1.a) is reported as "NO" (not occurring), the use (2.G.1.b) as "NA" (not applicable), and disposal (2.G.1.c) as "NE" (not estimated) due to a lack of data.

Regarding subcategory 2.G.2, UN COMTRADE statistics show that fluorinated substances—particularly those listed under HS codes 282619 and 382478—have been imported to or exported from Mongolia in recent years. However, due to the unavailability of precise data on the quantities and intended uses of these substances, this subcategory is also reported as "NE."

Historically, nitrous oxide (N_2O) was used as an anesthetic in Mongolia, but it is no longer in use. Because the specific date of discontinuation is unknown, emissions from medical applications (2.G.3.a) are reported as "NE" before 2009 and "NO" after 2010. Emissions from the use of N_2O in propellants for pressure and aerosol products (2.G.3.b) are reported as "NE" due to insufficient information. Although paper and pulp production (2.H.1) and food and beverage processing (2.H.2) activities do exist in Mongolia, they are not identified as sources of greenhouse gas emissions under the IPPU sector. Therefore, category 2.H is reported as "NA" (not applicable).

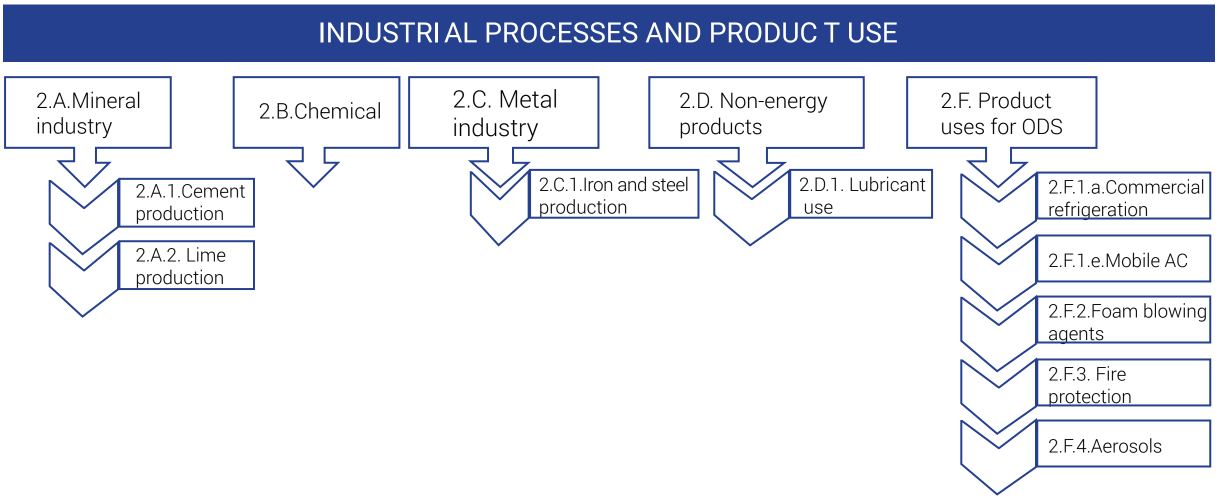


Figure I. 22. Coverage of the IPPU sector in Mongolia

The total emissions from IPPU sector accounts for only 1.5% (see Figure I. 9.) to national total. Aggregated emission estimates in IPPU sector presented in Table I.18.

Table I. 18. Overview of emissions in the IPPU sector in the base year and in the last year of inventory, in Gg, CO2-eq

Category	Gas	1990 (Base year)	2022 (Latest year)	Difference in 1990 and 2022, %	Contribution to total emission in 2022, %		
					Total CO_2-eq	Sector	Gas
2A	CO_2	249.23	585.75	135.02%	1.20%	82.51%	2.86%
2C	CO_2	0.00	2.00	-	0.00%	0.28%	0.01%
2D	CO_2	12.89	0.01	-99.89%	0.00%	0.001%	0.00%
2F	HFCs	0.00	122.17	-	0.25%	17.21%	100.00%
		Total			1.45%	100%	

Since 2015, GHG emissions from the IPPU sector have increased considerably. This increase is largely attributed to the growing consumption of products that serve as substitutes for ozone-depleting substances. Additionally, starting from 2014, the processing technology of two major cement plants transitioned from a wet process to a dry process, resulting in a production capacity of 1 million tons of cement per year.

The total IPPU emissions in 2022 were from the mineral industry (99.24%), the products used as substitutes for ozone-depleting substances (0.42%), and the rest of the subcategories (0.35%), as illustrated in Figure 24. In 2022, GHG emissions from the mineral industry rose by 135% compared to the base year 1990. Emissions from non-energy products related to fuels and solvents decreased by 99.92% from the base year. Meanwhile, emissions from ozone-depleting substance substitutes surged 122.17 Gg CO2-eq. Emissions estimates of all source categories for entire time series (1990-2022) included in this inventory provided in table I.7. and CRT.

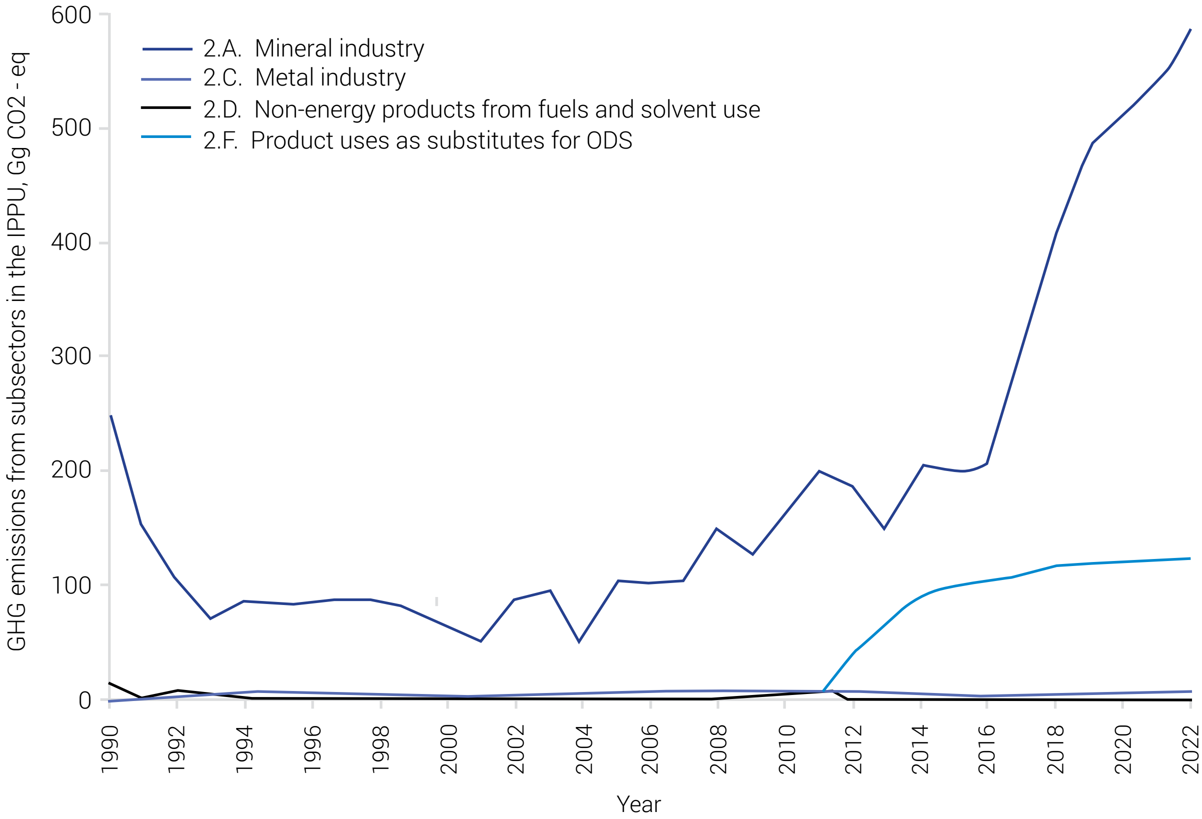


Figure I. 23. Contribution of subsectors to GHG emissions in the IPPU sector

1.7.2.2. Key categories

Emissions from Category 2.A.1 — Cement production (which is a significant source of carbon dioxide (CO_2) emissions), Category 2.A.2 — Lime production (another major contributor to CO_2 emissions due to the calcination process), and Category 2.F.1 — Refrigeration and Air Conditioning (primarily associated with emissions of hydrofluorocarbons (HFCs)) without LULUCF have been identified key categories by in 2022. (See Table I.3).

1.7.2.3. Methodologies and data source

The IPPU sector of the GHG inventory estimation was conducted using the 2006 IPCC GLs Volume 3 and applied Tier 1 method. Table I. 23 presents the selected methods and emission factors used in the IPPU sector.

Table I. 19. Methods and EFs applied in IPPU sector.

2	IPPU	CO_2		HFCs	
		Method	EF	Method	EF
2.A.	**MINERAL INDUSTRY**				
2.A.1.	Cement production	T1	D		
2.A.2.	Lime production	T1	D		
2.C.	**METAL INDUSTRY**				
2.C.1.	Iron and steel production	T1	D		
2.D.	**NON-ENERGY PRODUCTS FROM FUELS AND SOLVENT USE**				
2.D.1.	Lubricant use	T1	D		

2.F.	PRODUCT USES AS SUBSTITUTES FOR OZONE DEPLETING SUBSTANCES		
2.F.1.	Refrigeration and air conditioning	T1	D
2.F.1.a.	Commercial refrigeration	T1	D
2.F.1.e.	Mobile air conditioning	T1	D
2.F.2.	Foam blowing agents	T1	D
2.F.3.	Fire protection	T1	D
2.F.4.	Aerosols	T1	D

The general equations applied to estimate GHG emissions for each category in the IPPU sector are provided below.

2.A.1. Emission based on cement production: The emissions from cement production are estimated by Tier 1, applying the amount of cement produced and the default emission factor in accordance with the decision tree of the 2006 IPCC GLs.

2.A.2. Emission from lime production: The emissions from lime production were estimated by Tier 1, applying the amount of lime produced and the default emission factor in accordance with the decision tree of the 2006 IPCC GLs.

2.C.1. CO_2 emissions from iron and steel production: The emissions from iron and steel production were estimated by Tier 1, applying the amount of cement produced and the default emission factor in accordance with the decision tree of the 2006 IPCC GLs.

2.D.1. Lubricant: The emissions from lubricants are estimated by Tier 1, applying the amount of lubricant produced and the default emission factor in accordance with IPCC GLs.

2.F. Product uses a substitute for ODS: The emissions product used as a substitute for ODS was estimated by Tier 1 applying the amount and default emission factor in accordance with the 2006 IPCC GLs.

The emission factor and parameters for the IPPU sector are default values from IPCC guidelines, as illustrated in below table.

Table I. 20. Parameters and emission factors in the IPPU sector

2	INDUSTRIAL PROCESSES AND PRODUCT USE	Clinker fraction	EF for the clinker	CKD correction	CO_2 EF
2.A.	**MINERAL INDUSTRY**				
2.A.1.	Cement production	0.75/0.85	0.51/0.52	1.02	
2.A.2.	Lime production		0.75		
2.C.	**METAL INDUSTRY**				
2.C.1.	Iron and steel production				0.08
2.D.	Non-energy products from fuels and solvent use				
2.D.1.	Lubricant use	20/0.2			
2.F.	**Product uses as substitutes for ozone depleting substances**	**Growth rate**	**Lifetime**	**First year loss EF**	**Annual year loss EF**
2.F.1.	Refrigeration and air conditioning				
2.F.1.a.	Refrigeration and stationary air conditioning				

	HFC-134a	10.03	15		
	HFC-32	3.02	15		
	HFC-125				
	HFC-143a				
2.F.1.b.	Mobile air conditioning	1	15		
2.F.2.	Foam blowing agents				
	HFC-152a			50	25
	HFC-245fa			15	1.5
2.F.3.	Fire protection				
	HFC-125	3/4	15		
	HFC-227ea	3/4	15		

1.7.2.4. Mineral industry (2A)

The mineral industry (2.A) category in Mongolia encompasses greenhouse gas (GHG) emissions from key industrial processes, primarily focusing on cement and lime production. Under cement production (2.A.1), emissions are calculated from the operation of four major cement manufacturing facilities: the Darkhan Cement Plant, established in 1968; the Cement and Lime Plant, commissioned in 1983; Mon-Cement Materials LLC, which began operations in 2006; and MAK Eurocement LLC, operational since 2017. Since 2014, all cement production facilities in Mongolia have either transitioned to or commenced operations using dry processing technology, which is more energy-efficient and environmentally favorable compared to the older wet processing methods. This shift has implications for both emission factors and energy consumption patterns within the sector. For lime production (2.A.2), emissions are derived from activities at the Cement and Lime Plant, which includes a dedicated lime production line.

This facility has an estimated production capacity of approximately 65.0 tones of lime per year. The emissions from this process result primarily from the calcination of limestone ($CaCO_2$), which releases carbon dioxide (CO_2) as a byproduct. The activity data and emission factors used for this category align with IPCC guidelines to ensure consistency and accuracy in national inventory reporting. Some glass companies in Mongolia have tempering furnaces, but none have kilns for raw material production. Since tempering doesn't contribute to IPPU emissions, these emissions from glass production (2.A.3) are reported as not applicable (NA). Red brick production can emit CO_2 from the carbonate in the clay, similar to cement. However, accurate estimates are unrealistic due to a need for more information on brick weight, clay consumption, and carbonate content. There is currently no identified industrial ceramic production, and while ceramic tile production existed until 1995, no records are available. Consequently, this category (2.A.4.a) has been labelled as not estimated (NE) throughout the time series. A recent import of soda ash to Mongolia is recorded in the United Nations Commodity Trade Statistics Database (UN COMTRADE) as being several hundred tonnes per year. However, challenges arise in using these figures as activity data due to incomplete time series and lack of usage information. Thus, this category (2.A.4.b) is reported as "not estimated" (NE). Mongolia has no magnesium mines or production. This category (2.A.4.c) is marked as not occurring (NO). Within the mineral industry, cement production was responsible for 91% of the emissions, while lime production accounted for the remaining 9% in 2022 (Figure I.24).

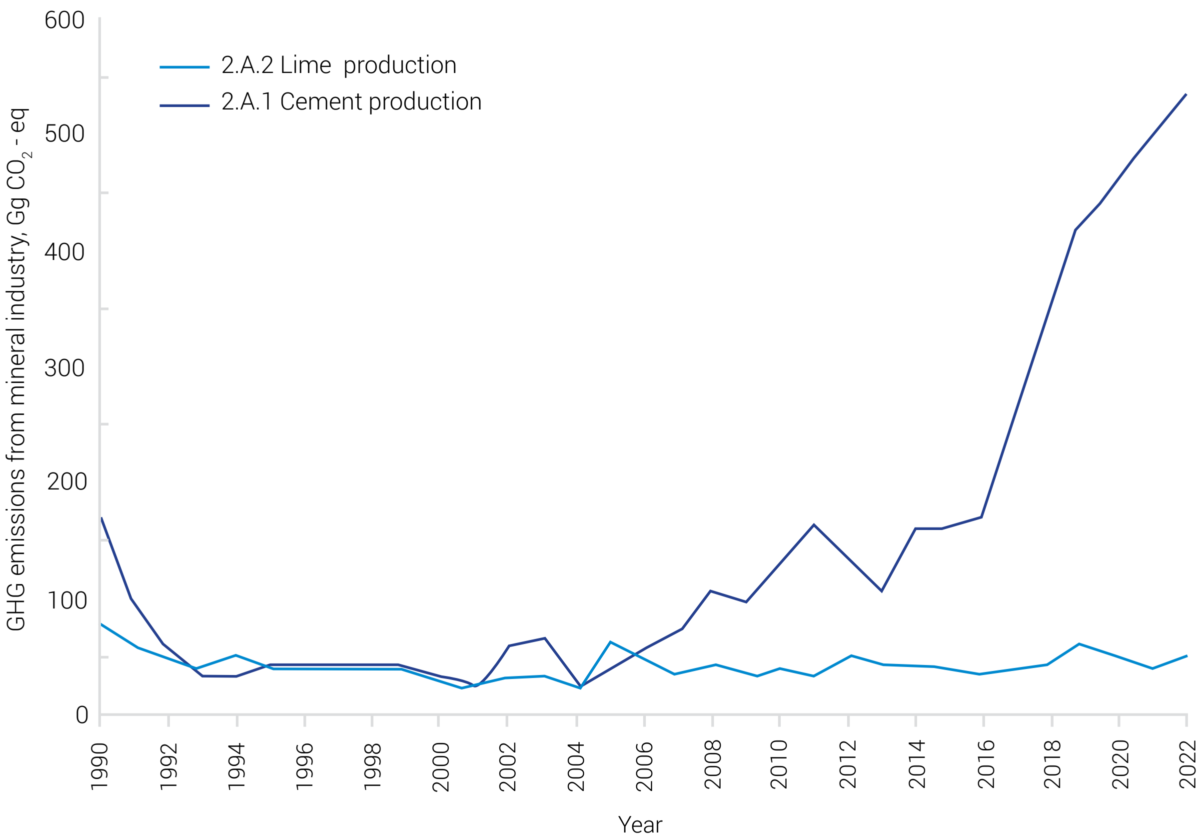


Figure I. 24. GHG emissions from mineral industry (2.A) by source categories

1.7.2.5. Metal industry (2C)

The metal industry (2.C) category in Mongolia accounts for greenhouse gas (GHG) emissions primarily from iron and steel production (2.C.1). This category includes emissions associated with iron and steel production activities in the country, which have been ongoing since 1995. In Mongolia, Electric Arc Furnace (EAF) technology is employed for steelmaking, which significantly influences the emission profile of the sector. As a result, the national GHG inventory under this category includes emissions only from pig iron production using metallurgical coke and steel production processes. The use of EAFs, which typically rely on recycled scrap and electricity rather than traditional blast furnace methods, results in comparatively lower direct CO_2 emissions. Nevertheless, emissions from pig iron production, which involves the reduction of iron ore using coke as a reducing agent, remain a relevant and reported source under this category.

In terms of other production activities under this category, ferroalloys production (2.C.2) is presumed to take place in Mongolia and may result in CO_2 and CH_4 emissions. However, due to the lack of reliable data on annual production, emissions from this source are not estimated and are reported as "Not Estimated" (NE). Mongolia does not produce aluminium (2.C.3) or magnesium (2.C.4); therefore, these categories are reported as "Not Occurring" (NO). Although the country produces and exports considerable quantities of lead (2.C.5) and zinc ores (2.C.6), it does not have domestic smelting facilities, and as a result, no IPPU-related emissions are generated. Consequently, these categories are also reported as "NO". CO_2 and CH_4 are emitted during Direct Reduced Iron (DRI) production in Mongolia. These emissions mainly result from the oxidation of reducing gases and carbon sources from fossil fuels like natural gas and coke. They are classified as "Included Elsewhere" (IE) under 1.A.2 (Fuel Combustion: Manufacturing and Construction Industries) until further data can distinguish between energy and non-energy emissions. Data on cast iron production after 2008, found in the Industrial Statistics 2017, indicates annual production is typically under 200 tons. This production is generally carried out in electric induction or arc furnaces, but the 2006 IPCC Guidelines do not specify an estimation method for cast iron, leading to its classification as "Not Estimated" (NE). This source category constitutes a small fraction, around 0.28% of the IPPU total emissions, as in 2022 (Figure I. 25).

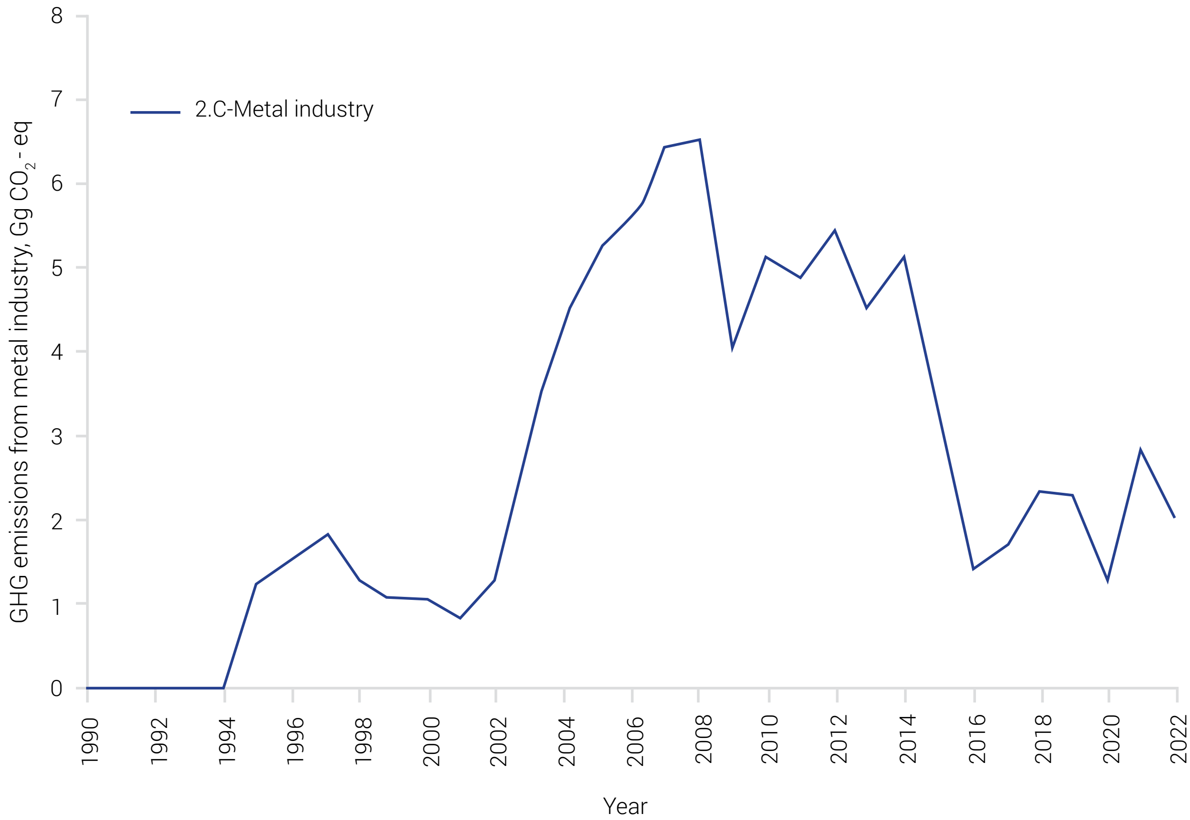


Figure I. 25. GHG emissions from metal industry (2.C)

1.7.2.6. Non-energy products from fuels and solvent use (2D)

The non-energy products from fuels and solvent use (2.D) category in Mongolia includes greenhouse gas (GHG) emissions primarily from lubricant use (2.D.1). This sub-category accounts for emissions resulting from the use of lubricants in both industrial processes and the transportation sector. Due to the absence of domestic oil refineries, Mongolia imports all lubricants, which include motor oils, industrial oils, and greases. Since there is no local lubricant production, the national inventory assumes that all imported lubricants are used within the same year they are brought into the country. However, it is difficult to determine the proportion of these lubricants that are combusted and contribute directly to CO_2 emissions, as lubricants are often used for mechanical and protective purposes rather than as fuels. Given this uncertainty, it is conservatively assumed that all lubricants imported are consumed as motor and industrial oils within the year of import. In the category of other products from fuels and solvent use, paraffin wax and bituminous fuel are grouped together in national statistics, making it challenging to distinguish their individual contributions. As a result, emissions for this subcategory (2.D.2) are classified as "Included Elsewhere" (IE) within the energy sector. Enhancing data on "non-energy use" would support more accurate emission estimates in the future. Solvent use in Mongolia (2.D.3) does not lead to GHG emissions under the IPPU sector and is therefore reported as "Not Applicable" (NA). Although asphalt production began in 2019, the scale remains minimal. According to the 2006 IPCC Guidelines, this activity (2.D.4) does not generate direct GHG emissions, though it may produce precursor emissions such as NMVOC, CO, and SO_2. Consequently, this category is also reported as "Not Applicable" (NA). This category accounts for about 0.001% of the IPPU sector in 2022, with lubricant consumption steadily declining since 2011 (Figure I.26).

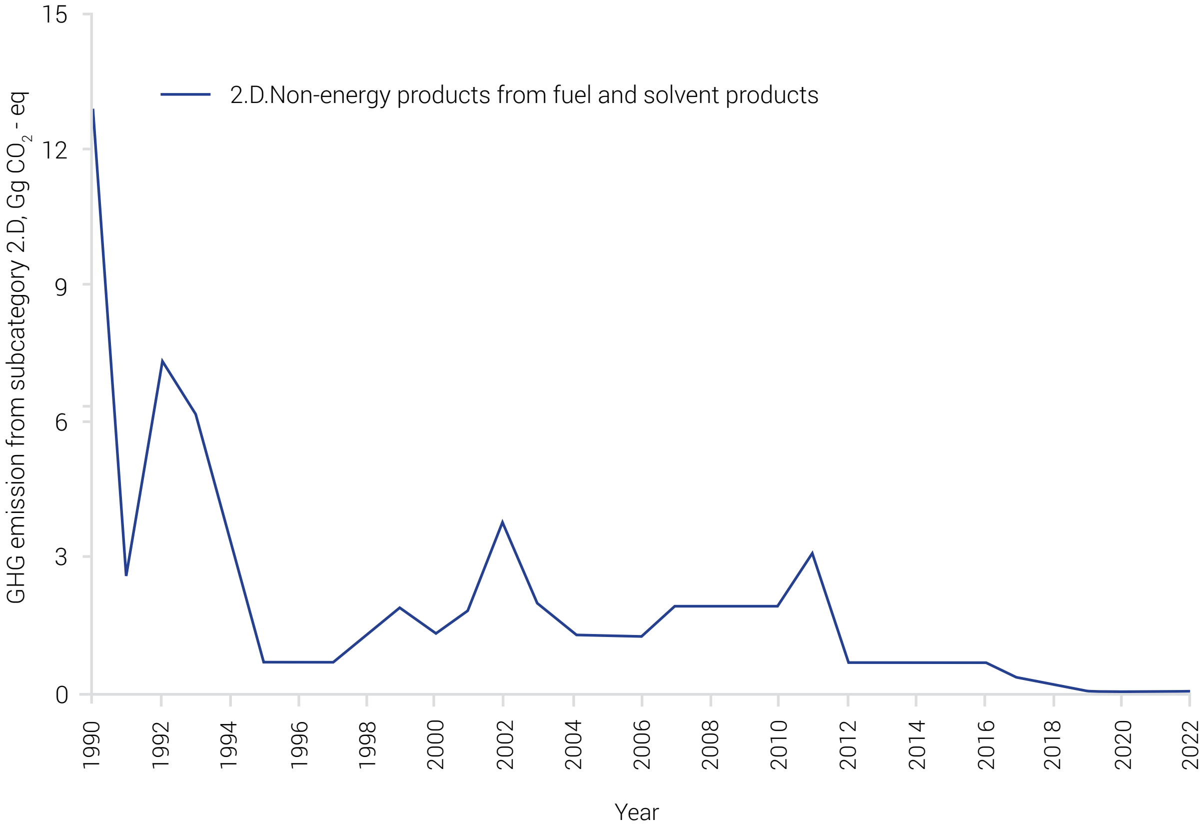


Figure I. 26. GHG emissions from non-energy products from fuel and solvent use (2.D)

1.7.2.7. Product uses as substitutes for ozone depleting substances (2F)

All substitutes for Ozone-Depleting Substances (ODS) in Mongolia are imported, with no local production or exports. Additionally, no chemicals are recovered or destroyed at the end of equipment's life, so consumption relies entirely on imports. On January 18, 2022, the Government of Mongolia ratified the Kigali Amendment to the Montreal Protocol, aiming to phase down HFC consumption (https://legalinfo.mn/). Starting in 2024, Mongolia's HFC usage must freeze at baseline levels, with an 80% reduction by 2047. This will improve data collection compared to previous ad-hoc surveys[28].

In Mongolia, emissions under the other product use (2.F) category primarily consist of hydrofluorocarbon (HFC) emissions from various application areas, including

[28] Annual Report. 2021. National Ozone Authority

Refrigeration and Air Conditioning (2.F.1), which encompasses mobile air conditioning systems and refrigerants imported either as bulk gases or pre-charged equipment; due to limited availability of detailed operational data, imported quantities are used as a proxy for activity data. The Foam Blowing Agents (2.F.2) subcategory includes emissions from extruded polystyrene (XPS) production utilizing HFC-152a since 2013 and from polyurethane spray applications using HFC-245fa since 2018, as reported by the National Ozone Authority (NOA); however, because of potential delays in consumption and limited data on actual usage timelines, all imported HFCs are assumed to be consumed in the year of import. In the Fire Protection (2.F.3) subcategory, HFC emissions are associated with equipment imports containing HFC-125 in 2013 and HFC-227ea in 2017, with no reported imports in other years. Finally, the Aerosols (2.F.4) subcategory considers Metered Dose Inhalers (MDIs) containing HFC-134a, which were imported in 2012 and 2013, but have since been replaced with non-HFC alternatives, resulting in no further emissions from this source after those years. Table I. 21 provides the main application areas for HFCs measured in Mongolia.

Table I. 21. Main application areas for HFCs in Mongolia

Application areas		HFC-23	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-245fa	HFC-227ea
Refrigeration	Domestic					x		
	Commercial		x		x	x		
	Large systems				x	x		
	Transport					x		
	Industrial chiller		x			x		
Air Conditioning	Residential and commercial			x	x	x		
	Chillers				x	x		
	Mobile					x		
Aerosols	Medical					x	x	x
Foam Blowing agents	Extruded Polystyrene				x			x

Currently, there are no relevant activities related to solvents (2.F.5) and other applications (2.F.6) found in Mongolia. All subcategories are therefore reported as NO.

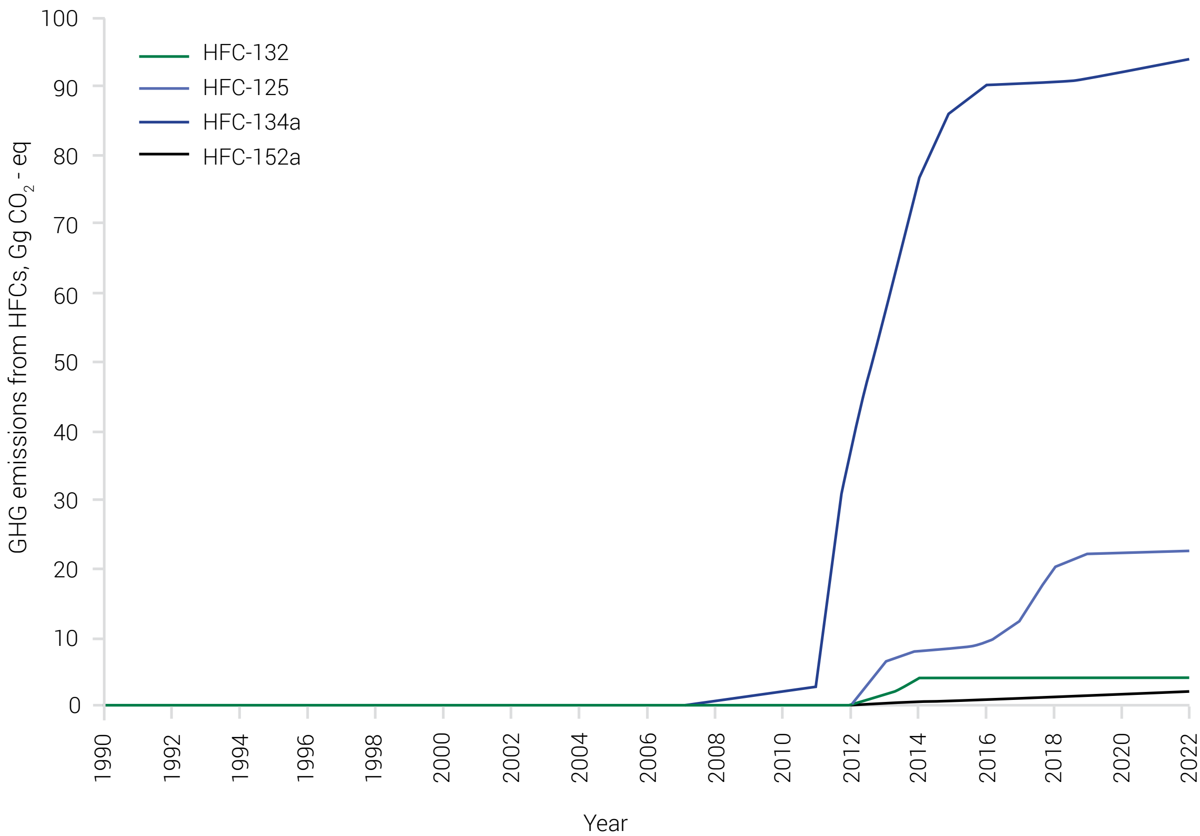


Figure I. 27. GHG emissions from HFCs (2.F) by source categories

In 2022, mobile air conditioning represented 97.98% of total GHG emissions (122.17 Gg CO_2-eq) from the Product used as substitutes for ozone depleting substances (2.F) category. The use of HFC as alternatives to ODS in Mongolia's commercial refrigeration and mobile air-conditioning sectors has surged in the past decade, driven by growth in construction and commercial services. The contributions of different HFCs are compared in Figure 27. Without intervention, HFC consumption is projected to rise from 39.86 tons in 2015 to 413 tons by 2030, with annual growth rates between 10% and 110% (NOA, 2021). In 2022, GHG emissions from foam blowing agents accounted for 0.011% (1.42 Gg CO_2-eq), while fire protection agents contributed 0.008% (1.03 Gg CO_2-eq) to the total emissions in the product uses substitutes for ozone-depleting substances (2.F) sector.

1.7.2.8. Sector specific recalculations

All GHG estimates have been recalculated for entire time series due to use of 100-year GWPs from the IPCC Fifth Assessment Report as referenced in Table I.11.

1.7.2.9. Sector specific QA/QC and verification

QA/QC described in 1.3.3 are applied in IPPU sector. All information and activity data used for estimation of emissions have been double-checked by sectoral experts and cross-checked experts from other sectors. Agriculture sector experts cross-checked the data for this IPPU sector AD, calculations and consistencies between BTR1 and CRT. The AD and methods used to estimate GHG emissions under this sector were documented by the expert sector and archived both in hard copies and electronically. Sector specific improvement and planned improvements.

1.7.2.10. Sector specific planned improvements

The time series of the activity data was covered for the period of 1990-2022 for this inventory. The IPCC inventory software was firstly used for the estimation.

Sector specific planned improvements is provided in Table I.34 under 1.8 data gaps and improvement plans.

1.7.3. AGRICULTURE SECTOR

1.7.3.1. Sector overview

In 2022, the agriculture sector was Mongolia's largest source of GHG emissions, contributing 55.2% (26,762.24 Gg, CO_2-eq) of the national total GHG emissions.

In Mongolia, greenhouse gas (GHG) emissions from the agriculture sector are primarily estimated based on four main production systems: the traditional semi-nomadic pastoral system, which involves the grazing of camels, horses, cattle, sheep, and goats across extensive rangelands; mechanized large-scale crop production, focusing on the cultivation of cereals and fodder crops; intensive farming operations that produce potatoes and a variety of vegetables using a mix of mechanized and manual methods; and intensive livestock systems, which include housed dairy cattle, pigs, and poultry managed under confined conditions. The size of livestock populations significantly influenced GHG emissions from the agriculture sector. Figure I.28 represents the coverage of categories in the Mongolian agriculture sector. Table I.22 presents the aggregated emissions in the main categories in the agriculture sector.

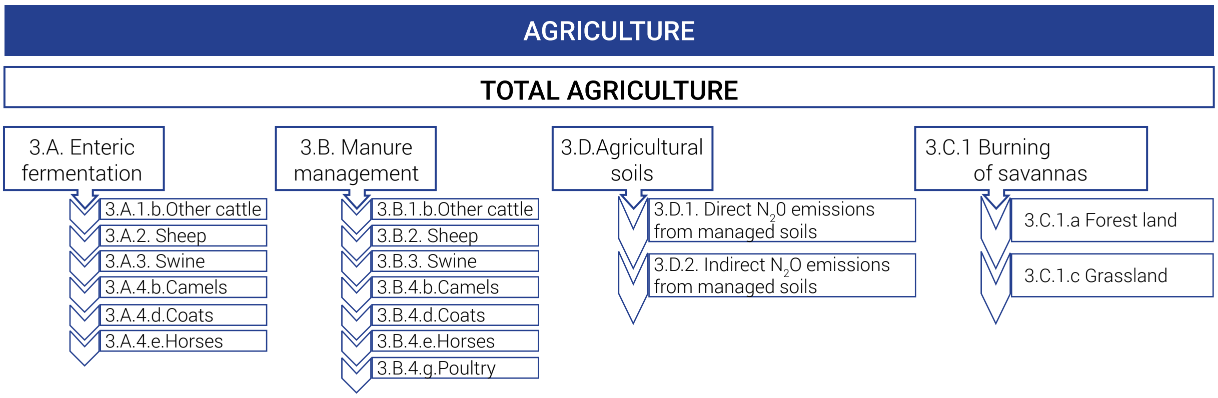


Figure I. 28. Coverage of the agriculture sector in Mongolia

Table I. 22. Overview of emissions in the agriculture sector in the base year and in the last year of inventory, in Gg CO2-eq

Category	Gas	1990 (Base year)	2022 (Latest year)	Difference in 1990 and 2022, %	Contribution to total emission in 2022, %		
					Total CO_2-eq	Sector	Gas
3A	CH_4	300.52	669.14	122.66%	38.63%	70.01%	91.37%
3B	CH_4	8.34	17.75	112.71%	1.02%	1.86%	2.42%

3D	N_2O	10.92	27.94	155.92%	15.27%	27.67%	95.04%
3E	CH_4	1.22	4.45	264.60%	0.26%	0.47%	0.61%
3E	N_2O	0.0002	0.00007	-65.64%	0.00004%	0.0001%	0.0002%
Total					55.17%	100%	

According to the 2022 level and trend assessments of greenhouse gas (GHG) emissions, both including and excluding Land Use, Land-Use Change, and Forestry (LULUCF), the key categories identified within Mongolia's agriculture sector are 3.A. Enteric Fermentation, 3.B. Manure Management, 3.D.1. Direct N_2O Emissions from Managed Soils, and 3.D.2. Indirect N_2O Emissions from Managed Soils.

Enteric fermentation (3.A) is a major source of methane (CH_4) emissions, resulting from the digestive processes of ruminant livestock such as cattle, sheep, goats, and camels, particularly under Mongolia's traditional semi-nomadic pastoral system. Manure management (3.B) also contributes significantly to CH_4 emissions through the anaerobic decomposition of manure, especially from housed livestock systems where manure is stored under oxygen-limited conditions. Direct N_2O emissions from managed soils (3.D.1) occur due to the application of nitrogen-based fertilizers (both synthetic and organic), livestock manure, and crop residues, which promote microbial nitrification and denitrification processes in the soil. Indirect N_2O emissions (3.D.2) arise from nitrogen losses through leaching, runoff, and volatilization of nitrogen compounds such as ammonia (NH_3) and nitrogen oxides (NO_x), which are later converted to N_2O after being transported from their original source areas to other parts of the environment.

Between 1990 and 2022, GHG emissions from agriculture increased from 12,407.15 to 26,762.24 Gg CO_2-eq, which is 115.7% increase. The increased emissions primarily due to the growth in domestic livestock population from 25,856.90 to 71,121.45 thousand heads.

In 2022, enteric fermentation (3.A) was the largest emitter in the agriculture sector, accounting for 70% of emissions. This was followed by the agricultural soil's subsector (3.D), which contributed 27.6% to the total (Figure I.29). The combined emissions of burning (3.C.1) and manure management (3.B) contributed only 2.3% to total GHG emissions in agriculture. All sub sectors except 3.E show upward trends from 1990 to 2022. The GHG emissions shares of 3.A and 3.D within the sectoral increased from 67.8% and 23.3% to 70%and 27.6%, respectively. Emissions estimates of all source categories for entire time series (1990-2022) included in this inventory provided in Appendix I.8. and CRT.

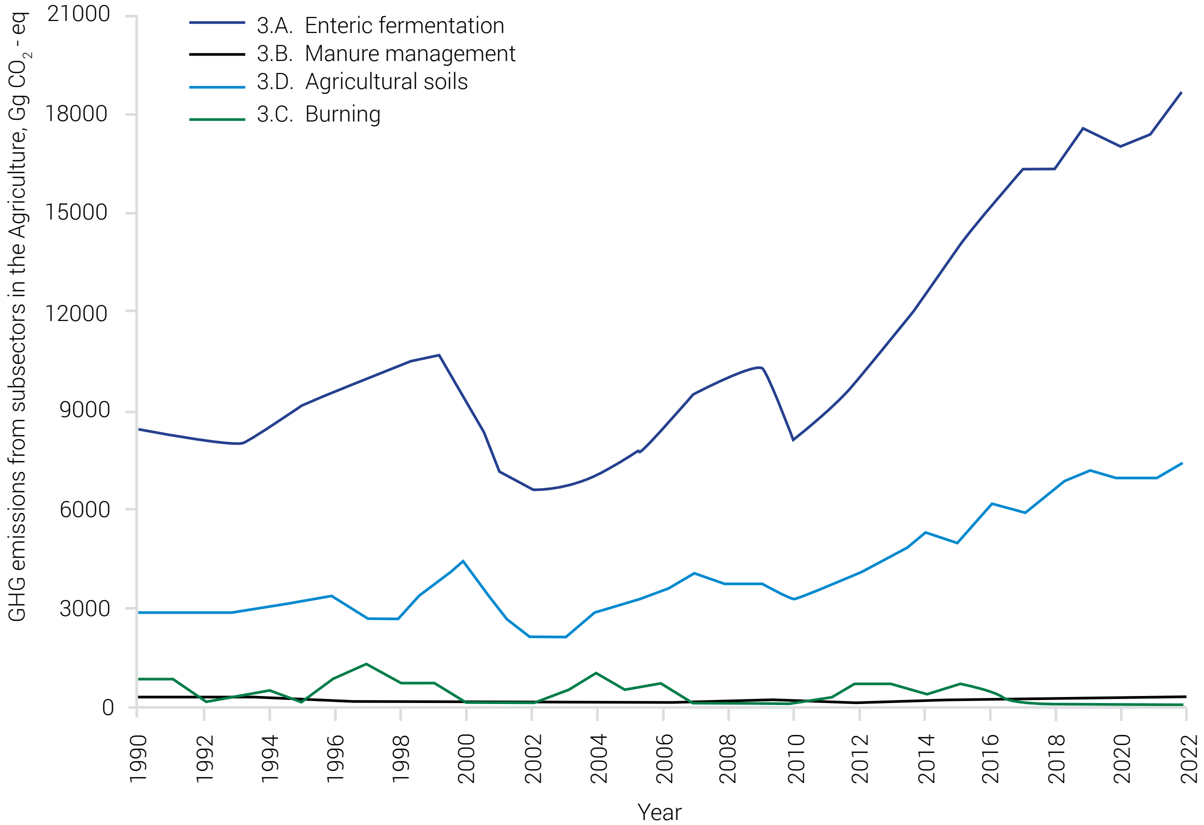


Figure I. 29. Contribution of subsectors to GHG emissions in the agriculture sector

1.7.3.2. Key categories

According to the 2022 level and trend assessments of greenhouse gas (GHG) emissions, both including and excluding Land Use, Land-Use Change, and Forestry (LULUCF), the key categories identified within Mongolia's agriculture sector are 3.A. Enteric Fermentation, 3.B. Manure Management, 3.D.1. Direct N_2O Emissions from Managed Soils, and 3.D.2. Indirect N_2O Emissions from Managed Soils. Enteric fermentation (3.A) is a major source of methane (CH_4) emissions, resulting from the digestive processes of ruminant livestock such as cattle, sheep, goats, and camels, particularly under Mongolia's traditional semi-nomadic pastoral system. Manure management (3.B) also contributes significantly to CH_4 emissions through the anaerobic decomposition of manure, especially from housed livestock systems where manure is stored under oxygen-limited conditions.

Direct N_2O emissions from managed soils (3.D.1) occur due to the application of nitrogen-based fertilizers (both synthetic and organic), livestock manure, and crop residues, which promote microbial nitrification and denitrification processes in the soil. Indirect N_2O emissions (3.D.2) arise from nitrogen losses through leaching, runoff, and volatilization of nitrogen compounds such as ammonia (NH_3) and nitrogen oxides (NO_x), which are later converted to N_2O after being transported from their original source areas to other parts of the environment.

1.7.3.3. Methodologies and data sources

In the Agriculture sector, the 2006 IPCC GLs, Vol. 4, Ch. 10 methodology have been used. Generally, emissions from Livestock (3.A) and Aggregate sources and non-CO_2 emissions sources on land (3.C) were estimated using the Tier 1 and default EFs values. Table I.23 presents the selected methods and emission factors used in the agriculture sector.

Table I. 23. Methods and EFs applied in Agriculture sector.

3	AGRICULTURE	CH_4		N_2O	
		Method	EF	Method	EF
3.A.	Enteric fermentation	T1	D		
3.B.	Manure management	T1	D		
3.C.1.a	Forest land	T1	D/	T1	D
3.C.1.c	Grassland	T1	D	T1	D
3.D.1.	Direct N_2O emissions from managed soils	T1	D		

The general equations applied to estimate GHG emissions for each category in the agriculture sector are provided below.

3.A. Enteric fermentation emissions from a livestock category: Emissions from enteric fermentation were calculated at Tier 1, following the 2006 IPCC GLs, Vol. 4, Ch. 10 methodology.

3.B. CH_4 emissions from manure management: GHG emissions from manure management consist of methane (CH4) and nitrous oxide (N_2O) gases from aerobic and anaerobic manure decomposition processes. The term „manure" is used here collectively to include both dung and urine produced by livestock. The emissions level depends on the amount of manure treated and handled within manure management systems and type of manure management systems.

The main manure management systems covered by this inventory were pasture/range/paddock for the cattle, sheep, goats, horses and camels, and a daily spread system of the swine and poultry. For these two systems, N2O emissions during manure storage and treatment are assumed to be zero, and N2O emissions from land application of Mongolian livestock are covered under the Aggregate sources and non-CO2 emissions sources on land (3.C) source category. Thus, only CH4 emissions were reported under the source category Manure management (3.A.2).

3.C.1.a. Forest land: The emissions from burning biomass combustion of forest land and grassland were estimated using the 2006 IPCC GLs. Vol. 4, Ch. 2 based on data wild forest and pasture fires happened in Mongolia.

Enteric fermentation (3.A) largest source of methane (CH_4) emissions from livestock in Mongolia. Methane is produced in herbivores as a by-product of enteric fermentation, where microorganisms break down carbohydrates for absorption into the bloodstream. The amount of methane released depends on the type of digestive tract, the animal's age and weight, and the quality and quantity of feed. Ruminant livestock, like cattle and sheep, are major sources of methane, while non-ruminants, such as horses and pigs, produce less. The structure of the ruminant gut promotes extensive fermentation of their diet (2006 IPCC GLs, Vol.4, Ch.10, page 10.24).

Figure I. 30 illustrates the total methane emissions produced by enteric fermentation by different types of livestock. CH_4 emissions decreased sharply due to loss of animals during harsh winters that happened in 1999-2002 in raw. Mongolia lost 3.3 million heads of livestock (10%) in winter 1999-2000, 4.2 million (14%)-2002-2001, and 2.2 million (8%) -2001-2002. 26% decreased CH_4 emission also is the result of harsh winter happened in 2009-2010 during which lost of over 11 million livestock Overall, total emissions from enteric fermentation increased from 8,414.51 Gg CO_2-eq in 1990 to 18,736.05 Gg CO_2-eq in 2022. Appendix I.8 presents the CH_4 emissions from enteric fermentation by livestock subcategories.

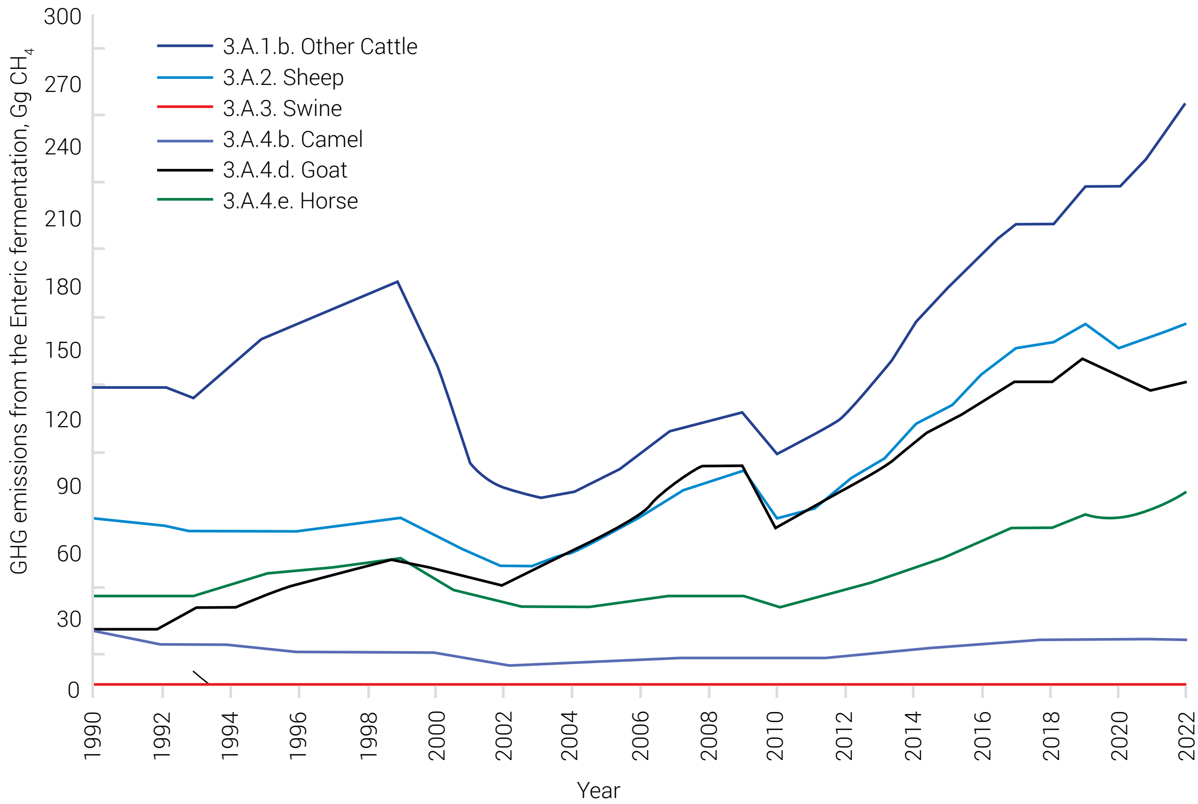


Figure I. 30. CH4 emissions from enteric fermentation by livestock, Gg CH4

1.7.3.4. Manure Management (3B)

Manure Management (3.B) considers methane CH_4 emissions from aerobic and anaerobic manure decomposition processes. The term "manure" refers to dung and urine from livestock. This inventory focuses on two systems: grazing areas for cattle, sheep, goats, horses, and camels, and a daily spreading system for swine and poultry. N_2O emissions during manure storage and treatment are assumed to be zero, and N_2O emissions from land application of Mongolian livestock are covered under the Aggregate sources and non-CO_2 emissions sources on land (3.D) source category. Figure I. 31 presents the trends of methane emissions from manure management by different livestock types. The emissions associated with manure management have increased, from 233.65 Gg CO_2-eq in 1990 to 496.99 Gg CO_2-eq in 2022. The considerable decrease in emissions in 2000-2002 and 2010 are due to high loss of livestock population during harsh winter happened in there years.

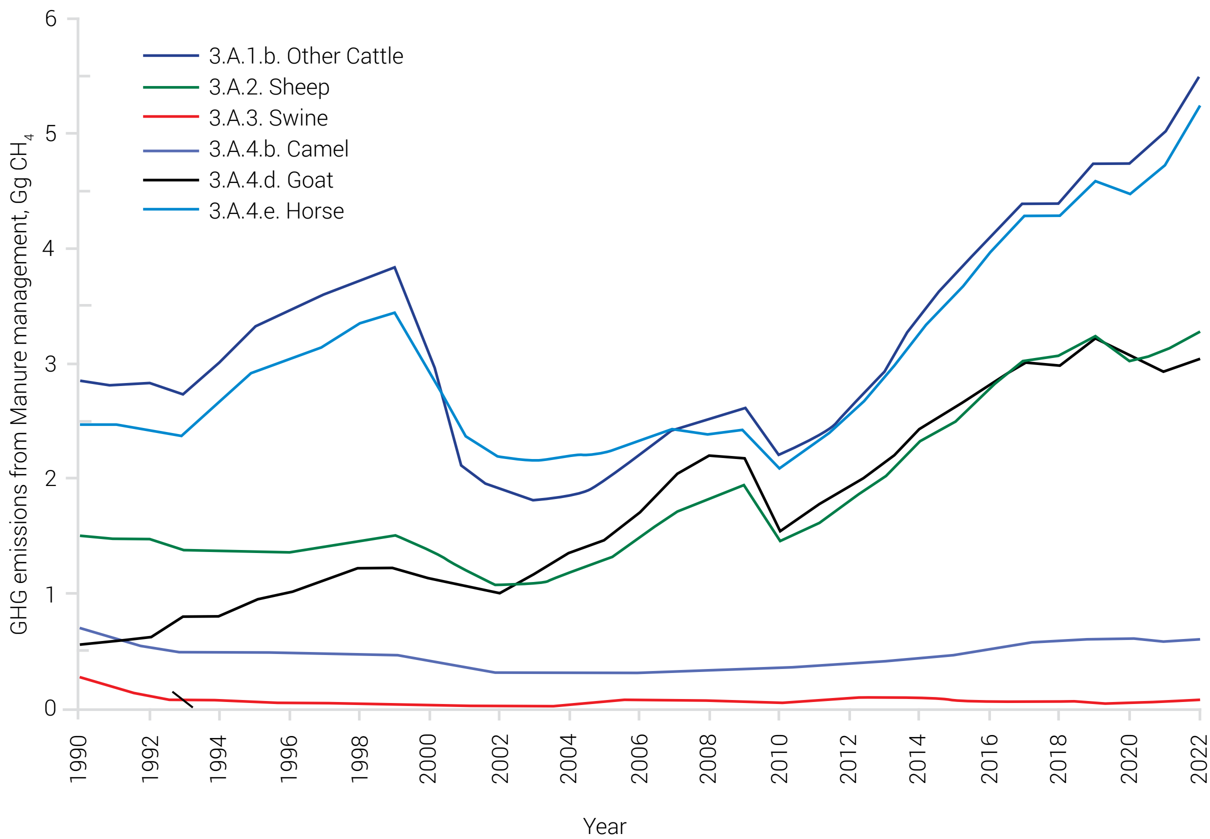


Figure I. 31. CH4 emissions from manure management by livestock, Gg CH4

In Mongolia, specialized dairy cattle breeds are rare, making up less than 1% of the total population; thus, all cattle are categorized as "other cattle." Broiler chickens are usually raised for about 60 days before slaughter. To avoid overestimation, the annual average poultry population is estimated using Equation 10.1 from the 2006 IPCC Guidelines.

In 1990, cattle contributed 20% of emissions from enteric fermentation, followed by sheep (11%), horses (6%), goats (4%), camels (4%), and swine (0.02%). By 2022, these shares changed to: cattle (39%), sheep (24%), goats (21%), horses (13%), and camels (3%). In 2022, the contributions of livestock to emissions from manure management were: cattle (31%), horses (30%), goats (17%), sheep (18%), camels (3%), swine (0.39%), and poultry (0.01%) (See Figure I. 31.)

1.7.3.5. Agricultural soils (3D)

This subsector includes emissions from two main source categories: Direct N_2O Emissions from Managed Soils (3.D.1) and Indirect N_2O Emissions from Managed Soils (3.D.2). Direct N_2O emissions (3.D.1) arise from the application of nitrogen-containing substances to agricultural soils, including synthetic fertilizers, organic fertilizers such as animal excreta and sewage sludge, droppings from grazing animals, and crop residues. These emissions also account for the cultivation of soils with high organic content, which can stimulate microbial activity leading to increased N_2O production through nitrification and denitrification processes.

Indirect N_2O emissions (3.D.2) result from agricultural practices that contribute to nitrogen losses through two main pathways. The first pathway involves the volatilization of nitrogen in the form of ammonia (NH_3) and nitrogen oxides (NO_x), which subsequently deposit as ammonium (NH_4^+) and nitrate (NO_3^-) onto soils and surface waters, where they undergo microbial transformation into N_2O. The second pathway includes nitrogen leaching and surface runoff caused by the application of synthetic and organic fertilizers, incorporation of crop residues, mineralization of nitrogen associated with soil organic carbon loss, and nitrogen inputs from the urine and dung of grazing animals. These inter-annual fluctuations highlight the complexity of nitrogen cycling in agricultural systems and its contribution to overall N_2O emissions in Mongolia's agriculture sector.

Direct N_2O emissions from managed soils are rising, contributing 72.47% to the total emissions of this category (See Figure I. 32). The indirect N_2O emissions in managed soils estimated 2,038.44 Gg CO_2-eq in 2022, representing 27.53% of total emissions within this subsector and increased 162.9% compared to 1990. The contribution of direct and indirect N_2O emissions in managed soils is compared in Appendix I.9 and Appendix I.13. The main contributor to these indirect N_2O emissions was the nitrogen (N) deposited by urine and dung from grazing animals on pastures, ranges, and paddocks, which made up 96.33% of the total. Other notable contributions included emissions from animal manure applied to soils (4.6%), synthetic fertilizers (3.1%), crop residues (0.55%), and other organic nitrogen additions applied to soils (0.004%). The considerable decrease in direct N2O emissions in 2000-2002 and 2010 are also due to high loss of livestock population during harsh winter that happened in there years.

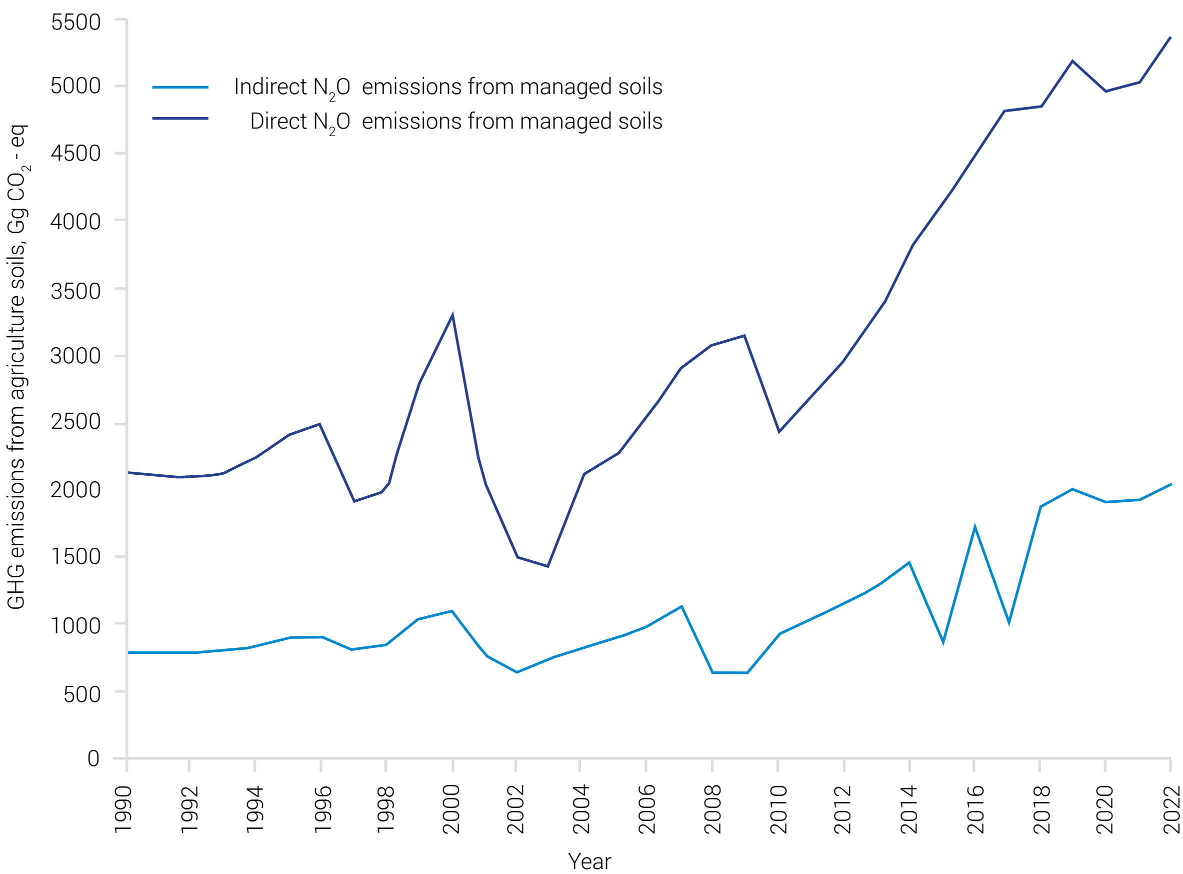


Figure I. 32. Emissions of agriculture soils (3.D) by subcategories, Gg CO2-eq

1.7.3.6. Burning (3.C.1)

This subsector includes emissions from biomass burning (3.C.1) considering biomass burning that consists of CH_4, N_2O, NO_x and CO emissions from biomass combustion of forest land and grasslands. Emissions from cropland and other lands are excluded due to the unavailability of data activity on that burned area. Fire is a disturbance that affects above-ground biomass and dead organic matter in forest ecosystems. In grasslands with little woody vegetation, the emphasis is on biomass burning, as this is the main component impacted by fire.

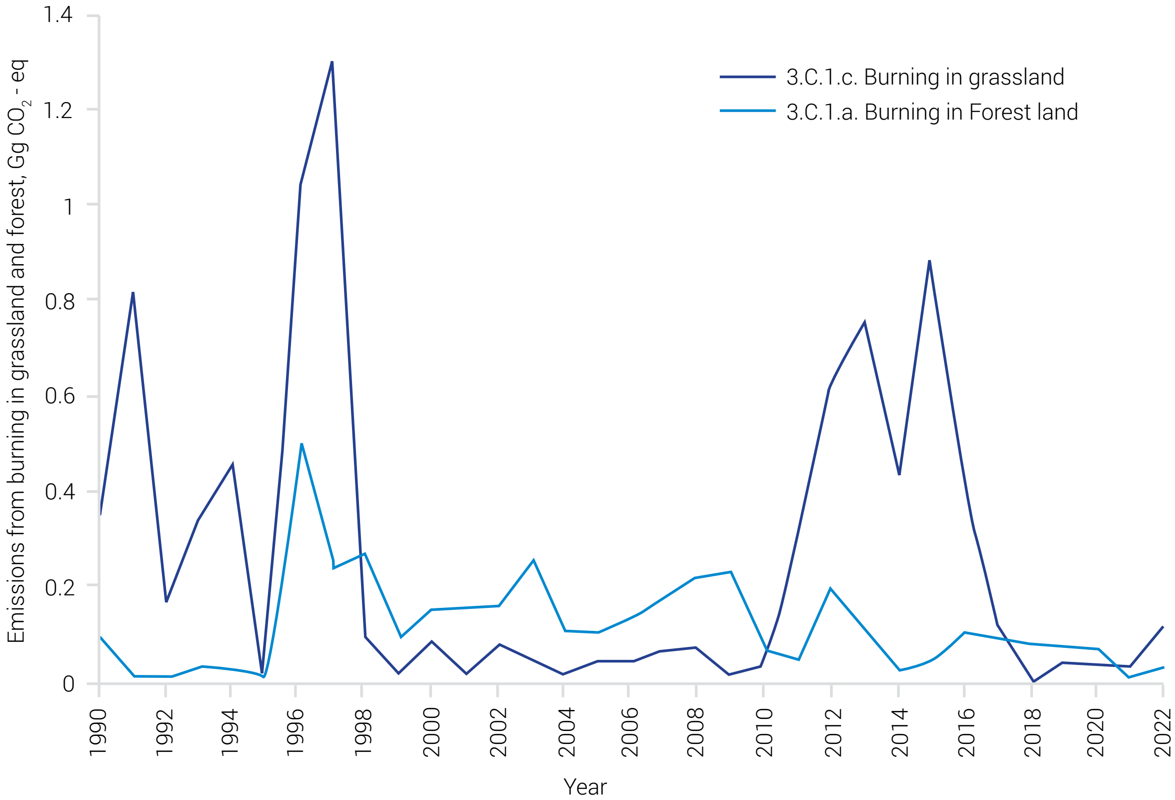


Figure I. 33. GHG emissions from Aggregate source and non-CO2 emissions sources and land (3.C) by source categories

In 2022, biomass burning emissions totaled 124.62 Gg CO_2-eq. The amount of emissions from biomass burning varies based on the total number of wildfires that occur each year. The N_2O emissions accounted for 49.83%, while CH_4 for 50.17% of biomass burning in 2022 (Appendix I.11).

1.7.3.7. Sector specific recalculations

All GHG estimates have been recalculated for entire time series due to use of 100-year GWPs from the IPCC Fifth Assessment Report as referenced in Table I.11.

1.7.3.8. Sector specific QA/QC and verification

QA/QC described in 1.3.3 are applied in agriculture sector All information and activity data used for estimation of emissions have been double-checked by sectoral experts and cross-checked experts from other sectors. The livestock numbers (AD) in Statistical yearbooks cross-checked with the National Statistic Office website information. Wase sector experts cross checked the data for agriculture AD, calculations and consistencies between the BTR1 and CRT.

The AD and methods used to estimate GHG emissions under this sector were documented by the agriculture sector expert and archived both in hard and electronic copies.

1.7.3.9. Sector specific planned improvements

The time series of the activity data was covered for the period of 1990-2022 for this inventory. The IPCC inventory software was firstly used for tthe estimation. Sector specific planned improvements is provided in Table I.34 under 1.8 DATA GAPS AND IMPROVEMENT PLANS.

1.7.4. LAND USE, LAND USE CHANGE AND FORESTRY (LULUCF)

1.7.4.1. Sector overview

The sink of LULUCF sector was -31,905.43 Gg, CO_2-eq in 2022 which accounts for 65.8% removal of the national GHG emissions of 48,509.11 Gg, CO2-eq (Figure I. 34.).

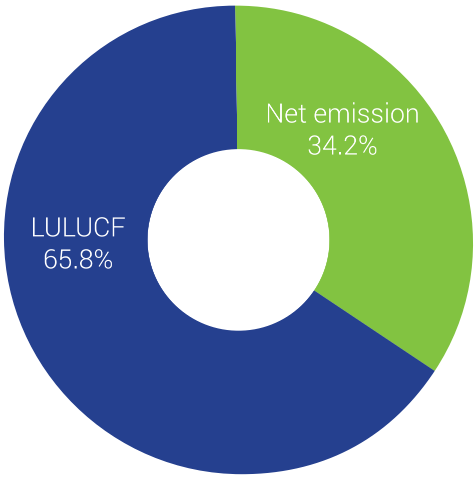


Figure I. 34. Removals of the LULUCF sector to national GHG emissions

Emissions of GHG CO_2, N_2O and CH_4 have been estimated from only Forest Land remained forest land (4.A.1) and Harvested Wood Products (4.G) subcategories. Due to lack of activity data availability emissions in other sub- categories (See Figure I. 35.) and not been estimated. Emissions from this two sub-categories are presented in Table I.24. Emissions estimates of all source categories for entire time series (1990-2022) included in this inventory provided in Appendix I.12. and CRT.

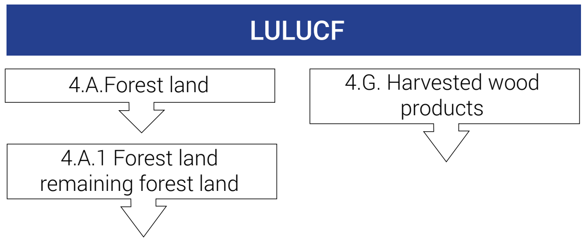


Figure I. 35. Coverage of the LULUCF sector in Mongolia

Table I. 24. Overview of emissions in the LULUCF sector in the base year and in the last year of inventory, in Gg CO_2-eq

Category	Gas	1990 (Base year)	2022 (Latest year)	Difference in 1990 and 2022, %	Contribution to total emission in 2022, %		
					Total CO_2-eq	Sector	Gas
4A	CO_2	-31996.60	-31975.88	-0.06%	-65.39%	100.22%	0.00%
4G	CO_2	-85.84	70.45	-182.08%	0.14%	-0.22%	0.34%
Total					-65.25%	100%	

1.7.4.2. Key categories

Key category identified within this sector is 4.A.1 Forest Land Remaining Forest Land.

1.7.4.3. Methodologies and data sources

Carbon dioxide removals are solely associated with the LULUCF sector. Mongolia's forests are divided into northern boreal forests and southern Saxaul forests. The National Forest Inventory (NFI, 2019)[29] assessed the boreal forests, while detailed data on Saxaul forests is limited. As of 2022, forest land covered 17,113,152 hectares. The forest sector acts as a net sink for greenhouse gases. Biomass carbon stock gains were calculated using the Mongolian forest mensuration guidebook (2012)[30]. Increment estimates were based on the annual growth of 110-year-old larch forests, which dominate 80% of the forested area of Mongolia and include species like Siberian pine, birch, and Scotch pine.

[29] http://forest-atlas.gov.mn/DataSetResults.aspx
[30] https://redd.unfccc.int/files/2018_frel_submission_mongolia.pdf

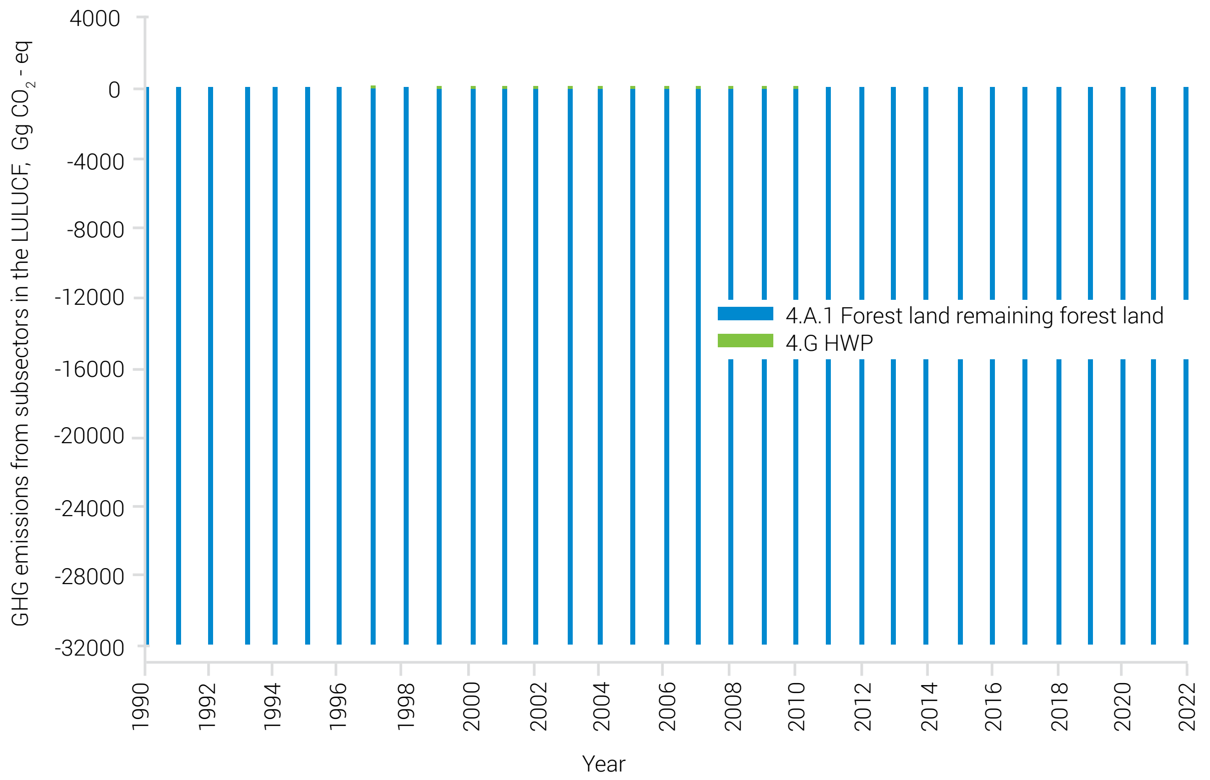


Figure I. 36. Contribution of sub sectors to GHG emissions in the LULUCF sector

The activity data of a LULUCF was gathered from a land use matrix conducted by the General Agency for Land Administration and Management, Geodesy, and Cartography (GALAGC). The agency conducted a study using a national land use and land cover map for the entire country based on 1:100 000 maps from 1970 to 1990. Thus, the land use matrix prepared for the 1990-2022 using Google collect. The results are converted to classification of IPCC land use categories. Emissions factors and parameters were taken from national studies as country specific (See Table I.25).

Table I. 25. Parameters applied in GHG emissions for the LULUCF sector.

4	LULUCF	Forest type		Reference
4.A.1. Forest land	Parameters	Boreal forest	Saxaul forest	
	Above ground biomass stock, td m./ha	67.7	4.84	
	Above ground net biomass growth (G), t d./ha year	0.83	0.12	Mongolian forest mensuration guidebook 2012, page 220, Table 57, Mean annual increment of 110- and 50-year-old larch forests "growth used intact and degraded forests annual growths, respectively. Mongolian Forest Resources report 2021, Annex 7

	Ratio of below ground biomass to above ground biomass (R), t root d./t shoot d.m	0.39	0.44	NFI 2019, Annex A –Data Models: Volume –Biomass –Carbon IPCC 2006, Vol. 4, Ch. 4, Table 4.4
	Biomass carbon and expansion factor (BCEFs)	0.53	3.95	Estimation of aboveground biomass and carbon stock in Mongolian boreal forest 2017, Table 12 Allometric model development for aboveground biomass of Saxaul 2018, Table 5 data used to further develop the BCEF value.
	Litter C stocks, tC/ha	15.9	0.01	NFI 2016, Saxaul is assumed to have 10 kg litter biomass
	Carbon fraction	0.51	0.47	IPCC 2006, Vol. 4, Ch. 4, Table 4.3
4.B.1. Cropland remaining cropland	Factor value type	Temperature regime	Moisture regime	IPCC default
	Land use (F_{LU})	Temperate/ Boreal	Dry	0.80
	Tillage (F_{LU})	All	Dry and moist/Wet	1.00
	Input (F_I)	Medium	Dry and moist/Wet	1.00
4.B.2. Land converted to cropland	Factor value type	Temperature regime	Moisture regime	IPCC default
	Land use (F_{LU}) @ year 0	Temperate/ Boreal	Dry	0.80
	Land use (F_{LU}) @ year 0-T	Temperate/ Boreal	Dry	1.00
	Tillage (F_{mr}) @ year 0	All	Dry, moist/ Wet	1.00
	Tillage (F_{mr}) @ year 0-T	All	Dry, moist/ Wet	1.00
	Input (F_I) @ year 0-T	Medium	Dry, moist/ Wet	0.95
	Input (F_I) @year 0-T	Medium	Dry, moist/ Wet	1.00
4.C.2. Land converted to grassland	Soil type	High activity clay mineral	Land use (FLU)	1.00
	Reference soil organic carbon, (t C/ha)	50.00	Management	0.95
	Carbon fraction of dry matter for woody	0.500	Herbaceous biomass stocks	6.5

	biomass (t C/t d.m)	0.470	present land (t d.m/ha)	6.5
4.E.2. Land converted to settlements	SOC	Litter	Carbon fraction	Reference
	50 tn C/ha for cool temperate	0.30 to 0.50	0.40 for litter	the 2006 IPCC GLs Vol.4, Ch 2, Table 2.3
4.G. Harvested Wood Product	Commodity classes	Density (oven dry mass over air dry volume), mg/m3	Carbon fraction	C conversion factor (per air dry volume), mg C/m3
	Sawnwood (aggregate)	0.458	0.5	0.229
	Coniferous sawnwood	0.45	0.5	0.225
	Non-coniferous sawnwood	0.56	0.5	0.28
	Industrial roundwood (aggregate)	0.458	0.5	0.229

1.7.4.4. Forest land (4.A)

A country-specific land matrix, obtained from the GALAGC using the Collect Earth program, was utilized for this subsector. The land matrix categories prepared into six types: forest land, cropland, grassland, wetlands, settlements, and other land, along with the conversions between these land subcategories. The Land (3.B) category of Mongolia includes emissions from the forest land and cropland categories includes Forest Land (3.B.1) considering forest land remaining forest land (3.B.1.a) and land converted to forest land (3.B.1.b).

Forest land remaining forest land subcategory covers Mongolia's boreal forests and Saxaul forests. The land converted to forest land subcategory involves the transformation of cropland, grassland, wetlands, and settlements into forest land. As of 2022, 171132 thousand hectares converted into forest land. Only information was available for Saxaul forest is the study of Mongolian Forest Research Association (FRA). This study reports there is the Saxaul forest in Mongolia covers 2,645,780 hectares of area[31]. Therefore, expert judgment was used to take 2,645,780 hectares of area for entire time series on the base discussion with experts of the Forest Research and Development Center and FRA.

Cropland (3.B.2) considering only area of land converted to cropland based on raw data from the land use change matrix for GHG inventory (ha) from 1986 to 2022. Since 2005, Mongolia's crop production has begun to recover, with private companies taking over former state-owned farms. The area of croplands has significantly decreased since 1990, and most lands were abandoned until 2006. Current policies require farmers to use abandoned land instead of cultivating new areas. Grassland (3.B.3) considering only the area of land converted to grassland based on raw data from the land use change matrix for GHG inventory (ha) from 1986 to 2022. Mongolia's grazing land is 110.3 million hectares. The grass land

[31] Mongolia's Forest Reference Level submission to the UNFCCC, Allometric Model Development for Above Ground Biomass of Saxaul Haloxylon ammodendron C.A.Mey.Bunge

remaining grassland category (3.B.3.a) includes managed pastures—areas used for grazing that have always been grassland, as well as those converted to grassland (3.B.3.b) over 20 years ago (2006 IPCC Guidelines). In Mongolia, grassland is mainly used as livestock pasture. Around 60% of these pastures can recover in 3 to 5 years with proper management, while about 40% may take 5 to 10 years, excluding climate change impacts (MEGD, 2014)[32].

Activity data for remaining grassland and land converted to grassland were not available, particularly regarding grassland degradation levels across different climate and geographical zones. The area of land converted to grassland was derived from the raw data in the land use change matrix for the GHG inventory (in hectares) covering the years 1986 to 2020. Almost no land information is available for the years prior to 1986. Therefore, expert judgment was used to estimate the 20-year changes from 1971 to 1985.

Settlements (3.B.5) considering only the area of land converted to settlements based on raw data from the land use change matrix for GHG inventory (ha) from 1986 to 2022. This category encompasses all types of urban formations used as settlements, such as areas associated with public or private land within cities, villages, or other types of settlements. In 2019 and 2020, surveys were conducted with the Institute of Geography and Geoecology (IGG) and the National University of Mongolia (NUM) to assess carbon pools in biomass and soil organic carbon (SOC) across five ecoregions in Mongolia. A report on these grassland surveys highlights their importance for the sector. While the data provides average biomass amounts for each ecoregion, the relationship between biomass levels and degradation or management status is unclear due to a lack of comprehensive data on degradation.

Emissions from Wetlands (3.B.4) and Other Land (3.B.6) were not estimated due to insufficient activity data. Carbon dioxide (CO_2) emissions from dead organic matter and soil carbon pools are considered not applicable (NA). Emissions of methane (CH_4), nitrous oxide (N_2O), and other gases resulting from forest and grassland fires are accounted for under the agriculture sector and therefore marked as included elsewhere (IE). Emissions from drained organic soils are not estimated (NE), and there is a lack of data regarding the impact of forest and grassland fires on converted land, also reported as not estimated (NE). The Tier 1 methodology was applied for grasslands, which does not account for carbon stock changes in biomass or soil organic carbon—these are reported as not estimated (NE). Savannah burning does not occur in Mongolia, and non-CO_2 emissions from this activity are marked as not applicable (NO). While the conversion of forest to grassland is estimated (E), no default values exist for dead wood and litter, resulting in a not applicable (NA) designation for those components.

Removals from forest land that remained intact were -31975.9 Gg CO_2-eq in 2022, up from -31996.6 Gg CO_2-eq in 1990. Key factors for these changes included forest regeneration and annual harvesting. About 1.0 million hectares of forests impacted by significant fires in the 1990s and early 2000s have begun to regrow naturally (MET, 2020).

Data on GHG emissions from grasslands show a link between degradation levels and carbon content in Mongolian steppe. With rising degradation, grassland emissions have increased, indicating that conserving and restoring these areas can support both ecosystem preservation and GHG reduction (JICA, 2022).

[32] Mongolia's State of Environment Report, Ministry of Environment and Green Development, 2013-2014

1.7.4.5. Harvested Wood Products (4.G)

This subsector covers the emission from Harvested wood products (HWP) (3.D.1) considering all wood material (including bark) left at the harvest site. The duration for carbon storage in products varies by use. Fuelwood and mill residue are typically burned in the year of harvest, while sawn wood in buildings can last for decades or over 100 years (2006 IPCC Guidelines, Vol. 4, p. 12.5). To prevent double-counting, harvested wood products in solid waste and energy use are treated as having immediate oxidation, resulting in no net emissions. Additionally, estimates for sawn timber do not include wood harvested for energy (2013 IPCC Supplement, p. 2.119). There are three default categories of harvested wood products including sawn wood (a), wood-based panels (b) and paper and paperboard (c).

In Mongolia, no wood-based panels or paper products are produced, as these industries closed in 1993 (FAO, 2023), resulting in zero inflow for categories (b) and (c). Consequently, all timber is classified as "sawn wood" used for both industrial and rural purposes. A national report indicates a 40% yield, with the remaining 60% as saw residue, which has a short lifespan (UNREDD, 2018). The wood production and emissions from HWP are presented in Figure I. 37. There is an inverse relationship between production and emissions; as more harvested wood products are utilized for carbon storage, total emissions decrease.

In 2022, GHG emissions from HWP were 70.45 Gg CO_2-eq, representing a 182.08% increase compared to the 1990 level of -85.84 Gg CO_2-eq, the only year when GHG removals occurred from HWP. In 2012, the Mongolian government approved the Law on Forestry. As a result, the Minister of Environment and Tourism established a maximum limit on the number of trees harvested and used from the forest each year. For example, in 2020, this limit was set at 1,437.90 thousand m3. Figure I.37 presents the overall trend of the HWP emission from 1990 to 2022.

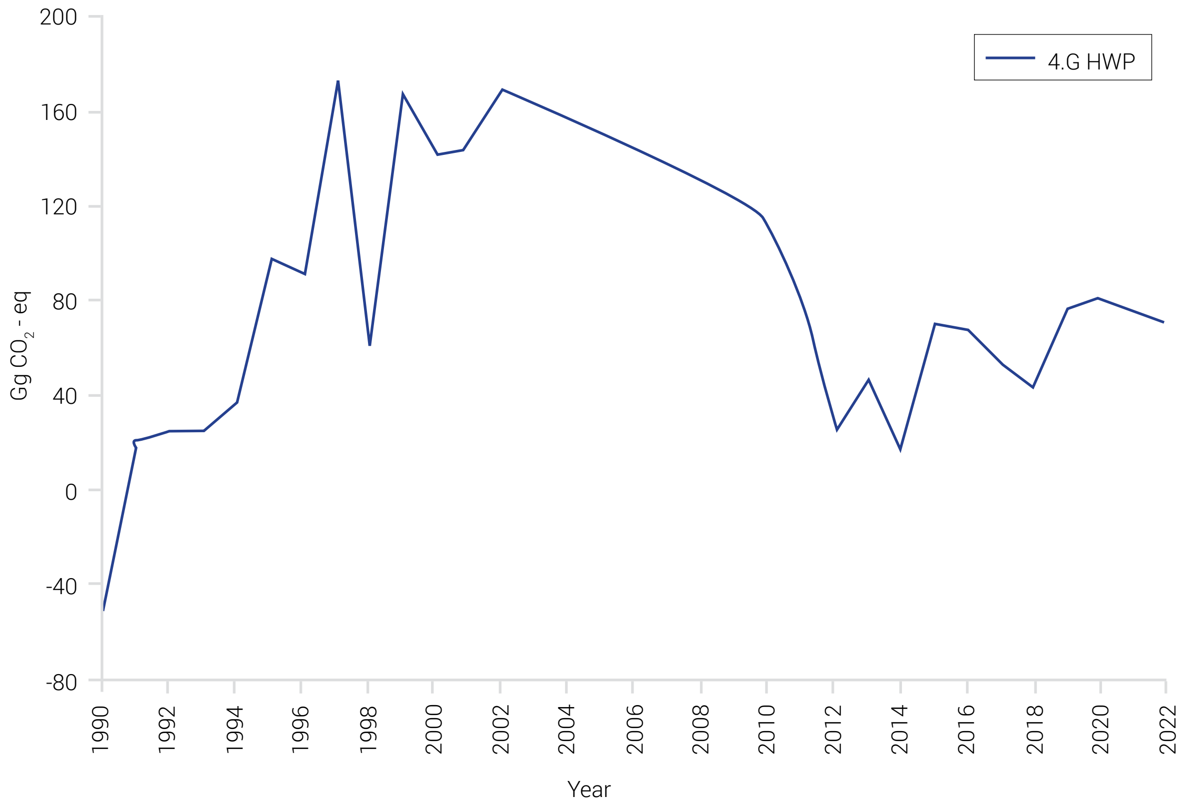


Figure I. 37. GHG emissions from harvested wood products (4.G) against wood production

1.7.4.6. Sector specific recalculations

GHG emission estimates included in this inventory have been recalculated for entire time series due to use of 100-year GWPs from the IPCC Fifth Assessment Report as referenced in Table I.11.

For the period from 1990 to 2022, updated land use data were reclassified according to the IPCC land use categories by GALAGC. These updated data were used for the GHG emissions for the the sector.

1.7.4.7. Sector specific QA/QC and verification

QA/QC described in 1.3.3 are applied in LULUCF sector. All information and activity data used for estimation of emissions have been double-checked by sectoral experts and cross-checked experts from other sectors. IPPU sector experts cross-checked the data, calculations and consistanvied between the report and CRT for this LULUCF sector. The AD and methods used to estimate GHG emissions under this sector were documented by the expert sector and archived both in hard copies and electronically.

1.7.4.8. Sector specific planned improvement

The time series of the activity data was covered for the period of 1990-2022 for this inventory. The IPCC inventory software was firstly used for tthe estimation. Sector specific planned improvements is provided in Table I.35 under 1.7 of this Chapter.

1.7.5. WASTE SECTOR

1.7.5.1. Sector overview

The GHG source categories covered in this current inventory in the waste sector are methane (CH_4) emissions from solid waste disposal sites (5.A.1, 5.A.2) and wastewater treatment and discharge (5.D.1, 5.D.2) and nitrous oxide (N_2O) emissions from wastewater treatment and discharge (5.D.1).

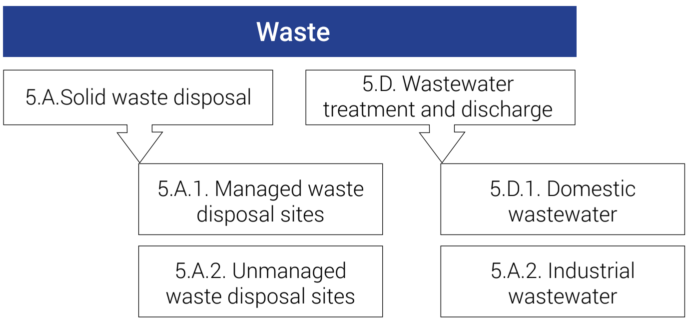


Figure I. 38. Coverage of the Mongolian waste sector GHG emissions inventory (NE- not estimated)

The total emission from waste sector was estimated 642.12 Gg CO_2-eq in 2022 and accounts for only 1.3% of national total GHG emissions. The aggregated emissions in the waste sector given in Table I.26 and trends of source categories in CO_2-eq are presented in Figure I. 39.

Table I. 26. Aggregated emissions in the Waste sector in the base year and in the last year of inventory, in Gg

Source category	Gas	1990 (Base year)	2022 (Latest year)	Difference in 1990 and 2022, %	Contribution to total emission in 2022, %		
					National total	Sector	Gas
CO_2-eq.	total	59.35	642.12	981.92	1.3		
5.A1, 5.A2, 5.D.1, 5.D.1,	CH_4	1.81	21.82	1105.53			
5.D.2	N_2O	0.0324	0.12	270.37		4.86	0.4

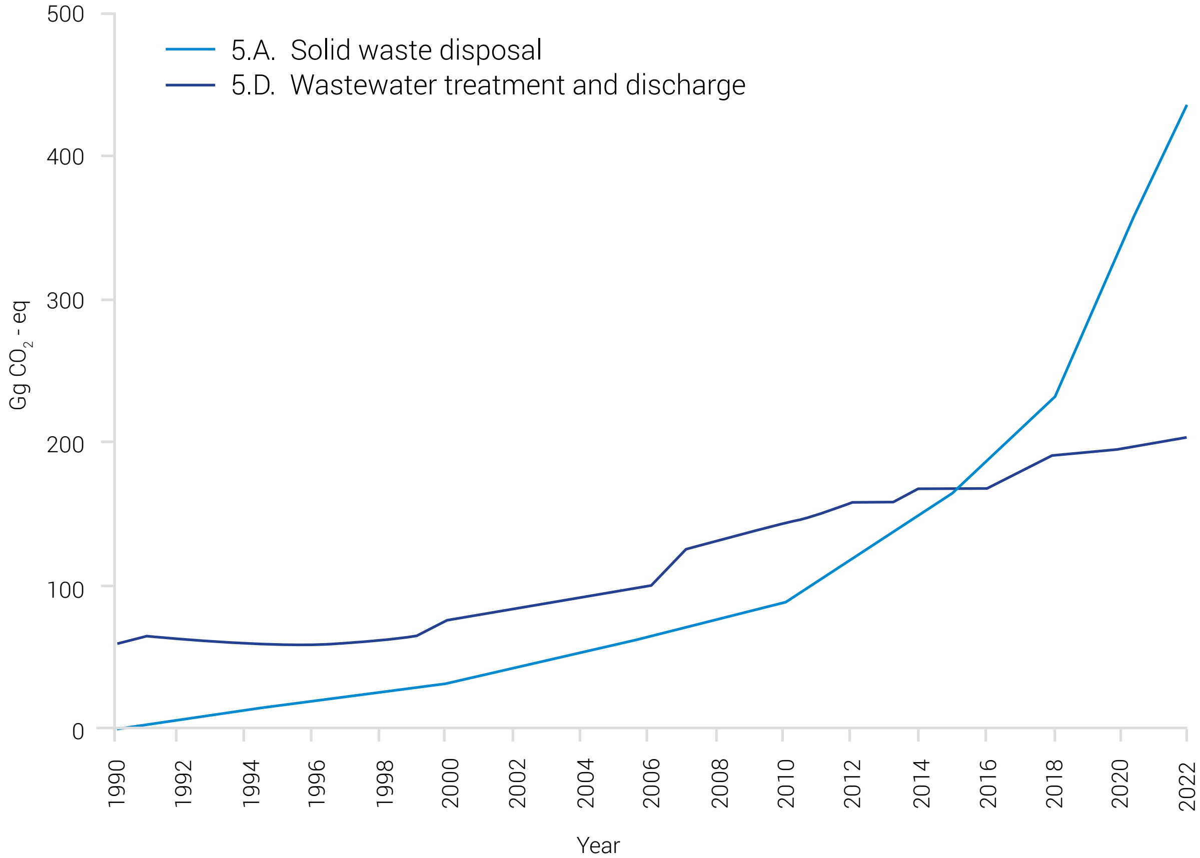


Figure I. 39. Trends of emissions of source categories

Emissions from source categories have been increasing since the base year due to population growth. The inter annual fluctuations explained by operational and management challenges at landfill sites, and the lack of operations in domestic wastewater treatment facilities and industrial wastewater treatment and discharge because of economic conditions and business entities capability to treat the wastewater.

1.7.5.2. Key categories

The source categories 5.A.1 Solid Waste Disposal and 5.D.1 Wastewater Treatment and Discharge are identified key categories by both the level and trend assessments of 2022 emissions, including and excluding LULUCF.

1.7.5.3. Methodologies and data sources

Table I.27 presents the selected methods and emission factors used in the waste sector.

Table I. 27. Methods and EFs applied in Waste sector.

Source categories	WASTE	CH_4		N_2O	
		Method	EF	Method	EF
5.A.	SOLID WASTE DISPOSAL				
5.A.1.	Managed waste disposal sites	T1/T2	D		
5.A.2.	Unmanaged waste disposal sites	T1/T2	D		
5.D.	WASTEWATER TREATMENT AND DISCHARGE				
5.D.1.	Domestic wastewater	T1	D	T1	D
5.D.2.	Industrial wastewater	T1	D	T1	D

Waste generation rate per capita and waste composition and their sources are provided in Table I.28 and Table I.27 respectively for Tier 2.

Table I. 28. References for waste generation from 1990-2022

Period	Generation rate, (kg/cap/year)	References	
1990-2007	121.91	Mongolia's NIR-2023, p. 158	(2023)
2008-2009	261.34	Troschinetz et al., (2009), Sustainable recycling of MSW in Developing countries, Waste management, Vol. 29, No.2, p. 915-923.	(2009)
2010-2014	306.6	Mongolia's NIR-2023, p. 158	[1]
2015-2017	408	Bolorchimeg B., (2017), Municipal solid waste management in Ulaanbaatar, Mongolia: Systems Analysis	(Municipal Solid Waste management in Ulaanbaatar, Mongolia: Systems Analysis, 2017)
2018	764.4	Waste account 2018-2019, (2021), National statistical Committee	(Waste account 2018-2019, 2021)
2019	817.2	Waste account 2018-2019, (2021), National statistics office	(Waste account 2018-2019, 2021)
2020	689.8	Waste account 2021, (2022), National statistical office	(Waste account 2021, 2022)

2021	725.3	Waste account 2021, (2022), National statistics office	(Waste account 2021, 2022)
2022	741.1	Waste account 2022, (2023), National statistics office	(Waste account 2022, 2023)

Table I. 29. References for waste composition from 1990-2022

Period	Sources in the reference	Waste composition	References
1990-2005	Based on the JICA report, 2005	Food waste- 15.6% Garden, park – 1% Paper and cardboard-7.4% Textile- 2.5% Wood- 0.3% Bulk municipal- 8.7% Inert- 64.5%	(Effects of introducing energy recovery processes to the municipal solid waste management system in Ulaanbaatar, Mongolia, 2024)
2006-2017	Namkhainyam B et al., 2014	Food waste- 24% Garden, park – 5% Paper and cardboard-18% Textile- 3.2% Wood- 2% Inert- 47%	(2023)
2018-2022	Respective year data	Food waste- 12.9-13.1% Paper and cardboard-6.4-7.9% Bulk municipal- 62-63.1. Inert- 15.9-18.7%	[4, 5, 6]

For the fraction estimates applied expert judgment on the base of available data. The fraction of the MSW disposed to Solid Waste Disposal Site (SWDS) is 65% and this rate was applied to the period of 1990-2018 due to the lack of coverage in the provinces (See. Figure. I.40). The National Statistical Office data used to estimate at 71-73% of the waste percentage that are deposited in landfilled from 2019. Although there is data on the incineration activity since 2019, emission from this category has not been included due to the insufficient data on the previous years.

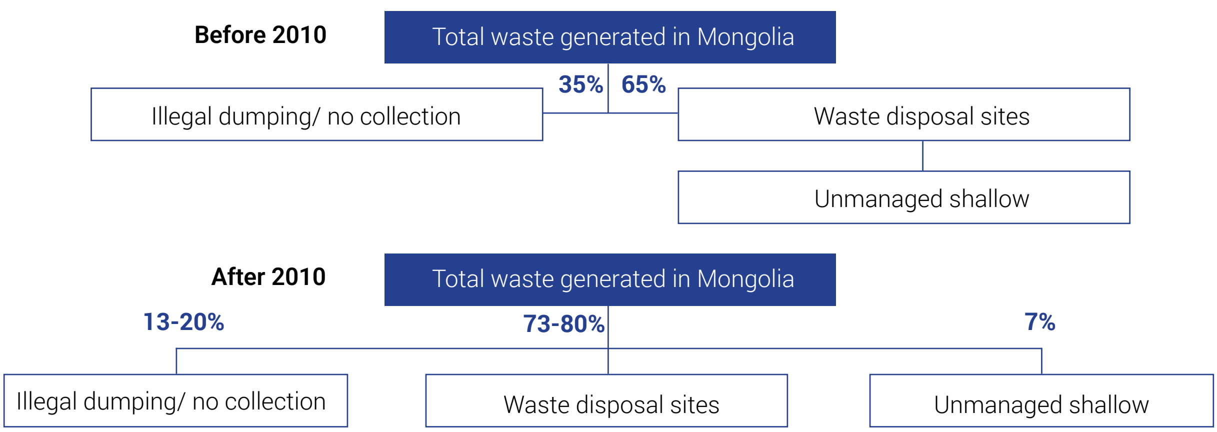


Figure I. 40. MSW treatment system in Mongolia

CH_4 emissions from MSW decomposition at SWDS were estimated using the IPCC First Order Decay (FOD) model using the above country-specific parameters to complete historical time series starting in the year 1990. Default IPCC parameters were adopted in terms of degradable organic carbon (DOC), fraction of DOC dissimilated (DOCf), and CH_4 generation rate constant (k) for each waste component, as summarized in Figure. The default 6-month delay time, 50% fraction of CH_4 in developed biogas, and Boreal and temperate dry climate zones were also adopted.

Table I. 30. Default IPCC waste characteristics parameters applied in the FOD model.

Waste type	Degradable organic carbon, (DOC)	Degradable organic carbon which decomposes in SWDS, (DOC_f)	CH_4 generation rate constant, k	Half-life time, $t_{1/2}$, h	Process start in deposition year, Month, M	Fraction to CH_4
Food waste	0.15	0.5	0.06	11.55	13	0.5
Garden	0.2	0.5	0.05	13.86	13	0.5
Paper	0.4	0.5	0.04	17.33	13	0.5
Wood	0.43	0.5	0.02	34.66	13	0.5
Textile	0.24	0.5	0.04	17.33	13	0.5
Bulk municipal	0.18	0.5	0.05	13.86	13	0.5

Waste account in 2022 stated that the recycling rate is 7.9% and it is still uncertain how many plastics and paper are recycled and there is no available data from previous years. Therefore, it is not included in the GHG estimations in this report.

1.7.5.4. Solid Waste Disposal (5.A)

Landfills are the major solid waste management systems in the country. Currently, Mongolia is lacking to introduce sophisticated infrastructure for recycling and composting, although there are attempts to reduce dependency on landfills and improve recycling rates.

Three main types of waste are generated and managed in Mongolia: Municipal Solid Waste (MSW), industrial and hazardous waste, and healthcare waste. Due to limited information on industrial and hazardous waste generation, composition, and disposal practices in the country, GHG inventory of Mongolia includes only MSW. MSW is all waste collected by local authorities generated from households, commercial institutions, public institutions, green (garden/park) waste, and waste from construction and demolition sites.

This category covers the CH_4 emissions from the anaerobic decomposition of degradable fractions of municipal solid waste (MSW) in Mongolia's managed anaerobic Solid Waste Disposal Site (SWDS) under Category 5A1, unmanaged disposal sites under Category 5A2.

The total CH_4 emission from solid waste was estimated to be 15.61 Gg-CH_4 and 437.02 Gg CO2-eg. CH_4 emissions estimated 13.8 Gg-CH_4 (386.3 Gg CO2-eg) from managed waste disposal sites (5.A.1) and 1.81 Gg-CH_4 (50.72 Gg CO2-eg) from unmanaged waste disposal sites (5.A.2) in 2022. CH_4 emissions from managed waste disposal sites are increasing due to population growth and CH_4 emissions from unmanaged waste disposal sites are decreasing starting from 2010 as the fraction is decreasing (Figure I.41).

Figure I. 41. Trends of emissions from solid waste.

1.7.5.5. Wastewater treatment and discharge (4.D)

Mongolia has three main types of domestic wastewater treatment and discharge pathways: sewerage systems, septic tanks, and latrines where no CH_4 recovery or flaring occurs. The degree of utilization of centralized wastewater treatment plants data was available only in domestic wastewater treatment plant in Ulaanbaatar city for 2000, 2010, and 2020 (Information database, n.d.) (See Table I.31.). The data was collected from the Water supply and sewerage authority of Ulaanbaatar city.

Table I. 31. Reference for the degree of utilization of modern, centralized wastewater treatment plants, 1990-2022.

Period	Degree of coverage, %
1990-2000	72.80
2001-2010	47.08
2011-2020	39.44
2021-2022	49.26

1.7.5.6. Wastewater Treatment and discharge (5D)

Domestic and industrial wastewater treatment and discharge are the sources for CH_4 and N_2O emissions in the waste sector. This category covers the CH_4 emissions from domestic wastewater (5.D.1) and industrial wastewater (5.D.2) and N_2O emissions from industrial wastewater 5.D.2.

The total CH_4 emission from domestic wastewater was 6.21 Gg-CH_4 and 205.1 Gg CO2-eg. CH_4 emissions from domestic wastewater are estimated 5.24 Gg-CH_4 (5.D.1) and 0.97 Gg-CH_4 from industrial wastewater (5.D.2) in 2022.

Total emissions (CH_4 + N_2O) from domestic wastewater source categories increased from 48.08 Gg CO_2-eg) to 178.06 Gg CO_2-eg or by 270.3% compared to base year due to increased population and CH_4 emissions from industrial wastewater increased from 11.27 Gg CO_2-eg to 27.04 Gg CO2-eg or by 56.6% due to industrial production (Figure.I.42).

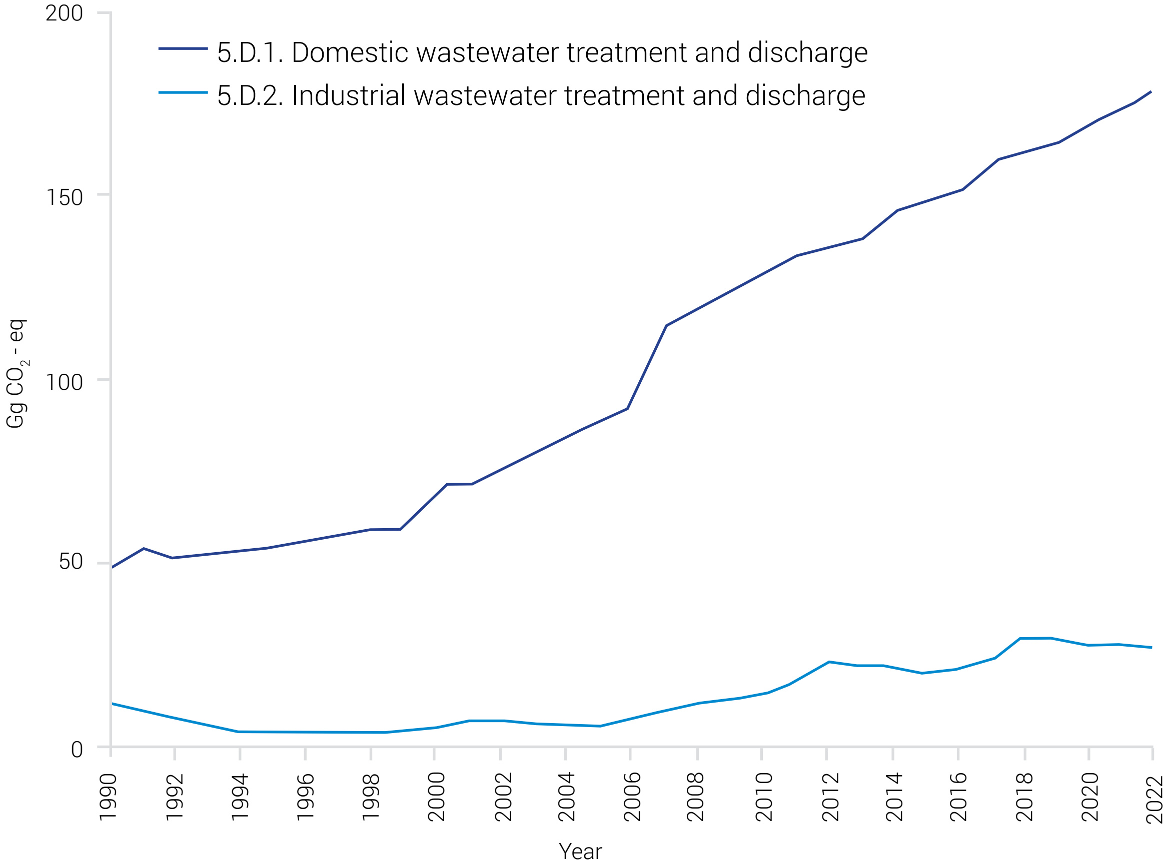


Figure I. 42. Category 5D GHG emissions by wastewater type.

1.7.5.6. Sector specific recalculations

All GHG estimates have been recalculated for entire time series due to waste generation rate per capita, fraction of the MSW disposed and use of 100-year GWPs from the IPCC Fifth Assessment Report as referenced in Table I.11.

1.7.5.7. Sector specific QA/QC and verification

QA/QC described in 1.3.3 are applied in waste sector. All information and activity data used for estimation of emissions have been double-checked by sectoral experts and cross-checked experts from other sectors. Energy sector experts cross-checked the data for this waste sector AD, calculations and consistencies between BTR1 and CRT. The AD and methods used to estimate GHG emissions under this sector were documented by the expert sector and archived both in hard copies and electronically.

1.7.5.8. Sector specific planned improvements

For this current submission CH_4 emissions from unmanaged waste disposal sites (5.A.2) estimated and used more detailed waste generation rate per capita, fraction of the MSW disposed and GWPs from the IPCC Fifth Assessment Report.

Sector specific planned improvements are provided in Table I.36 under 1.8 of this Chapter.

1.8. DATA GAPS AND IMPROVEMENT PLANS

For the current inventory, use of country-specific EFs and values have been significantly expanded compared to the previous inventory report. Mongolia is still lacking in AD to inventor all source categories. Thus plan to improve the inventory and prioritize improvements for key categories first, according to the 2006 IPCC Guidelines. The sector specific planned improvement are presented below.

1.8.1. Energy

In the previous reports and this inventory, the country used the Tier 2 method and country specific emission factors. Mongolia should develop its national Energy Balance Tables (EBTs). These tables are vital for estimating greenhouse gas (GHG) emissions from the energy sector and shaping energy policies. This table should be reviewed and approved by sectoral experts at national level (See. Table I.32).

Table I. 32. Improvement plan for the energy sector

Data gaps	Improvement actions	Time frame	Responsible institution
1.A.1 Energy industries			
Institutional arrangement in energy sector	Improve the institutional framework in place to elaborate on the national energy balance.	2026	MoE, NSO, CCRCC
Data management in Energy sector	Implement a data compilation system for the elaboration of the energy balance.	2026	MoE, NSO
Data management	Ensure that the personnel of NSO and other relevant agencies/ institutions receive the necessary resources, training, and expertise to effectively compile national energy balances and energy statistics	2025	CCRCC
Use the higher tier method for key category	Energy sector in Mongolia has developed country-specific carbon content coefficients and emissions factors. MECC and MoE will be approved and will be applied to the next GHGI.	2026	MoE, MECC, CCRCC

Emissions from heat plants (1.A.1.a.ii) and oil distribution were not estimated due to insufficient data.	Data collection of these subcategories will be collected and reviewed by sectoral experts and will be used for next GHGI.	2026	MoE
1.A.2 Manufacturing industries and construction			
EBTs of the IEA are used instead of national EB Ts.	The national EBTs will be finalized.	2025	MoE, MEEI, NSO
Since fuel combustion data is unavailable by industry, emissions were aggregated from this category.	Data collection will be improved for more accurate emissions estimation.	2026	
1.A.3 Transport			
Data management in Transport	Implement a data compilation system for the different types of transport, especially in cars.	2025	MoRT, NSO
Data exchange system	Improve and establish the data management system for the GHGI	2025	MoRT, CCRCC, NSO
Use the higher tier method for key category	Mongolia will develop country-specific carbon content coefficients for motor gasoline to enhance CO_2 emissions in road transportation.	2028	MoE
1.A.4 Other sectors			
Data on improved coal briquettes is limited due to its new development, leading to insufficient information on consumption, carbon content, and emission factors.	Laboratory analysis is necessary to measure the carbon content of improved coal briquettes. This assessment is essential for accurately evaluating CO_2 emissions and other greenhouse gas parameters.	2027	MoE
1.B.1 Solid fuels			
Data on fugitive emissions from the transport and distribution of oil products needs to be collected.	Assessment of the the activity data collection will be implemented and GHG emissions will be considered	2026	MoE
1.B.2 Oil and natural gas			
The oil refinery is currently under construction, and once it is commissioned and operational, the activity data collection will begin.	GHG emissions will be calculated in subsequent submissions.	2026	MoE

1.8.2. IPPU

Enhancements in the Industrial Processes and Product Use (IPPU) sector are essential for improving the quality and reliability of Mongolia's greenhouse gas (GHG) inventory. These improvements are planned over both the short and medium term to ensure better data accuracy, transparency, and compliance with international reporting standards. In the short term, the focus will be on strengthening the foundation of the inventory system. This includes collecting additional activity data to close existing gaps, improving the accuracy and level of detail of collected data, and refining the methodologies used in data analysis. Furthermore, efforts will be made to strengthen institutional capacity and establish a more effective coordination framework for data collection and reporting. In the medium term, attention will shift to the development of sustainable systems for tracking and reporting hydrofluorocarbon (HFC) consumption. This will allow for a more robust estimation of HFC and perfluorocarbon (PFC) emissions. Additionally, a thorough assessment of the currently available data in Mongolia will be carried out to identify barriers to implementing the Tier 2 methodology. Addressing these challenges will help transition to more advanced estimation techniques, improving the overall accuracy and integrity of the IPPU inventory. These improvements will contribute significantly to Mongolia's ability to monitor emissions effectively and support the development of informed policies for climate change mitigation.

Table I. 33. Improvement plan for the IPPU sector.

Data gaps	Improvement actions	Timeframe	Responsible institution
2.A. Mineral industry			
Due to a lack of reliable data throughout the time series, the import and export of clinker are considered to be zero.	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2026	MoFALI
Emissions from category (2.A.4.a) are not estimated (NE) because of insufficient data on the average weight of a brick, clay consumption per piece, and carbonate content.	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2026	MoFALI
Emissions from category (2.A.4.b) are not estimated (NE) due to incomplete time series data and lack of usage information.	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2026	MoFALI
2.C. Metal industry			
Due to the lack of a precise estimation method, emissions from cast iron production (2.C.1) are not estimated (NE).	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2026	MoFALI
Due to insufficient information on annual FeSi50 production, emissions from Ferroalloys production (2.C.2) are not estimated (NE).	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2026	MoFALI
2.D. Non-energy products from fuels and solvent use			
Paraffin wax (2.D.2) and bituminous fuel are mixed in statistics, and it is not easy to separate activity data.	Data collection will be improved for more accurate GHG emissions estimation.	2026	MoFALI

2.F. Product uses as substitutes for ozone depleting substances			
It is not possible to determine the exact year of HFC-152a consumption (2.F.2). Therefore, it is assumed that all imported HFCs are consumed within the year they are imported.	Data collection will be improved for more accurate GHG emissions estimation.	2026	NOA
2.G. Other product manufacture and use			
Due to insufficient information, the propellant for Pressure and Aerosol Products (2.G.3.b) is not estimated (NE).	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2026	NOA

1.8.3. Agriculture

Mongolian livestock consists of local Indigenous breeds characterized as very low productivity. Nearly 100% of Mongolia's livestock manure is deposited on pastures and rangelands. This practice allows the manure to decompose in more aerobic conditions, resulting in lower methane (CH_4) emissions. Consequently, more detailed research is needed to investigate this issue further. Additionally, Mongolia's climate significantly affects the types of forage available and the amount digested by livestock each year. Local experts (Namkhainyam et al., 2014) developed methane (CH_4) emission factors for enteric fermentation and manure management specific to Mongolia. These factors were not used in the previous submission due to high uncertainty. To reduce this high uncertainty during the GCP/MON/016/CBT project, new country-specific factors for enteric fermentation in cattle by age and gender were created. However, this submission cannot include them as they still need verification and approval from authorized institutions.

Table I. 34. Improvement plan for the agriculture sector.

Data gaps	Improvement actions	Timeframe	Responsible institution
3.A. Livestock			
Need to use country specific data and parameters	To reassess and improve emission factors and parameters for enteric fermentation and manure management will be reviewed and will be applied to the next GHGI.	2026	MoA
3.C. Aggregate source and non-CO2 Emissions sources and Land			
Need to develop data management for calculating burnt forest area	Data collection will be calculated constantly for more accurate GHG emissions estimation.	2026	MECC
Need to include activity data on burnt areas of the grassland	Data collection will be improved for more accurate GHG emissions estimation.	2026	GALAGC, NAMEM

1.8.4. LULUCF

The activity data for land use categories and matrices in accordance with IPCC should be finalized in Mongolia.

Table I. 35. Improvement plan for the LULUCF sector.

Data gaps	Improvement actions	Timeframe	Responsible institution
3.B. Land			
Due to a lack of activity data (cropland (3.B.2), and wetlands (3.B.4) subcategories) and country-specific methods for calculations (settlements (3.B.5) and other land (3.B.6), emissions and removals from these subcategories were not estimated (NE).	A new activity database is needed for remaining grassland and land converted to grassland, along with elevating GHG estimation to Tier 2 or higher for this subcategory.	2025	GALAGC
No land use information was available before 1986; thus, reconstructing the 20-year cumulative land activity data requires accurate assumptions based on historical data.	Develop an accurate method to calculate the 20-year cumulative land area matrix for six land categories and related land conversions from one to another.	2025	GALAGC, CCRCC
Accurate, real-time data on the Saxaul forest area and its annual changes needs to be included	Saxaul forest areas will be recalculated for each year since 1990 for the GHGI.	2025	GALAGC
Activity data on perennial and crop plants is combined.	Activity data needs to be separated for more accurate GHG emissions estimation.	2025	GALAGC
Carbon stock changes, and relevant GHG emissions from Grassland have not been estimated.	Data collection will be improved for more accurate GHG emissions estimation.	2026	GALAGC
3.D. Other			
Real-time data for fuelwood and sawn wood productions is insufficient.	Data collection will be improved for more accurate GHG emissions estimation.	2026	NAF

1.8.5. Waste

In order to improve the Waste sector GHG estimation, the following actions planned:

- Conduct some survey/ research to improve the activity data
- The indicating parameters should be collected as suggested in the IPCC methods
- Establishment/improvement of infrastructures such as inbound truck-weighing systems at landfill sites of rural areas
- Revision of legal/ regulations in terms of the waste handling sites to monitor/control the incoming waste material to estimate the different types of solid waste
- Capacity building activities in the solid waste and wastewater sector

Table I. 36. Improvement plan for Waste sector.

Data gaps	Improvement actions	Timeframe	Responsible institution
4.A. Solid waste disposal			
The collection of the activity data does not match the IPCC activity data	Raw data collection standard method or indicating parameters will be changed according to the IPCC	2026	Ministry of Environmental and Climate Change National Standard Committee
Waste estimation in rural areas is based on the volume of collection trucks. Thus, the amount is not reliable	At least provincial-level landfill sites should have an automated truck-weighing system	2026	Ministry of Environment and Climate Change
The waste category was based on research studies but not on dumped waste in landfills.	There should be a legally compliant material sampling process at least twice a year during the warm season and cold season at the landfill site to estimate the landfilled amount of waste	2026	Ministry of Environment and Climate Change
Waste segregation does not occur. Thus, all the estimation was based on the small-sized research studies that were reported	Installment of the segregation units at the landfill is essential to get reliable data on the waste category	2027	Ministry of Environment and Climate Change
Time series data on waste generation rate for rural areas not available (both managed and unmanaged solid waste disposal)	Research activity should be taken to estimate the generation rate, especially in rural areas. The selection of the soum for research can be based on the poverty level, population or tourist attraction sites.	2026	Ministry of Environment and Climate Change
Sector-based industrial solid waste data is not available	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2027	Ministry of Environment and Climate Change And MoFALI
The generated sludge (both industrial and municipal) was never reported in the solid waste activity data	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2027	Ministry of Environment and Climate Change and Ministry of Urban Development, Building and construction
4.B. Biological treatment of solid waste			
Emissions of biological treatment are not estimated because of lack of data	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2027	Ministry of Environment and Climate Change
4.C. Incineration and Open Burning of Waste			
Due to the lack of data on waste incineration, which is mixed with clinical waste/hazardous waste and municipal waste, and also the lack of time series data it was not estimated (NE) (4.C.1)	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2028	Ministry of Environment and Climate Change Ministry of Health

Although it is regulated by law, prohibiting the open burning of waste, it might have occurred in rural areas before 2000. The lack of time series data resulted in the not estimation (4.C.2)	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2028	Ministry of Environment and Climate Change
4.D. Wastewater treatment and discharge			
The wastewater treatment and discharge pathway does not reported due to the lack of the information	The wastewater treatment and disposal system of whole of Mongolia will be estimated and drawn	2026	Ministry of Environment and Climate Change Ministry of Urban Development, Building and construction Water agency
Municipal wastewater treatment and disposal in rural areas are not estimated (NE) due to the lack of data/ information. Also, the industrial and municipal wastewater in rural areas mixed, which hinders the estimation (4.D.1)	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2027	Ministry of Environment and Climate Change Water Agency
Industrial wastewater in rural areas is mixed thus its challenging to segregate the data to estimate (4.D.2). The number of constructed wetlands is not available	Data collection will be improved and GHG emissions will be calculated in subsequent submissions.	2027	Ministry of Environment and Climate Change Water Agency

CHAPTER TWO: INFORMATION NECESSARY TO TRACK PROCESSES MADE IN IMPLEMENTING AND ACHIEVING THE NATIONAL DETERMINED CONTRIBUTIONS

2.1. NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

National circumstances and institutional arrangements are provided in the Appendix II of this report.

2.2 DESCRIPTION OF A PARTY'S NATIONALLY DETERMINED CONTRIBUTION UNDER ARTICLE 4 OF THE PARIS AGREEMENT, INCLUDING UPDATES (B)

Mongolia's updated the Intended Nationally Determined Contribution (NDC) in 2019, and the updated NDC endorsed by Government Decree No. 407 dated 19 November 2019, affirms the country's commitment to the objectives of the Paris Agreement through a comprehensive national climate mitigation strategy. The NDC aims to reduce GHG emissions by 7.2% in 2020, 12.3% in 2025, and 22.7% in 2030 relative to the baseline scenario. Particularly, the energy sector will provide 66.7% of the reductions in GHG emissions, followed by the agricultural sector with 31.3%, the industry sector with 1.4%, and the waste sector with 0.6%.

If conditional measures—such as carbon capture and storage (CCS) and waste-to-energy systems—are implemented, the total mitigation could reach 27.2%. The LULUCF sector plays a crucial role in the successful implementation of the NDC in Mongolia i.e., additional forest-based sequestration would raise the reduction potential to 44.9% by 2030.

The implementation timeframe for the NDC spans 2021–2030, with continuous monitoring against the structured summary format required under paragraph 65(a) of the MPGs. The target covers four gases: CO_2, CH_4, N_2O, and HFCs, fulfilling paragraph 65(c) on gases covered.

To enhance the technical robustness of its NDC, Mongolia revised its 2030 BAU emissions baseline using the 2006 IPCC Guidelines for National GHG Inventories and AR5 global warming potential (GWP) values, resulting in an updated estimate of 78,800 Gg CO_2-eq, revised from 74,300 Gg CO_2-eq. This revision reflects the application of improved methodologies and the integration of updated national activity data across all key sectors, ensuring consistency with paragraph 64(b) and paragraph 65(b) of the MPGs.

Table II. 1. Key elements of Mongolia's NDC

Information	Description
Targets and Description	1. Mongolia intends to achieve a target to mitigate its GHG emissions by 22.7%, by 2030, compared to 2010 by the BAU scenario, excluding LULUCF.
Target Type	Multi-year emission reduction below a projected baseline
Target Year	2030
Base Year	2010

Base Year Value	GHG emissions level in 2010: 27,400 Gg CO -eq, without LULUCF (recalculated by AR5) Please see Figure II.1.
Implementation Period	2021–2030
Sectors	Sectors covered as contained in Annex I to decision 5/CMA.3: Energy, Industrial Processes and product use, Agriculture, LULUCF, Waste
Gases	CO_2, CH_4, N_2O, HFCs
Intention to use of ITMOs	The Governments of Mongolia and Japan signed a bilateral cooperation document for the introduction of the JCM in 2013. Both governments are using the JCM and implementing projects on renewable energy use, energy efficiency. Joint Crediting Mechanism (JCM) with Japan[33]
Any updates or clarifications of previously reported information	The last inventory used 2006 IPCC Guidelines for National GHG Inventories and AR5 global warming potential (GWP) values. Accordingly projected emissions with business-as-usual (BAU) scenario updated. Please see Figure II.1

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

2.3.1. Description of Selected Indicators

Mongolia used the same unit as the NDC base year and target percentage for the tracking of progress towards implementing and achieving the NDC. This selected indicator is annual total GHG emissions without LULUCF aligned with the scope of the NDC in CO_2-eq.

Table II. 2. Structured summary: Description of selected indicators

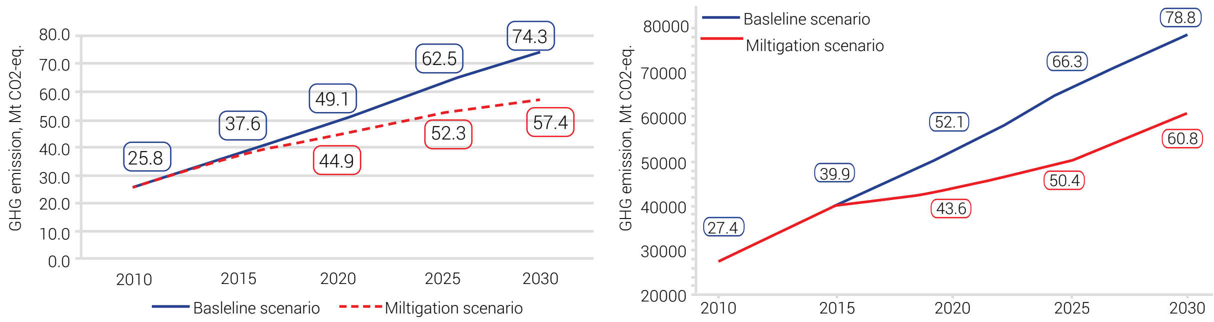
Indicator(s) selected to track progress	Description
Indicator	Annual total GHG emissions in CO_2-eq without LULUCF consistent with the scope of the NDC.
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate	The reference level is national total GHG emissions without LULUCF compared to business-as-usual (BAU) scenario in inventory year (2022) relative to the base year (2010) emissions levels, without LULUCF. The reference level value was 54,525.77 Gg CO_2 eq in 2022.
Updates in accordance with any recalculation of the GHG inventory, as appropriate	Revised the reference level value due to use of the 2006 IPCC Guidelines for latest inventory of National GHG emissions with AR5 global warming potential (GWP) values. Please see Figure II.1.
Relations to NDC	The indicator is defined in the same unit as the target of the NDC. Therefore, this can be used for tracking progress in implementing and achieving the NDC target.

33 MET & MOE Japan (2023). *Joint Crediting Mechanism (JCM) Implementation Report.*

The selected indicator aggregates anthropogenic GHG emissions across four key sectors: energy, agriculture, industrial processes, and product use (IPPU), and waste.

The reference level may be updated as improved emission factors, activity data, or methodologies become available, in accordance with paragraph 65(c) of the MPGs[34].

The emissions inventory for 2022 was compiled using IPCC 2006 guidelines and GWP values from IPCC AR5, as described in Chapter 1. The BAU baseline that was defined in Mongolia's NDC using GWP values from IPCC SAR. Accordingly projected emissions with business-as-usual (BAU) scenario updated with GWP values from IPCC AR5 (Figure II.1).



a) BAU scenario included in NDC with GWP-AR2

b) Update BAU scenario included in NDC with GWP-AR5

Figure II. 1. Comparison of baseline GHG emissions and mitigation scenarios in Gg CO2-eq, AR5

By establishing this indicator, Mongolia reinforces its commitment to climate transparency and accountability, setting a strong foundation for enhanced ambition and international cooperation in future NDC cycles.

This indicator enables the transparent quantification of progress in achieving the NDC mitigation target and adheres to Article 4.13 of the Paris Agreement, which requires that Parties account for anthropogenic emissions and removals in a manner that promotes environmental integrity, transparency, accuracy, completeness, comparability, and consistency[35]. It also fulfills the requirements of Decision 18/CMA.1 by using harmonized accounting approaches and providing clarity on both methodological assumptions and data sources[36].

2.3.2. Tracking Progress Towards Implementing and Achieving NDC

In accordance with Article 13 of the Paris Agreement and aligned with MPGs §§64–67 and §118, this section presents Mongolia's progress in implementing and achieving its NDC for the years 2021 and 2022. The assessment is based on the most recent national greenhouse gas (GHG) inventory data and implementation progress by sector, as reported in CTF Table 1 under the Enhanced Transparency Framework (ETF).

The assessment covers the years 2021 and 2022, using the 2010 base year and a updated Business-as-Usual (BAU) scenario for 2022 as reference points. Mongolia's national GHG inventory is the principal data source, applying IPCC 2006 Guidelines with AR5 global warming potentials (GWPs) following reporting requirements under the Enhanced Transparency Framework (ETF)[37].

34 Decision 18/CMA.1, Annex, para. 65(c).
35 UNFCCC (2015). Paris Agreement, Article 4.13.
36 Decision 18/CMA.1, Annex, paras. 64(a)–(c), 65(a)–(c).
37 Mongolia's GHG inventory was prepared using the IPCC 2006 Guidelines and AR5 GWPs (100-year time horizon) as per paragraph 37 of the MPGs.

Table II. 3. Summary of progress towards implementing and achieving the NDC and the contribution by Mongolia

		National total GHG emissions
Base year (2010) value		23'931.77 Gg CO_2-eq
Baseline scenario (2022)		54'525.77 Gg CO_2-eq
Values in the implementation period	2021	45'740.01 Gg CO_2-eq
	2022	48'509.11 Gg CO_2-eq
Target year		2030
Target level		22.7% reduction (18'000 Gg CO_2-eq as recalculated following the change in metrics) compared to the BAU scenario.
Progress made towards the NDC		The most recent level of the indicator is 7.6% below the BAU scenario.

Mongolia's GHG emissions totaled 45,740.01 Gg CO_2-eq in 2021 and 48,509.11 Gg CO_2-eq in 2022[38] relative to the 2022 BAU scenario of 54,525.77 Gg CO_2-eq, this reflects a reduction of 7.6%, or approximately 6,016.7 Gg CO_2-eq emissions[39].

In 2022, GHG emissions were reduced by 6,016.7 Gg CO_2-eq under NDC, achieving approximately 73.3% of the total reduction target of 8,205.8 Gg CO_2-eq set for the inventory year (relative to the business-as-usual scenario). This reduction also represents 33.4% progress towards the 2030 target of reducing emissions by 18,000 Gg CO_2-eq beyond the 2022 baseline.

Table II. 4. CTF TABLE 4. Structured summary: tracking progress made in implementing and achieving the NDC.

Indicator (s)	Unit	Reference Level	Implementation period of the NDC			Target Level	Target Year	Progress made towards the NDC, as of 2022
		2022 (BAU)	2020	2021	2022			
National total GHG emission	Gg CO_2 equivalent	54,525.77	43,604.77	45,740.01	48,509.11	60,800.00	2030	7.6% reduction compared to BAU scenario

Energy Sector: In 2022, Mongolia achieved a reduction of approximately 2,655.6 Gg CO_2-eq, representing a 3.35% decrease relative to the Business-as-Usual (BAU) scenario. This mitigation outcome was primarily driven by renewable energy deployment and improvements in energy efficiency. The national energy balance reflects a growing share of solar and wind energy in installed capacity. These developments reflect incremental but measurable progress toward the 2030 mitigation target outlined in the updated NDC.

Agriculture (Livestock Sector): The livestock sector remains the dominant source of methane emissions in Mongolia's GHG profile. Emissions increased from 17,889.63 Gg CO_2-eq in 2021 to 19,233.03 Gg CO_2eq in 2022, primarily due to continued herd growth and enteric fermentation. Although mitigation activities such as improved manure management and trials on dietary

38 Government of Mongolia. National GHG Inventory, 2023 submission.
39 Reduction calculated as (54,525.77 – 48,509.11) = 6,016.7 Gg CO_2-eq.

feed additives were initiated, these are not yet implemented at scale.

Industrial Processes and Product Use (IPPU): IPPU sector emissions rose from 666.1 Gg CO_2-eq in 2021 to 709.9 Gg CO_2-eq in 2022, driven by higher production volumes of cement and lime and increasing use of HFCs in refrigeration and air conditioning systems.

Waste Sector: GHG emissions from the waste sector increased from 587.8 Gg CO_2-eq in 2021 to 642.1 Gg CO_2-eq in 2022. The rise is attributed to higher volumes of municipal solid waste generation and limited implementation of landfill gas recovery systems. Methane emissions from unmanaged solid waste disposal and wastewater treatment are detailed in *Sections 1.7.5 of Chapter 1*[40].

Challenges and Opportunities: Persistent gaps remain in MRV systems, inter-sectoral data sharing, and access to domestic and international climate finance. Capacity-building needs are particularly acute at subnational levels. However, key opportunities exist to scale up mitigation particularly in renewable energy, climate-smart livestock systems, and the circular economy.

2.3.3. Methodologies and accounting approaches

To ensure consistency in tracking progress toward its economy-wide emission reduction target, Mongolia applies internationally accepted methodologies, national datasets, and sectoral modeling frameworks. These are aligned with the Modalities, Procedures, and Guidelines (MPGs) under the Paris Agreement, ensuring coherence between reporting under Article 13 and NDC implementation.

Table II. 5. Structured summary CTF Table 3: Methodologies and accounting approaches

Reporting Requirement	Description or Reference
Key parameter	Mongolia tracks its total national GHG emissions (without LULUCF) as the primary metric for assessing progress toward its economy wide NDC mitigation target[41].
Assumptions	The 2030 BAU baseline is projected at 78,800 Gg CO_2-eq, using the 2006 IPCC Guidelines and 2019 Refinements. Macroeconomic assumptions include a 5.5% average annual GDP growth rate and demographic trends based on NSO statistics[42]. Sectoral assumptions reflect prevailing practices and policies across energy, agriculture, IPPU, and waste.
Definitions, data sources, and models	Definitions and data sources used for NDC tracking are consistent with those in Mongolia's inventory report[43].
Accounting for emissions and removals	Mongolia applies IPCC-approved methods and Decision 18/CMA.1 to estimate GHGs, using the 2006 IPCC Guidelines and 2019 Refinements[44]. Anthropogenic emissions and removals are reported using AR5 100-year GWP values[45].
Inventory consistency	The NDC tracking framework and GHG inventory are methodologically aligned, with national totals[46].

40 See Chapter 1, Sections 1.7.5: Solid Waste Disposal and Wastewater Treatment Emissions
41 UNFCCC (2018). Decision 18/CMA.1: Modalities, Procedures and Guidelines for the Enhanced Transparency Framework, *Annex, para. 65(a).*
42 National Statistics Office (2022). Population and GDP Projections for Long-Term Planning 2021–2030.
43 MET (2023). National Inventory Report of GHG Emissions: 2022 Submission to UNFCCC.
44 IPCC (2006). 2006 Guidelines for National GHG Inventories; *IPCC (2019).* Refinement to the 2006 Guidelines.
45 IPCC (2014). Fifth Assessment Report (AR5), Working Group I: Climate Change 2013 – The Physical Science Basis.
46 UNFCCC (2021). Common Tabular Format (CTF) Tables for Biennial Transparency Reports.

Avoiding over/ underestimation	Conservative approaches and Tier 1 methods are applied where uncertainty is high. Tier 2 methods are used in key categories (e.g. livestock, fuel combustion) with higher-quality data. Data trends are validated using Mongolia's MRV system[47].
Baseline methodologies	Mongolia applies a multi-model approach to baseline construction: IPCC 2006 Guidelines & 2019 Refinements, GIZ NDC Accounting Guidance[48] LEAP Modeling for energy and GHG projections[49], FAO NDC Tracking Tool for AFOLU sector baselines[50], Kaya Identity decomposition to assess sectoral drivers (e.g., GDP, energy intensity), and National statistical assumptions from NSO and ministries
Metrics	GHG emissions are expressed in CO_2-equivalent using AR5 GWP values over a 100-year time horizon, per Decision 18/CMA.1[38].
Consistency in communication/ implementation	Metrics, methodologies, and assumptions are consistent across communication and implementation cycles in accordance with Decision 4/ CMA.1, paragraph 12(b)[51].
Inclusion of categories	Mongolia strives to include all anthropogenic emissions and removals. Once a category is included, it is maintained unless transparently justified and documented.
Natural disturbances	No specific methodologies to exclude emissions from natural disturbances are currently applied; emissions are reported as observed.
Harvested wood products (HWP)	Emissions and removals from HWPs are not yet included in NDC accounting. No specific IPCC approach has been applied for this category.
Cooperative approaches and ITMOs	Mongolia participates in cooperative approaches under Article 6, applying robust accounting to avoid double counting. JCM projects with Japan follow approved methodologies adapted to Mongolian conditions[52].
Sustainable development in cooperation	Cooperative approaches support sustainable development, with publicly available methodologies and transparent governance under the JCM[53].
Technical changes and updates	Any methodological changes or recalculations are transparently reported in subsequent submissions and reflected in recalibrated time-series datasets[54].
Exclusions	Any excluded emission categories or activities are clearly documented, with rationale in line with IPCC Guidance and Decision 4/CMA.1.

47 MET (2022). MRV System for Climate Action in Mongolia: Procedures, QA/QC, and Tiered Methodologies.
48 GIZ (2020). Guidance for Accounting of NDCs under the Paris Agreement.
49 SEI (2021). LEAP System: Long-range Energy Alternatives Planning for Mongolia's Energy Sector Modeling.
50 FAO (2023). NDC Tracking Tool for AFOLU Sectors, v3.0, https://www.fao.org/in-action/ndc-tracking/en
51 UNFCCC (2018). Decision 4/CMA.1: Further Guidance in Relation to the Mitigation Section of Decision 1/CP.21, para. 12(b).
52 MET (2022). Annual JCM Report: Mongolia-Japan Bilateral Cooperation under Article 6.
53 JCM Secretariat (2023). *JCM Project Methodologies and Governance*, https://www.jcm.go.jp/
54 MET (2023). GHG Time Series Recalculation Protocol and Technical Update Documentation.

2.4. MITIGATION POLICIES AND MEASURES, ACTIONS, AND PLANS, RELATED TO IMPLEMENTING AND ACHIEVING A NATIONALLY DETERMINED CONTRIBUTION UNDER ARTICLE 4 OF THE PARIS AGREEMENT

2.4.1. Mitigation Policies and Measures and Institutional Arrangements

Existing policy documents are well linked to each other and largely consistent in terms of goals, targets and objectives set. Governmental officials exhibit good knowledge of the policy documents[55].

The mitigation component of Mongolia's contribution is based on a policies and measures approach. That is to say, fulfilment of the NDC will be considered complete if the policies and actions listed in the NDC are implemented. The proposed policies and measures represent the ambitious plans of existing national strategy and legislation. Some of them area the state policy for the energy sector[56], Urban public transport investment programme[57] the National action plan for climate change[58], Green development policy[59], and the "Mongolian Livestock" national programme (Parliament resolution No. 23, 2010).

Sustainable Development Vision-2030 was updated the policy in 2020 with the Sustainable Development Vision-2050[60]. Mongolia VISION 2050 Long term development policy is a key policy document for achieving and supporting Mongolia's objective to become climate resilient by 2050. After approval Vission 2025, the State Great Khural has rescinded many policies reflected in the NDC of Mongolia after submitting the NDC to the UNFCCC to eliminate duplication and contradiction. These are Sustainable Development Vision 2030, Green Development Policy of Mongolia, the, National Action Program on Climate Change, the State Policy on The Energy Sector of Mongolia, the State Policy on Forest, and the State Policy on the Food and Agricultural Sector.

Mongolia's Vision-2050 Long Term Development Policy includes all NDC measures in policy issues and objectives, creating a supportive environment in the sectors working towards climate change adaptation and mitigation.

In June 2021 the NCC approved the Action Plan for implementation of Nationally Determined Contribution (APNDC)[61]. The APNDC covers both mitigation and adaptation measures. Thus, the advantages of the NDC of Mongolia is that the principal targets reflected in the NDC are consistent with Mongolia's policy and legal environment. The framework incorporates regulatory, financial, and institutional mechanisms aimed at supporting low-carbon and inclusive economic development across key sectors. This chapter provides the implementation of mitigation measures identified in APNDC for the period 2021-2022.

Target 2 of the APNDC aims to mitigate climate change and reduction of GHG emission in line with the long-term development framework, Vision 2050. The APNDC identified 41 mitigation measures under 14 goals:

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55 United Nations. (2018). Environmental performance reviews: Mongolia synopsis. New York and Geneva.
56 The Government of Mongolia. (2015). State policy on energy. Parliament resolution No. 63,
57 The Government of Mongolia, (2015). Urban public transport investment programme
58 The Government of Mongolia, (2012). National action plan for climate change. Government resolution No. 171
59 The Government of Mongolia. (2014). National Green Development Policy of Mongolia. The Parliament Resolution No 43. 13 June 2014. Ulaanbaatar
60 Government of Mongolia. (2020). Mongolia Vision 2050 Long term development policy. Parliament Resolution 52, 13 May 2020. Ulaanbaatar
61 Government of Mongolia. (2020). *Action Plan for Implementation of the Nationally Determined Contribution (AP-NDC).*

1. Reduce GHG emission from energy generation by increasing renewable energy sources.
2. Reduce GHG emissions by improving efficiency of energy supply.
3. Reduce GHG emissions by reducing livestock numbers and improving livestock quality and productivity, rather than increasing livestock numbers.
4. Reduce GHG emissions by using waste heat from cement plants
5. Reduce GHG emissions by using fly ash in cement production.
6. Utilization of coal mine methane
7. Improving energy efficiency in IPPU sector
8. Reduce GHG emission by switching to Euro-5 standard fuels
9. Reduce energy consumption by limiting the use of raw coal in Ulaanbaatar City
10. Insulate precast panel apartments in Ulaanbaatar City.
11. Reduce GHG emissions by reducing the waste volume for landfill through the improvement waste treatment and recycling process
12. Increase the share of the population with access to improved sanitation and sewerage facilities.
13. Reduce GHG emissions from forest fires and maintain carbon sequestration
14. Reduce GHG emission caused by forest pest infestation, and maintain carbon sequestration

The implementation timeline for these measures is five years (2021–2025). Given that the current BTR-1 reporting period covers 2011–2022, no quantitative assessment of outcomes has been conducted yet due to lack of adapted national climate action tracker methodologies.

However, only 2 mitigation measures have been started and ongoing and 12 adapted but not yet started. These measures are presented in the Table below:

Table II. 6. Adopted and under implementation Mitigation policies and measures, actions, and plans.

Name	Objectives	Type of instrument	Status	Sector(s) affected.	Gases	Start year of implementation	Implementing entities
Use of renewable energy sources (Hydro PP, Wind PP, Solar PP, Heat pumps for heating utilities)	Construction of Erdeneburen hydropower plant (HPP-90 MW), 50-100 MW hydropower plant in the central region, 2 wind farms with a total capacity of 15 MW, 5 solar power plants with a total capacity of 35.3 MW	Regulatory	Adopted	Energy	CO_2, CH_4, N_2O	2020	Ministry of Energy
Reduce electricity and heat transmission and distribution grid losses and improve the heat supply in cities and towns	To build 2810.3m pairs and 2620.5m single lines in 8 sections of heat supply in Ulaanbaatar, to expand and renovate 1400m old lines, Implement the "Energy Project-2" project to reduce electricity distribution network losses	Regulatory	Adopted	Energy	CO_2, CH_4, N_2O	2020	Ministry of Energy
Reduce internal use of combined heat and power plants (CHPP) and improve the efficiency of power plants	Establish heating stations, heating networks and heat distribution centers in 10 aimag centers, improve the heat supply of Ulaanbaatar, from TPP-3 to the city center	Regulatory	Adopted	Energy	CO2, CH4, N2O	2020	Ministry of Energy
Switch to Euro - 5 standart fuel	Switch to fuel at Euro-5 standard	Regulatory	Adopted	Energy	CO2, CH4, N2O	2020	Ministry of Mining and Heavy Industry
Switch to coal export transportation to rail transport from auto transportation	Transfer of coal export for from road transportation to railway transportation.	Regulatory	Adopted	Energy	CO2, CH4, N2O	2020	Ministry of Road and Transportation
Insulate old precast panel buildings in Ulaanbaatar city	Under the financial mechanism for thermal engineering renovation, insulating prebuilt 258 block apartment buildings, and insulating 2,000 private housing units in ger areas.	Regulatory	Adopted	Energy	CO2, CH4, N2O	2020	Ministry of Urban Development Construction and Housing
Limit the use of raw coal in Ulaanbaatar city and switch to the use of improved fuel	Limit the use of raw coal in Ulaanbaatar city and switch to the use of improved fuel	Regulatory	Implemented	Energy	CO2, CH4, N2O	2020	Ulaanbaatar Mayor's Office (UB CMO)
Energy saving measures	Improve the efficiency of industrial electric engines and install energy-efficient lighting. Implement MNS ISO-50001: 2019 standard for energy management system, improving energy consumption norms for unit production and services in the industrial sector.	Regulatory	Implemented	Energy	CO2, CH4, N2O	2020	Ministry of Energy

Regulate and reduce the livestock number	Based on genetic resources and insemination methods, increasing the number of quality livestock through the implementation of livestock and pasture management, establishing a technological service unit to improve the number, quality, and efficiency of livestock, and establishing control over breeding and selection policies, technological works, and services. Optimizing meat and meat products to limit the number by creating meat stocks and supporting the export of meat and meat products.	Regulatory	Adopted	Agriculture	CH_4, N_2O	2020	Ministry of Food Agriculture and Light Industry
Improve the livestock manure management	Conduct research, develop method and techniques for estimating emissions of GHG in the pastoral livestock sector and optimizing livestock manure management.	Regulatory	Adopted	Agriculture	CH_4, N_2O	2020	Ministry of Food Agriculture and Light Industry
Use waste heat from cement plants	Create legal environment to exempt imported electricity generation equipment from customs and VAT for using waste heat in cement plants, Develop and present recommendations to the cement plants for constructing heat plants from waste.	Regulatory	Adopted	Industrial processes and product use	CO_2, HFCs	2020	Ministry of Environment and Climate Change
Use fly ash in cement production	Construction of powdered ash silo with a capacity of 10-15 thousand tons at Amgalan Thermal Power Plant, building a facility with a capacity of 50-60 thousand tons per year for the purpose of collecting, storing and loading powdered ash for power plants.	Regulatory	Adopted	Industrial processes and product use	CO_2, HFCs	2020	Ministry of Urban Development Construction and Housing
Use coal bed methane	Developing master plan to promote methane supply from coal deposits, Construction of power plant based on methane near underground coal mines.	Regulatory	Adopted	Industrial processes and product use	CO_2, HFCs	2020	Ministry of Mining and Heavy Industry
Reduce the waste volume for landfill through the improved waste treatment and recycling process	Reduce the size and quantity of landfills and open dumpsites at centralized landfills through promotion of waste recycling industries. Establishing a plant with the capacity of 700 tons of food waste to recycle per year at the location of 'Narangiin Enger' landfill site. Construction of new landfill facility with crushing plant for construction waste at the Moringiin Davaa waste dumping site. Establish a plant to collect and transport household waste in Ulaanbaatar, Establish waste sorting plant at the Tsagaandavaa landfill site.	Regulatory	Adopted	Waste management	CH_4, N_2O	2020	Ministry of Environment and Climate Change
Increase the share of the population with access to improved sanitation and hygiene facilities	Renovation and construction of treatment facilities in 10 provincial centers (such as Arkhangai, Uvurkhangai, Bulgan, Umnugovi, Dornogovi, Khuvsgul, Khentii, Sukhbaatar, Dundgovi, Darkhan-Uul) and Khujirt soum center of Uvurkhangai Province. Renovation and construction of new treatment facilities in 5 aimag centers (Bayan-Ulgii, Dornod, Govisumber, Zavkhan, Uvs). Construction of new treatment plant in Ulaanbaatar. To build and renovate water and sanitation facilities of soum kindergartens, schools, hospitals, in a way that is resistant to natural disasters caused caused by climate change, and to introduce technological solutions using water and energy efficient and sources of renewable energy.	Regulatory	Adopted	Waste management	CH_4, N_2O	2020	Water Supply and Sewerage Authority of Ulaanbaatar City

2.4.2. Sectoral policies

2.4.2.1. Energy Sector

Renewable Energy Expansion: Mongolia has prioritized renewable energy to reduce reliance on coal and diversify its energy mix. Key initiatives include the construction of 10 MW solar farms in Gobi-Sumber and Dornogovi provinces, which have expanded Mongolia's solar energy capacity, leveraging the region's high solar irradiance. Projects in Tuv and Sukhbaatar aim to exploit the country's strong wind resources, with wind energy capacity projected to exceed 200 MW by 2025. To support the integration of these renewable sources, Mongolia established its first large-scale battery storage power station with a capacity of 80 MW, enhancing grid stability and reducing curtailment of renewable energy.

Hydropower is a cornerstone of Mongolia's transition to a low-carbon energy system. The Erdeneburen Hydropower Plant (90 MW) and Eg River Hydropower Plant (315 MW) will collectively reduce coal consumption by more than 1,000,000 tons annually, significantly lowering GHG emissions. These projects also improve energy security by providing consistent power generation, particularly during winter months when coal plants dominate energy supply.

Thermal Power Plant Upgrades: While transitioning to renewable energy, Mongolia continues to modernize its coal-based power infrastructure to improve efficiency and reduce emissions. The Choibalsan Thermal Power Plant was expanded by 50 MW, while the Amgalan Thermal Power Plant increased its capacity by 116 MW to meet growing urban energy demands. The "New Revival Policy" led to the operationalization of the 150 MW Buuruljuut Power Plant in 2024, reducing strain on aging infrastructure.

Energy Efficiency and Building Retrofitting: Mongolia's efforts to improve energy efficiency focus on reducing energy waste and enhancing building performance. This initiative aligns with national goals to lower urban energy consumption and reduce GHG emissions. Additionally, the introduction of smart metering systems in key urban areas helps optimize energy usage and provides actionable data for further efficiency improvements.

Challenges and Opportunities: Mongolia's energy transition faces challenges, including high upfront costs for renewable energy infrastructure, limited technical capacity, and harsh climatic conditions that can affect project implementation. However, the country's abundant renewable energy resources (solar, wind, and hydro) offer immense potential for growth. Investments in renewable energy and international partnerships, such as those supported by the Green Climate Fund (GCF), will be critical to overcoming these barriers and achieving Mongolia's NDC targets.

2.4.2.2. Industry sector

The Industrial Processes and Product Use sector contributes 1.5% (709.94 Gg CO_2-eq) of the national total GHG emissions (excluding LULUCF) in 2022. The main contributor to the total emissions from IPPU sector is the mineral industry (cement and lime production) and it represents 82.5% of emissions. Under the "New Revival Policy," value-added processing plants for mining and agricultural products will be developed in phases. The steel and copper concentrate industries are central to the industrialization effort. Key projects include the construction and operation of the Erdenet copper concentrate plant, the Tavantolgoi coal processing plant, and steel plants in the Darkhan-Selenge region. Plans are also underway to establish tanneries and sub-retrieval centers in Darkhan. A major goal for economic independence is to promptly launch the oil refinery and begin domestic gasoline production. GHG emissions from industrial activities are expected to rise substantially.

2.4.2.3. Agriculture, Forestry, and Other Land Uses (AFOLU) sector

Reducing emissions from livestock is challenging, but there is significant potential to increase carbon sequestration through improved forest management and better land resource practices. As outlined in the NDC commitment, reducing livestock herd sizes is crucial for sustainable grazing, though it may affect livelihoods if not carefully managed.

2.4.2.4. Waste sector

Mongolia has implemented several key policies and measures to manage waste and mitigate GHG emissions, reflecting a commitment to sustainable development and climate action. The Law on Household and Industrial Waste (2017) regulates waste management practices, aiming to reduce waste generation and promote recycling. It contains several mitigation measures aimed at improving waste management practices and reducing environmental and public health risks, including those related to GHG emissions. One of the core areas the law addresses is the regulation of waste collection, transportation, and disposal. It stipulates that only registered and licensed individuals or entities are allowed to handle the collection and transportation of waste, particularly hazardous waste. This ensures that waste is managed professionally and safely, minimizing risks of environmental contamination during transit. The law also requires that waste transportation be carried out using vehicles that meet technical and environmental safety standards, preventing leaks, spillage, or emissions that could contribute to pollution.

Another significant measure is the restriction on the establishment of waste disposal sites. The law prohibits the location of centralized landfills in environmentally sensitive or high-risk areas such as urban centers, water protection zones, and mining regions. This helps to reduce the risk of soil and water pollution, which can indirectly contribute to climate impacts, particularly in areas where landfill methane emissions are poorly managed.

In terms of waste reduction and circular economy practices, the law promotes the reuse of materials and the recycling of waste as raw inputs for new products. It requires the organization and financial support of waste sorting and recycling activities. This is an important mitigation measure, as increased recycling and reuse reduce the need for raw material extraction and energy-intensive production, both of which are significant sources of GHG emissions. By fostering a more circular approach to materials, the law supports a shift toward low-carbon economic practices.

The National Waste Management Strategy and Action Plan (NWMISAP) for Mongolia was officially approved and launched in July 2017. This initiative was developed through a collaboration between the Ministry of Environment and Tourism (MET) of Mongolia, the United Nations Environment Program (UNEP) International Environmental Technology Centre (IETC), and the Asian Institute of Technology's Regional Resource Centre for Asia and the Pacific (AIT RRC.AP), with financial support from the Government of Japan. The NWMISAP outlines a comprehensive framework for waste management in Mongolia, focusing on ensuring sound management of solid wastes, promoting conservation and efficient use of resources, striving for environmentally sound technologies and approaches, and mitigating adverse impacts to the climate by GHG emissions and short-lived climate pollutants (SLCPs) generated by the waste sector.

While the NWMISAP provides a strategic framework, its implementation involves various initiatives and projects aimed at enhancing waste management practices across the country. These include public awareness campaigns, infrastructure development, and policy reforms to promote recycling and reduce waste generation. However, challenges remain, such as limited recycling infrastructure outside the capital and the need for greater public participation in waste management efforts.

Additionally, the Ulaanbaatar Waste Management Improvement Strategy and Action Plan 2017–2030 (UWMISAP) was developed in parallel to address the specific challenges of waste management in the capital city. This localized plan aims to improve waste management practices in Ulaanbaatar, aligning with the national strategy while addressing city-specific needs.

2.4.3. Evaluation of Policies and Measures

Due to methodological lack, it was difficult to quantitively assess the implementation policies i.e., to what degree progress has been made to meet mitigating objectives in NDC and national policies. Because Mongolia lacks in national tracking system, information on financial obligations, and climate governance. The mitigation measures in NDC require US$6.3 billion for implementation. As referenced in the implementation plan NDC of Mongolia, most of the funding is expected to be accessed from multilateral donors and other international sources, yet the domestic finance is to be mobilized through public-private partnerships, commercial banks, and government funding mechanisms for those actions identified as unconditionally in the NDC.

For this reporting policies and measures are assessed qualitatively based on their performance relative to 2030 targets, using a five-point scale (A–E) as per the Enhanced Transparency Framework (ETF).

Table II. 7. Evaluation of Policies and Measures

Policy/Measure	Evaluation (A–E)	Remarks
Renewable energy expansion	B	Progress made, with additional renewable projects under development.
Large energy consumers agreement	B	Initial reductions achieved; monitoring to ensure compliance.
Livestock management optimization	B	Improved practices adopted, with continued focus on manure management.
Gender-inclusive agricultural training	A	Positive impact observed in empowering women and promoting sustainable practices.
Recycling initiatives	B	Moderate advancements in recycling capacity; further scaling required.
Methane capture at landfills	C	Early-stage implementation; requires accelerated action to meet targets.

2.5. SUMMARY OF GREENHOUSE GAS EMISSIONS AND REMOVALS

Mongolia's greenhouse gas (GHG) emissions and removals provided in Chapter 1.

2.6 PROJECTIONS OF GREENHOUSE GAS EMISSIONS AND REMOVALS

Mongolia's GHG emissions projections are "with measures" scenario, integrating all implemented and planned policies up to 2030. This scenario incorporates renewable energy expansion, methane reduction programs in agriculture, enhanced waste management systems, and sustainable land-use strategies. These efforts align with NDC and Mongolia's long-term commitment to achieving net-zero emissions by 2050 while ensuring sustainable development.

Projections of GHG emissions between 2020 and 2040 in Mongolia have been estimated. For the estimating of emissions from energy sectors, which accounts for the majority of the GHG emissions and results from a Long-range Energy Alternatives Planning system (LEAP) model were used. LEAP is a scenario-based energy-environment modeling tool. Scenarios are based on a accounting of how energy is consumed, converted and produced in a given region under a range of alternative assumptions on population, economic development, technology and other related measures. Projection of emissions from agriculture, land-use change, and forestry (LULUCF), and waste sectors were calculated up to 2040 based on previous trends, considering social and economic changes, and currently implemented or adopted policies and measures. It presents the aggregated projections of the GHG.

Table II. 8. Projections of the national total emissions

Total	Most recent year in the NIR	Projections of GHG emissions and removals			
Unit	Gg CO_2 eq				
Years	2022	2025	2030	2035	2040
CO_2 emissions with CO_2 from LULUCF	-11,418	-5,123.00	1,712.44	8,547.87	15,383.30
CO_2 emissions without CO_2 from LULUCF	20,487.43	20,911.20	23,469.30	26,027.39	28,585.49
CH_4 emissions with CH_4 from LULUCF	20,078.08	19,994.12	22,170.37	24,346.62	26,522.87
N_2O emissions without N_2O from LULUCF	7,821.42	7,539.15	7,919.96	8,300.77	8,681.58
HFCs	122.17	133.78	153.13	199.2	217.28
Total with LULUCF	NA	NA	NA	NA	NA
Total without LULUCF	48,509.11	50,400	60,800	69,520	78,720

2.7 EMISSION PROJECTIONS BY SECTOR

By 2030, total GHG emissions (without LULUCF) are projected to reach 60,800 Gg CO_2-eq. These key sectoral outcomes are as follows:

Energy Sector: Expected to achieve a 45% emissions reduction by 2030 through renewable energy deployment, improved grid efficiency, and fossil fuel substitution[62].

[62] MET&MoE (2023). *National Renewable Energy Roadmap*

Agriculture Sector: Projected to reduce emissions by 10% by 2030, by implementing herd management, feed improvement, and biogas adoption[63].

IPPU Sector: Projected to reduce emissions by 25% by 2030, supported by cleaner production technologies, waste heat recovery, and emissions monitoring in cement and mining operations[64].

Waste Sector: Forecast to decrease emissions by 20% by 2030, aided by landfill gas recovery, composting, and improved recycling and waste segregation[65].

LULUCF Sector: Expected to deliver steadily increasing net removals—from –31,810.21 Gg CO_2-eq in 2010 to –31,905.43 Gg CO_2-eq in 2022—through reforestation, urban greening, and degraded land rehabilitation[66].

Table II. 9. Projections of GHG emissions and removals by sector

	Most recent year in the NIR	Projections of GHG emissions and removals			
Unit	Gg CO_2 eq				
Years	2022	2025	2030	2035	2040
Energy	20,394.81	24,906.87	30,046.38	34,355.67	38,902.16
Industrial processes and product use	709.94	359.51	433.69	495.90	561.52
Agriculture	26,762.24	24,648.11	29,734.22	33,998.74	38,498.00
Forestry/LULUCF	-31,905.43	NA	NA	NA	NA
Waste management/ waste	642.12	485.51	585.70	669.70	758.33
Total with LULUCF	16,603.67	50,400	60,800	69,520	78,720
Total without LULUCF	48,509.11	50,400	60,800	69,520	78,720

63 MET & MoFALI (2024). Livestock Methane Reduction Strategy 2030.
64 Ministry of Construction and Urban Development (2023). Industrial Decarbonization Action Plan.
65 Municipality of Ulaanbaatar (2022). Waste Sector GHG Mitigation Strategy.
66 MET & FAO (2023). Forest Carbon Partnership Facility Report – Mongolia.

CHAPTER THREE: INFORMATION RELATED TO CLIMATE CHANGE IMPACTS AND ADAPTATION UNDER ARTICLE 7 OF THE PARIS AGREEMENT MONGOLIA'S FIRST BIENNIAL TRANSPARENCY REPORT UNDER THE PARIS AGREEMENT

3.1. NATIONAL CIRCUMSTANCES RELEVANT TO ITS ADAPTATION ACTIONS, INCLUDING BIO GEOPHYSICAL CHARACTERISTICS, DEMOGRAPHICS, ECONOMY, INFRASTRUCTURE, AND INFORMATION ON ADAPTIVE CAPACITY.

This chapter presents the Institutional Arrangement, which outlines the roles and responsibilities of relevant government institutions in relation to climate change adaptation in Mongolia. It also describes the legal framework and regulations governing adaptation-related policies and plans. The Appendix II of this report highlighted national circumstances, including bio geophysical characteristics, demographics, economy, and infrastructure (see Appendix II).

Due to a combination of political, geographic, and social factors, Mongolia is recognized as highly vulnerable to climate change impacts. As of 2022, Mongolia ranked 54th out of 185 countries in the ND-GAIN Index, which assesses a country's vulnerability to climate change and its readiness to improve resilience. Mongolia ranks as the 157th most vulnerable and 73rd most ready country globally. The country's low vulnerability score and high readiness score place it in the lower-right quadrant of the ND-GAIN Matrix, indicating that while adaptation challenges persist, Mongolia is relatively well positioned to implement adaptive strategies[67].

Mongolia's exposure to climate-related hazards is further underscored by its ranking in the INFORM Risk Index, where it placed 126th out of 191 countries. This indicates a moderate level of hazard exposure and institutional vulnerability, with drought identified as the strongest driver of risk[68]. Thus, Mongolia is situated in one of the world's most climate-sensitive regions, where the impacts of climate change are already evident and projected to intensify. Climate change has been a key contributor to the increasing frequency and severity of natural hazards in recent years and, if unaddressed, is expected to become the dominant driver of loss and damage in the future[69].

International cooperation plays a critical role in supporting Mongolia's adaptation strategy. The Green Climate Fund (GCF) provides financing for large-scale adaptation initiatives. The United Nations Environment Programme (UNEP) supports Mongolia in the development of its National Adaptation Plan (NAP) and climate finance strategies. Development partners such as the Asian Development Bank (ADB) contribute to strengthening infrastructure resilience and facilitating the transition to a low-carbon economy. Moreover, Mongolia's engagement with regional platforms such as the Asia-Pacific Adaptation Network (APAN) enhances knowledge exchange and capacity building on climate adaptation[70].

67 University of Notre Dame. (2022). Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index: Mongolia. https://gain.nd.edu/our-work/country-index/
68 INFORM Risk Index. (2022). European Commission.
69 Ministry of Environment and Tourism (MET). (2024). "Environmental State Report 2021–2023", Ulaanbaatar.
70 MET, Government of Mongolia. (2022). GCF, UNEP, ADB institutional reports.

3.1.1. Institutional arrangements and legal frameworks

The institutional framework for climate adaptation in Mongolia builds on the foundational structure described in Chapter 1 (see Figure I.1). This chapter discusses the mandates and coordination roles of key government ministries and agencies that are responsible for formulating and implementing adaptation policies.

At the national level, the National Climate Committee (NCC) serves as the primary body for cross-sectoral coordination, promoting alignment with international climate agreements and frameworks, and providing strategic guidance. The NCC fosters inter-agency collaboration, supports stakeholder engagement, and ensures policy coherence across sectors. The roles and responsibilities of the key stakeholders are summarized below:

Table III. 1. Stakeholders' map for adaptation

Stakeholder	Responsibilities
Ministry of Environment and Climate Change (MECC)	Leads the implementation of national and sectoral adaptation plans and policies.
Ministry of Food, Agriculture, and Light Industry (MOFALI)	Promotes climate-smart agricultural practices and sustainable land management to improve rural climate resilience.
Ministry of Urban Development, Construction, and Housing (MUDCH) and municipal authorities	Ensures that urban planning and infrastructure projects integrate climate-resilient design to mitigate risks such as flooding, extreme heat, and urban heat islands.
Ministry of Health (MoH)	Strengthens the public health system's capacity to manage climate-related health risks, including heat stress, air pollution, and vector-borne diseases.
Ministry of Finance (MoF)	Mobilizes and allocates financial resources for adaptation actions and mainstreams climate risks into national and subnational budgets.
Ministry of Economic Development (MED)	Integrates climate adaptation into macro-economic policy, ensuring alignment between sustainable development goals and long-term economic growth strategies.
National Agency for Meteorology and Environmental Monitoring (NAMEM)	Conducts scientific climate assessments, disseminates data on climate scenarios, risk profiles, and vulnerability assessments, and supports early warning systems.

In addition, local governments play a critical role in contextualizing and implementing adaptation strategies. They translate national frameworks into localized action, manage region-specific risks, develop, and maintain climate-resilient infrastructure, and lead disaster response and recovery initiatives. By incorporating community-level knowledge and fostering self-sufficiency, local authorities ensure the sustainability and inclusiveness of climate adaptation efforts[71].

[71] Ministry of Environment and Tourism (2022); UNDP (2023); Government of Mongolia Climate Governance Review; Figure I.1 in Chapter 1.

3.2. LEGAL FRAMEWORK

Mongolia VISION 2050 Long term development policy[72] is a key policy document for achieving and supporting Mongolia's objective to become climate resilient by 2050. This policy document consists of 9 strategic goals: (1) National unified values, (2) Human development, (3) Quality of Life, (4) Economy, (5) Good governance, (6) Green Development, (7) A peaceful and secure society, (8) Regional development and (9) Ulaanbaatar.

The government's strategic orientation for the climate change is under strategic goal 6: Green Development which objective is to improve Mongolia's "capacity to adapt to climate change and desertification and to reduce their negative impacts" by implementing appropriately identified adaptation activities and measures. This objective also aims to promote environmentally friendly green development, maintain ecosystem balance, ensure environmental sustainability, create conditions for present and future generations to reap its benefits, and improve the quality of human life.

Mongolia's other legal framework for climate adaptation are foundational environmental and sectoral laws, including Law on Air of Mongolia[73], the Environmental Protection Act (1995)[74], the Water Act (2012)[75], and the Soil Protection and Prevention from Desertification Act (2012). However, enforcement of these laws is challenged by limited financial and technical capacity, which affects the country's ability to respond to growing climate challenges.

Strengthening the adaptation framework requires enhanced policy coherence, improved governance, and innovative financing mechanisms. Addressing gaps in capacity and resource mobilization will be critical. Initiatives such as the Billion Tree Movement, green finance programs through the Bank of Mongolia and local commercial banks, and increased collaboration with international partners are essential to align Mongolia's adaptation efforts with sustainable development goals and global climate commitments. By leveraging these mechanisms and integrating innovative solutions, Mongolia can enhance its resilience to climate change and ensure the successful implementation of its National Adaptation Plan.

3.3 IMPACTS, RISKS, AND VULNERABILITIES

3.3.1. Current and Projected Climate Trends and Extreme Events

3.3.1.1. Observed Climate Trends

Mongolia's climate is characterized by an extreme continental regime with four distinct seasons, large diurnal temperature variations, and low precipitation, which varies significantly by region due to topographical and geographical factors[76]. The minimum air temperature can drop as low as −40.2°C to −45.9°C during January and rise to 35.0°C to 40.3°C in July, the hottest month[77].

Based on long-term records from meteorological stations across Mongolia, the

72 Government of Mongolia. (2020). Mongolia Vision 2050 Long term development policy. Parliament Resolution 52, 13 May 2020. Ulaanbaatar

73 The Government of Mongolia. (1995). Mongolia Law on Air. 17 March 1995. Ulaanbaatar

74 Government of Mongolia. (1995). Law on Environmental Protection (amended in 2007 and 2012)

75 Government of Mongolia. (1995).Water Law (2004, amended in 2010 and 2012)

76 National Agency for Meteorology and Environmental Monitoring (NAMEM), Mongolia Climate Bulletin, 2023.

77 MET. (2024). "Environmental State Report 2021–2023", Ulaanbaatar.

annual mean air temperature has increased by approximately +2.4°C between 1940 and 2022, indicating a robust warming trend driven by both global and regional climate change dynamics[78] (Figure III.1).

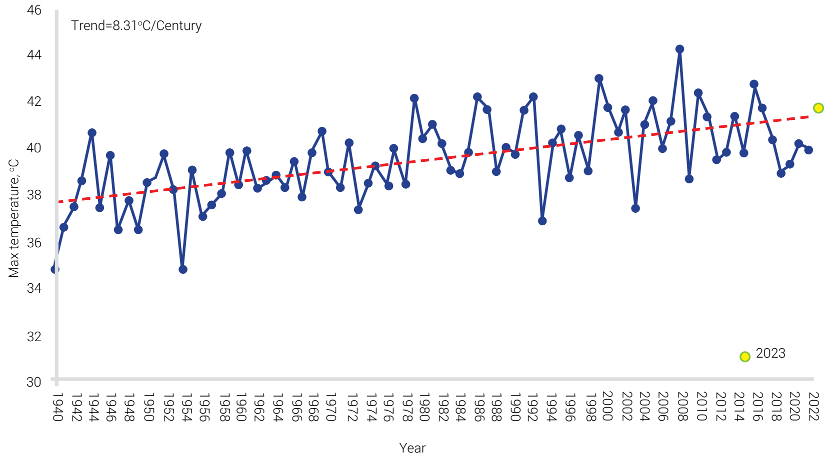

Figure III. 1. Trends of the maximum temperature and minimum temperature

Average annual precipitation levels remain low, rarely exceeding 350 mm/year in the northern regions and dropping to below 40 mm/year in the southern Gobi region. Although no statistically significant trend in total annual precipitation is evident, a slight decreasing trend in summer precipitation has been observed over the 1940–2022 period, which may have implications for water resources, agriculture, and ecosystem services (Figure III.2)[79]. On the other hand, the maximum precipitation has increased, which certainly increases the risk of flash floods (Figure III.2.). In recent years, the intensity of precipitation is increasing i,e, a higher percentage of precipitation in Mongolia has come in the form of intense single-day events. Figure III.2 illustrates the trends of daily maximum precipitation.

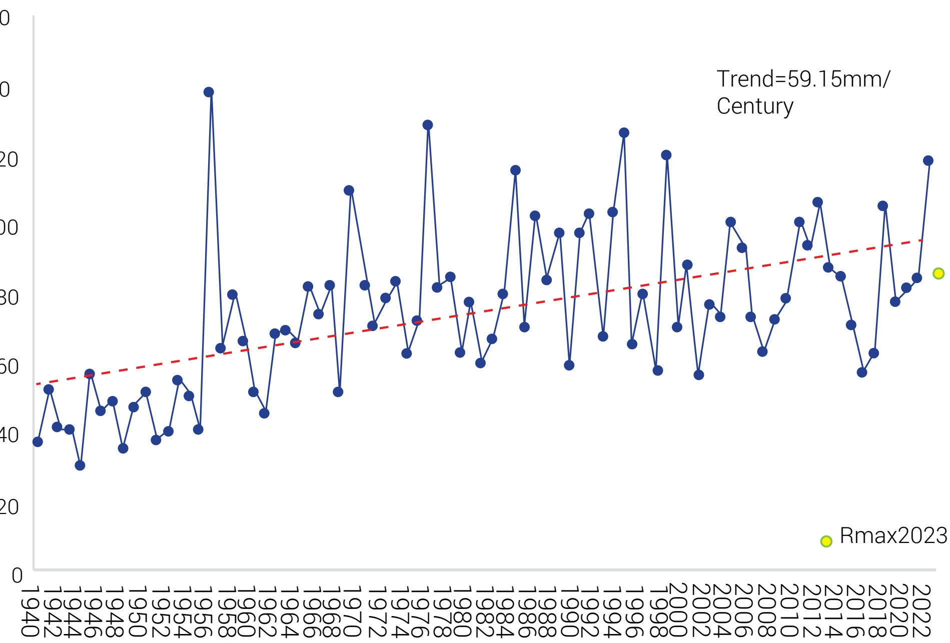

Figure III. 2. Maximum precipitation anomalies, 1940-2022

78 Ibid.: trend confirmed by time series analysis from 45+ national weather stations across diverse ecozones.
79 Information, Research Institute of Meteorology, Hydrology and Environment (IRIMHE). (2023). Statistical analysis by the Institute of Meteorology, Hydrology and Environment NAMEM datasets.

Minimum temperature anomalies show a positive warming trend of approximately +0.85°C per century, indicating fewer extremely cold events and more frequent warmer nights, in line with regional warming signals.

3.3.1.2. Projected Climate Trends

Mongolia's climate modeling and scenario analysis utilize Shared Socioeconomic Pathways (SSPs) consistent with the IPCC Sixth Assessment Report (AR6)[80] and Coupled Model Intercomparison Project Phase 6 (CMIP6) ensemble outputs. Projections reveal significant warming trends across all scenarios, with magnitude varying based on GHG emissions trajectories[81, 82].

These projected changes underscore the urgent need for climate-resilient planning in key sectors such as pastoralism, critical infrastructure, water resource management, and public health. Strategic adaptation measures across these areas will be essential to safeguard Mongolia's economy, ecosystems, and vulnerable communities from climate risks.

The table below presents a summary of projected climate trends for Mongolia, based on national downscaling and analysis conducted by the Institute of Meteorology, Hydrology and Environment (IMHE) using the CMIP6 model outputs and emission scenarios from the IPCC Sixth Assessment Report (AR6)[83].

3.4. TEMPERATURE PROJECTIONS

Under the SSP1-2.6 low-emissions scenario, mean annual surface air temperatures are projected to stabilize at approximately +1.4°C above the 1995–2014 baseline by 2080, contingent upon successful global mitigation[84]. Conversely, under the SSP5-8.5 high-emissions scenario, temperatures are projected to increase by +6.1°C by 2080, with seasonal summer extremes reaching +6.5°C, particularly in the Gobi and steppe regions[85].

Such warming would significantly heighten climate risks, including:

- Accelerated land degradation and pasture loss,
- Increased evapotranspiration and water stress,
- Permafrost thawing and subsidence,
- Thermal degradation of rural and urban infrastructure[86].

Table III. 2. Projected Change in Annual Mean Surface Air Temperature in Mongolia (°C)

Time Period	Scenario	Median Annual Increase	Seasonal Range (Winter–Summer)
2030	SSP1-2.6	0.9	0.7–1.4
	SSP2-4.5	1.2	1.0–1.4
	SSP3-7.0	1.1	0.9–1.5

80 IPCC Sixth Assessment Report (AR6), (2021). Working Group, I Summary for Policymakers.
81 MET. (2024). Mongolia's State of the Environment Report 2021–2023. Ulaanbaatar
82 Institute of Meteorology, Hydrology and Environment. (2023). Climate Change Vulnerability Assessment for Mongolia. Ulaanbaatar.
83 Institute of Meteorology, Hydrology and Environment (2023), based on IPCC AR6 and CMIP6 projections, using SSP scenarios for national-level downscaling.
84 IRIMHE. (2022). *National Climate Projections Using SSPs*, 2022.
85 Intergovernmental Panel on Climate Change (IPCC), (2021). Sixth Assessment Report (AR6), WG1 Summary for Policymakers.
86 MET. (2022). *National Climate Risk Profile: Mongolia*, 2022; World Bank CCKP.

	SSP5-8.5	1.4	1.1–1.5
2050	SSP1-2.6	1.4	1.1–1.8
	SSP2-4.5	2.0	1.8–2.3
	SSP3-7.0	2.1	1.9–2.9
	SSP5-8.5	2.7	2.4–2.9
2080	SSP1-2.6	1.4	1.2–1.7
	SSP2-4.5	2.9	2.6–3.3
	SSP3-7.0	4.6	4.2–5.0
	SSP5-8.5	6.1	5.6–6.5

Summer temperatures under SSP5-8.5 are projected to reach up to +6.5°C by 2080, with regional maxima exceeding +7°C, notably in southern and southeastern aimags. These conditions would pose serious threats to agro-pastoral livelihoods, biodiversity, and ecosystem service stability[87].

Table III. 3. Projected Seasonal Temperature Changes in Mongolia (°C)

Season	Scenario	2030	2050	2080
Summer	SSP1-2.6	1.4	1.8	1.7
	SSP5-8.5	1.5	2.9	6.5
Winter	SSP1-2.6	0.7	1.1	1.2
	SSP5-8.5	1.1	2.4	6.1

Summer temperatures is projected to increase by 6.5°C by 2080 under SSP5-8.5 scenarios, with regional extremes potentially exceeding 7°C, particularly in the Gobi and steppe zones Such warming would lead to increased evapotranspiration, pasture degradation, reduced crop yields, and more frequent heat stress in livestock.

3.5. PRECIPITATION PROJECTIONS

The scenario indicates that while total annual precipitation in Mongolia is not projected to change dramatically, significant shifts are expected in seasonal distribution, interannual variability, and precipitation form, particularly under SSP5-8.5 high-emissions scenarios.

The SSP5-8.5 projections reveal the following dynamics:

- Delayed onset and shortened duration of summer rainfall,
- Increased interannual variability in seasonal precipitation totals,
- A greater proportion of winter precipitation falling as rain instead of snow.

These changes are expected to disrupt hydrological regimes, particularly in glacier- and snow-fed basins in Mongol-Altai and Khangain mountains. Resulting impacts may include shifts in river flow timing, reduced groundwater recharge, and increased pressure on agricultural and pastoral water use, particularly during the spring growing season. These cause sectoral impacts, such as summer rainfall disruptions

[87] National University of Mongolia & IMHE, Climate Impacts by Agro-Ecological Zones, 2022.

may delay sowing periods which may result in shorten the growing season, and reduce crop yield reliability, particularly in central and southern agro-ecological zones. Winter precipitation shifts—from snowfall to rainfall—will diminish seasonal snowpack accumulation, reducing spring meltwater availability for irrigation, livestock watering, and domestic use.

3.6. EXTREME EVENTS

Ensemble-based projections indicate that under the SSP5-8.5 scenario, Mongolia will experience a substantial increase in the frequency, duration, and severity of extreme weather events by the end of the 21st century[88]. These extremes are expected to have compounding effects across rural livelihoods, urban infrastructure, ecosystem stability, and public health systems.

Table III. 4. Impacts of extreme events

Extreme Event	SSP5-8.5 Projections	Key Drivers	Impacts
Heatwaves	Frequency to increase by 30–50% annually by 2080	Rising temperatures and declining soil moisture	Reduced crop yields, heat-related illnesses, energy demand surge
Droughts	2–3 times more frequent by 2100	Increased evapotranspiration, monsoon delay	Water scarcity, pasture degradation, and out-migration
Dust and Sandstorms	Higher frequency and severity	Land degradation and prolonged drought periods	Reduced air quality, respiratory risks, ecosystem damage
Dzuds (Severe Winters)	Intensification with freezing rain and ice crusts	Precipitation volatility, sudden winter warming	Increased livestock mortality, rural economic losses
Heavy Rainfall & Flooding	20% increase in rainfall intensity by 2080	Enhanced atmospheric moisture, storm surges	Infrastructure failure, landslides, and water system disruption

These projections underscore the importance of implementing anticipatory adaptation measures, including:

- Development of climate-resilient agricultural practices,
- Improved early warning systems,
- Permafrost and snowpack monitoring, and
- Urban flood risk management planning[89].

3.6.1. Drought and Dust Storms

Mongolia faces a growing interplay of meteorological and hydrological droughts, intensified by climate extremes, land degradation, and snowpack variability. The MET report confirms significant increases in climatic variability, with frequent droughts and intensifying dust storm risks that threaten ecosystems, infrastructure, and rural livelihood[90].

[88] Mongolian Academy of Sciences (MAS), IMHE. Projected Climate Extremes and Impact Models under SSP5-8.5, *2022*.
[89] UNDP & MET. (2021). National Climate Adaptation Strategy and Risk Reduction Guidelines for Mongolia.
[90] MET. (2024). Mongolia's State of the Environment Report 2021–2023. Ulaanbaatar

Table III. 5. Conditions and types of drought and dust storms

Type	Description
Meteorological Drought	Mongolia has a median annual probability of severe meteorological drought at approximately 4%, as measured by the Standardized Precipitation Evapotranspiration Index (SPEI) below -2. Analysis of SPI12 values (1940–2023) indicates prolonged drought conditions from 1997–2011. However, 2021 and 2023 were classified as very wet years (SPI +0.6 to +0.8), leading to localized flooding. Future climate projections under SSP5-8.5 suggest severe droughts may occur 2–3 times more frequently, with the return period shortening from once every 100 years to once in 40 years under >2°C warming[91].
Hydrological Drought	Declines in river discharge and aquifer recharge have been observed in major river basins. The 2021–2023 period was marked by precipitation variability exceeding 60% deviation from climatological norms in western and southern regions, leading to water supply stress for agriculture and ecosystems[92].
Dzud Phenomenon	Mongolia's dzud events—cold winters following dry summers—remain a major climate-induced risk. Between 2021 and 2023, dzuds caused substantial livestock losses in drought-affected provinces. Climate models suggest dzud risk may increase by 5–40% by 2080, especially in overgrazed areas with high livestock densities and poor pasture regeneration[93].
Dust Storms	Dust storm activity has significantly increased, particularly in the Gobi and steppe zones. In 2023, peak wind speeds of 43 m/s were recorded in Khovd province, and storm frequency correlates with vegetation loss, soil degradation, and drought recurrence. Economic damage from wind-related events exceeded 1.8 billion MNT in 2023, disrupting transportation, agriculture, and livelihoods[94].

3.6.2. Permafrost and peatlands

Mongolia's permafrost and peatlands are critical ecosystems that serve as carbon sinks, regulate hydrological cycles, and support biological diversity. However, these ecosystems are under increasing threat due to rising temperatures, changing precipitation regimes, and land-use intensification. Recent cryosphere and ecosystem monitoring efforts have confirmed the accelerated pace of degradation, particularly in taiga forest zones and high mountain permafrost regions of northern and western Mongolia[95].

Permafrost: A Carbon Buffer in Decline: Permafrost covers approximately 29% of Mongolia's landmass, with the majority of this area situated in the Altai, Khangai, and Khentii mountain regions. It plays a critical role in stabilizing long-term carbon reserves and maintaining regional hydrological balance. However, both regional climate modeling and national cryosphere assessments highlight significant degradation trends.

Permafrost extent is projected to decline to 22% by 2016–2035, 11% by 2046–2065, and potentially as low as 1% by the 2090s under high-emissions scenarios such as RCP8.5 or SSP5-8.5. This projected contraction signals a widespread retreat of continuous and discontinuous permafrost zones, which has serious implications for Mongolia's ecological

91 https://www.ipcc.ch/report/ar6/
92 MET, 2024. Mongolia's State of the Environment Report 2021–2023. Ulaanbaatar
93 IRIMHE, 2023. Statistical analysis by the Institute of Meteorology, Hydrology and Environment NAMEM datasets
94 MET, 2024; National Emergency Management Agency, 2024
95 National Agency for Meteorology and Environmental Monitoring (NAMEM), Cryosphere and Permafrost Monitoring Report, 2022.

stability, infrastructure, and carbon feedback dynamics[96].

Effects of Thawing: Thawing permafrost initiates the decomposition of long-frozen organic material, releasing substantial quantities of carbon dioxide (CO_2) and methane (CH_4) into the atmosphere. These gases are high global warming potential (GWP) greenhouse gases, and their release contributes to positive climate feedback loops that further amplify regional and global warming trends[97].

Infrastructure Instability: Ground subsidence caused by thawing permafrost poses significant risks to the structural stability of roads, buildings, and pipelines, particularly in permafrost-dependent soums of western and northern Mongolia. The integrity of foundational infrastructure is compromised as soil cohesion declines in thawed active layers[98].

Hydrological Disruption: The thaw-induced alteration of subsurface water discharge and retention dynamics increases the probability of seasonal flooding, waterlogging, or the drying of wetlands and pastureland. These changes directly affect grazing capacity, agricultural output, and pastoral water access[99].

Biodiversity Impacts: The stress imposed by permafrost degradation alters alpine biodiversity patterns, as cold-adapted species become increasingly marginalized. Habitat fragmentation and changes in microclimatic conditions disrupt plant phenology, soil microbiota, and species migration ranges[100].

At Risk: Carbon-Dense, Water-Retaining Ecosystems: Mongolia's peatlands are primarily located in taiga forest-steppe zones and high-elevation mountain valleys, where they serve as natural water buffers during dry periods and sequester large volumes of organic carbon. These ecosystems are especially prevalent in Khuvsgul, Bulgan, and Arkhangai aimags[101].

However, field-based observations and satellite time-series analyses confirm a dramatic rise in peatland erosion, oxidation, and desiccation. These changes are attributed to the combined impacts of rising temperatures, decreased snow cover, and anthropogenic pressures, including overgrazing and drainage for land conversion[102].

Human and Climate Pressures: The oxidation of peat is being accelerated by increasing surface temperatures and reduced seasonal snow cover, leading to the conversion of formerly stable carbon sinks into net carbon sources. The functional integrity of peatland ecosystems is further undermined by unsustainable grazing practices and drainage activities related to agricultural expansion and infrastructure development[103].

Restoration Priority: In response, the national peatland conservation program has identified over 30 high-priority peatland restoration sites. These sites were selected based on criteria including community dependence, carbon stock potential, and ecosystem fragility[104].

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96 IRIMNE, 2022. Permafrost Modeling and Scenario Assessment Report under RCP8.5 and SSP5-8.5 Pathways. Ulaanbaatar.

97 Schuur, E. A. G. et al. (2015). Climate change and the permafrost carbon feedback, Nature; IPCC AR6 WG1 (2021).

98 Ministry of Construction and Urban Development (2022), Permafrost Infrastructure Risk Assessment in Mongolia.

99 Institute of Meteorology, Hydrology and Environment (IMHE), Hydrological Impacts of Cryosphere Change, 2022.

100 Mongolian Academy of Sciences (MAS), Climate Change Impacts on Alpine Ecosystems, 2021.

101 Ministry of Environment and Tourism (MET), Peatland Inventory and Carbon Stock Baseline Study, 2021.

102 UNDP and Ministry of Environment and Tourism (MET). Peatland Climate Resilience and Restoration Strategy for Mongolia. Ulaanbaatar, 2022.

103 Ministry of Environment and Tourism (MET). Peatland Restoration Priority Mapping and Action Plan. Ulaanbaatar, 2022.

104 Ministry of Environment and Tourism (MET). Mongolia's State of the Environment Report 2021–2023. Ulaanbaatar, 2024.

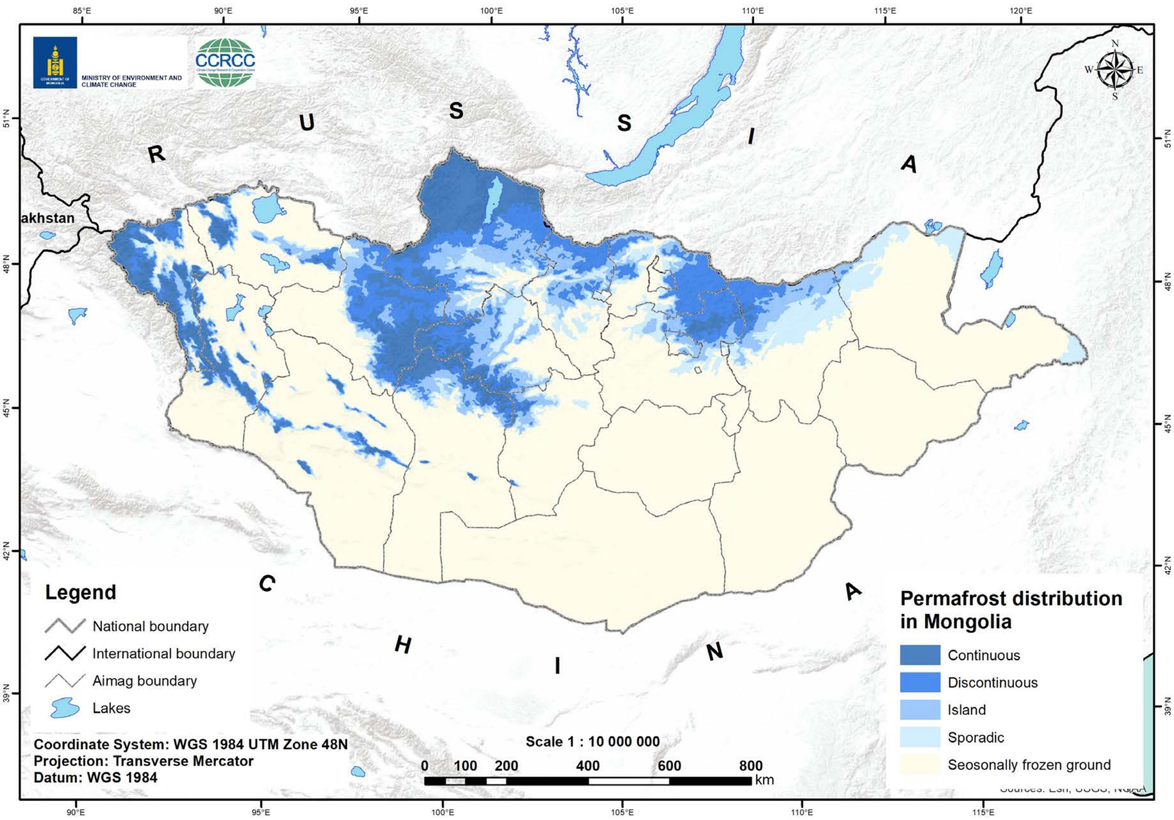

Figure III. 3. Permafrost distribution of Mongolia

3.7. OBSERVED AND POTENTIAL IMPACTS OF CLIMATE CHANGE

Various climate study reports[105,106,107] highlights that different sectors and society will experience both positive and negative impacts from changing climate. For example: Milder winters may reduce energy consumption.

Agriculture: The increased temperature would have positive impacts on agriculture production as the heat needed for plants, and the number of frost-free days is projected to increase. Increased spring and autumn temperatures resulted in increased growing season which is positive impacts for crop production in Mongolia. On other hand, there is some negative impacts, increased number of hot days above 25°C, and number of days with high wind resulted in increased evapotranspiration, increased risk for more severe soil erosion and more rapid depletion of soil moisture. The projected further increases in temperature and any decrease in precipitation would cause the need for more irrigation to sustain crops and increase production under more adverse climatic impacts. Plant growth is likely negatively impacted by high daytime temperatures. Due to prolonged high temperatures or heat wave, livestock most likely experience heat stress which is likely to decline milk production, and slower growth.

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105 MET. 2024. Mongolia's State of the Environment Report 2021–2023. Ulaanbaatar

106 Institute of Meteorology, Hydrology and Environment (IMHE). Climate Change Vulnerability Assessment for Mongolia. Ulaanbaatar, 2023.

107 World Bank Group and Asian Development Bank. Climate Risk Country Profile: Mongolia. Washington, DC, 2021.

Social: One of the serious negative impacts of climate change is increased risk of flash flooding from more frequent extreme rainfall (Please see Box 1). One example of severe floods that happened in June-July 2021[108] provided Box 1 below:

Box 1. Example of Flood.

Devastating flash floods occurred all around the country at different scales due to prolonged heavy rainfall between 28 June and 29 July 2021. The rainfall is averaged to be 46-60 millimeters across the country. The flash floods and heavy rain severely affected roughly 2,343 households in several locations including Arkhangai, Umnugovi, Orkhon, Dornogovi, Govi-Altai, Uvurkhangai, Tuv, Zavkhan, Dornod, Selenge, Khuvsgul, Bayan-Ulgii, Uvs, Khovd provinces and Songinokhairkhan, Bayangol, Bayanzurkh, Sukhbaatar, Chingeltei districts. The most severely affected provinces were Umnugovi and Tuv provinces, local emergency management agency received 474 rescue calls and search and rescue operation was implemented for 497 people.

The prolonged rain across the country affected both urban and rural areas in Mongolia. In Ulaanbaatar, the capital of Mongolia, certain areas were severely damaged and inundated by heavy rain, causing massive stress among the citizens. Old bridges, roads and avenues in Ulaanbaatar which were built without sewage system were most severely affected. Six districts in Ulaanbaatar were heavily disturbed by the flash flooding and over 234 households had been affected at different severity levels.

Box 1. Example of Flooding in Mongolia

Further increased changes in precipitation pattern may have serious implications to societies resulted from extreme events like flash floods and others.

Health and Environment: Daily temperatures, heat waves, and cold spells are a natural part of day-to-day variation in weather. As the climate warms overall, heat waves and cold spells are likely to become more frequent, longer, and more intense. Heat waves will most likely lead to illness and death, particularly among older adults, young children, and other populations of concern. In addition, exposure to extreme heat is likely to increase wildfire damaging pasture and ecosystems. According to the NEMA report[109] in 2021 prolonged heat waves with the temperature reaching 41^{0}C caused in 73 wildfires happened in 12 provinces, particularly 11 only on July 26-27, and four on July 4. The fires killed three people and injured six others

108 National Emergency Management Agency. 2021. Flash floods. Emergency report. Ulaanbaatar.
109 NEMA.2021. Heat wave causes numerous wildfires in Mongolia.

and killed 936 livestock. About 984 firefighters, 164 border guards and 2,022 residents have been mobilized to stop the fires.

Infrastructure: Extreme cold is likely to lead to power outages as heavy demands for heating strain the power grid and fuel. Infrastructure, particularly transport systems, has been disrupted by snow and ice. The icy sidewalks of winter increase the chance of falling which can cause fractures. In winter, driving is never safe and ice patches on the road, or many snowfalls can cause accident-related car accidents.

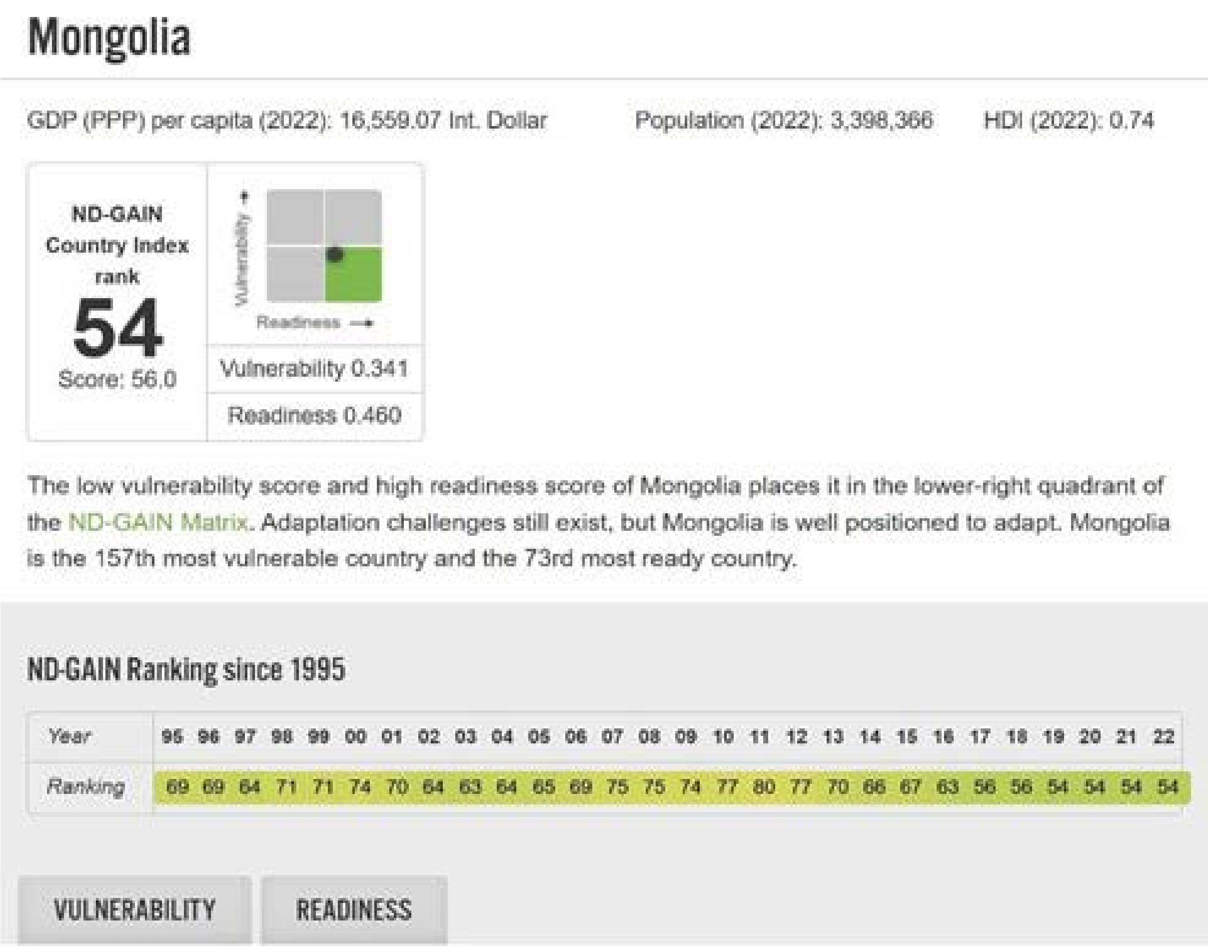
Projected Climate Impacts and Vulnerabilities in Mongolia under SSP5-8.5 is shown in table below:

Table III. 6. Projected Climate Impacts and Vulnerabilities in Mongolia under SSP5-8.5

Category	Impact	Details	Analysis
Extreme Weather Events	Increased Frequency and Severity	Projections under SSP5-8.5 indicate intensified heatwaves, longer droughts, and extreme cold spells.	CMIP6 models show a 30–50% increase in heatwave frequency by 2100. Cold spells and dzuds are expected to intensify during transitional seasons, impacting health and infrastructure (IPCC, 2021; MET, 2024).
	Impacts on Livelihoods	Pastoral and agricultural households are highly vulnerable to climate-induced economic shocks such as crop failure and livestock mortality.	Economic risks are rising, especially in rural soums with high dependence on natural systems. This threatens food security and long-term income stability (IRIMHE, 2023).
Ecosystem Stress	Desertification	Desertification is expanding, especially in southern and eastern provinces, driven by declining rainfall and vegetation loss.	Under SSP5-8.5, arid zones are projected to expand by 25–30% by 2080, degrading pasturelands and reducing land productivity (MET, 2024).
	Biodiversity Loss	Habitat fragmentation and temperature-driven species migration are occurring in steppe and forest-steppe ecosystems.	Endemic and alpine species face extinction risk. Forest-steppe zones critical to carbon balance are increasingly stressed (IPCC, 2021).
Water Resource Strain	Snowmelt Reductions	Earlier melt and lower snow accumulation compromise spring river flow and downstream availability.	Hydrological models project 25–35% reduction in spring runoff by 2080, notably affecting the Selenge and Tuul river basins (IRIMHE, 2023; MET, 2024).
	Aquifer Depletion	Increased drought pressure has led to higher dependence on groundwater for livestock and agriculture.	Overextraction in southern and Gobi regions is projected to increase by 50%, raising risks of aquifer depletion and long-term supply deficits (NEMA, 2024; MET, 2024).

The ND-GAIN Vulnerability Index score of 0.341, indicating relatively lower susceptibility to climate-related hazards[110]. However, its Readiness Index score of 0.460 reveals gaps in institutional, economic, and social preparedness, pointing to the need for enhanced adaptive capacity and improved governance systems to fully utilize adaptation financing and opportunities. ND-GAIN Mongolia Index presented in Figure III.4.

110 University of *Notre Dame. (2022). Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index: Mongolia.* https://gain.nd.edu/our-work/country-index/



Mongolia

GDP (PPP) per capita (2022): 16,559.07 Int. Dollar Population (2022): 3,398,366 HDI (2022): 0.74

ND-GAIN Country Index rank

54

Score: 56.0

Vulnerability 0.341

Readiness 0.460

The low vulnerability score and high readiness score of Mongolia places it in the lower-right quadrant of the ND-GAIN Matrix. Adaptation challenges still exist, but Mongolia is well positioned to adapt. Mongolia is the 157th most vulnerable country and the 73rd most ready country.

ND-GAIN Ranking since 1995

Year	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
Ranking	69	69	64	71	71	74	70	64	63	64	65	69	75	75	74	77	80	77	70	66	67	63	56	56	54	54	54	54

VULNERABILITY READINESS

Figure III. 4. ND-GAIN Mongolia Index Rank, 2022

At the sectoral level, the ND-GAIN framework applies a composite vulnerability-readiness model to evaluate climate risks and prioritize adaptation needs across key systems: agriculture, water resources, infrastructure, and public health[111]. In the case of agriculture, Mongolia faces high exposure to prolonged droughts, which jeopardize pasture productivity, livestock health, and rural livelihoods[112]. Water resources are impacted by glacial retreat, reduced snow accumulation, and increasing variability in precipitation, leading to seasonal scarcity and competition among users[113]. Infrastructure, particularly in permafrost zones, is increasingly at risk due to thaw-induced ground instability, threatening roads, pipelines, and buildings[114]. Public health systems are projected to experience rising burdens from waterborne illnesses, respiratory stress, and temperature extremes, especially in vulnerable and underserved populations[115].

[111] University of Notre Dame. (2024). ND-GAIN Methodology Report. Accessed 2024.
[112] MET. (2023). Climate Risk Assessment for the Agriculture Sector. Ulaanbaatar.
[113] IRIMHE (2023). Mongolia's Climate Change Vulnerability Assessment. Ulaanbaatar.
[114] World Bank Group & Asian Development Bank. (2021). Mongolia Climate Risk Country Profile. Washington, D.C.
[115] UNDP & Ministry of Health. (2023). Climate-Health Impact Profile for Mongolia. Ulaanbaatar.

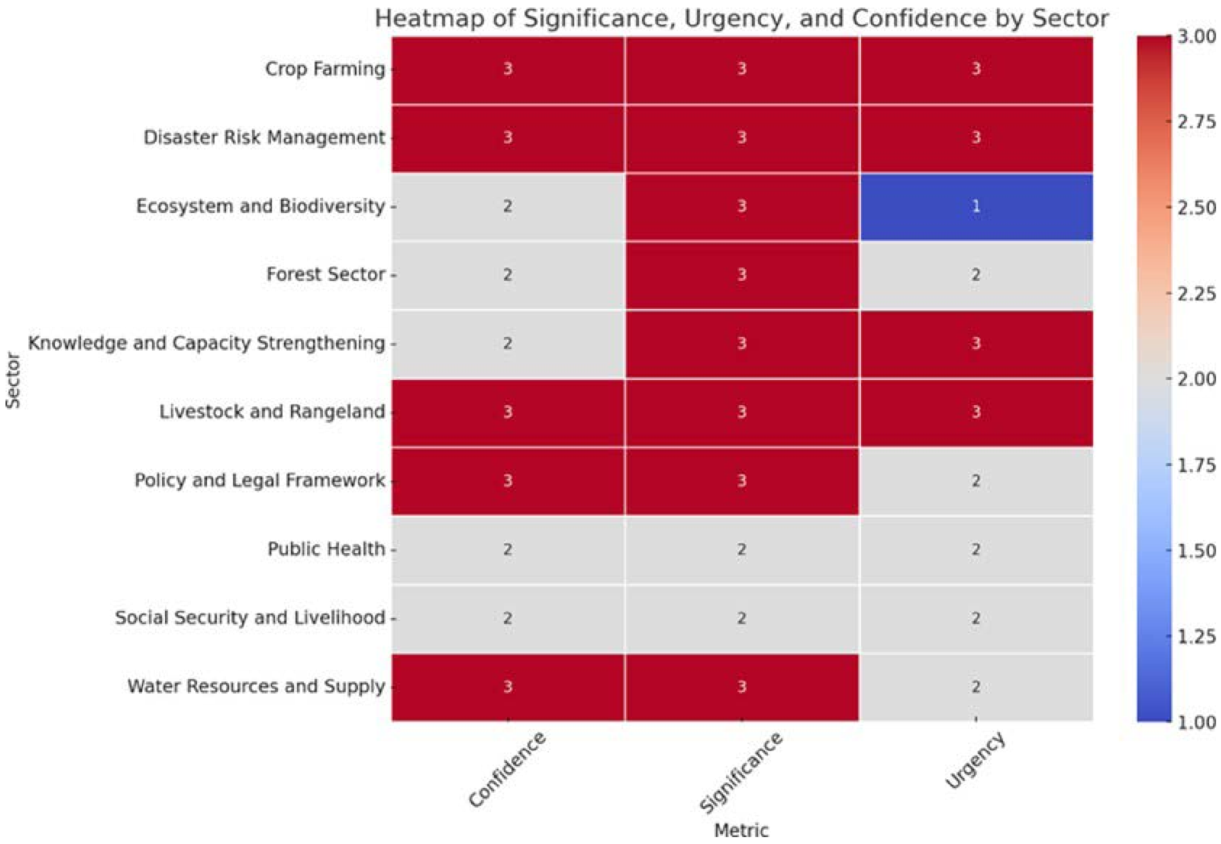


Figure III. 5. Assessment of significance, urgency, and confidence by priority sector

This above figure illustrates expert-weighted sectoral vulnerability using a multi-criteria evaluation of exposure, sensitivity, and adaptive capacity. It reflects both observed climate impacts and confidence in projected risk trends, based on national data, IPCC AR6 assessments[116].

According to the INFORM Risk Index metrics, drought is likely to be the most important driver of increasing crisis risk because of climate change followed by governance and infrastructure to Mongolia (Figure III.6)[117]. These indicators highlight the importance of integrated disaster risk reduction (DRR), social protection programs, and early warning systems as part of national resilience-building and climate adaptation strategies.

[116] IPCC. (2022). Sixth Assessment Report (AR6), Working Group II: Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/

[117] INFORM Risk Index 2022, European Commission.

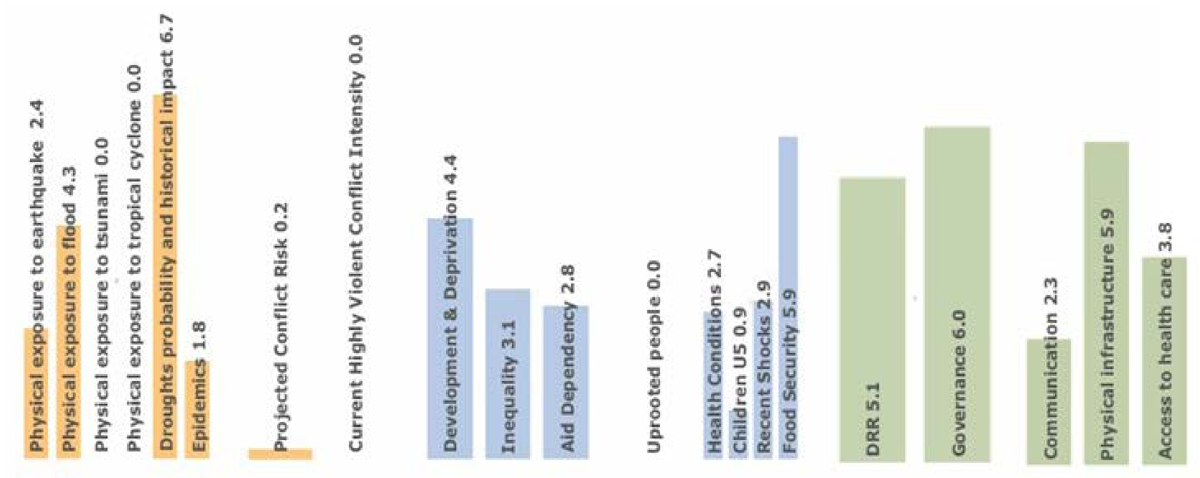


Figure III. 6. Mongolia's INFORM Risk Index

At the subnational level, analysis using the INFORM Risk Index framework highlights spatial disparities in vulnerability and coping capacity[118]. Provinces such as Tuv, Khuvsgul, and Uvs consistently show elevated risk scores due to a combination of extreme weather exposure (e.g., dzuds, floods, droughts), limited institutional infrastructure, and economic reliance on climate-sensitive sectors like livestock herding[119]. These regions are therefore prioritized for localized adaptation investments, early warning systems, and resilience-building programs, in line with Vision 2050 development priorities[120].

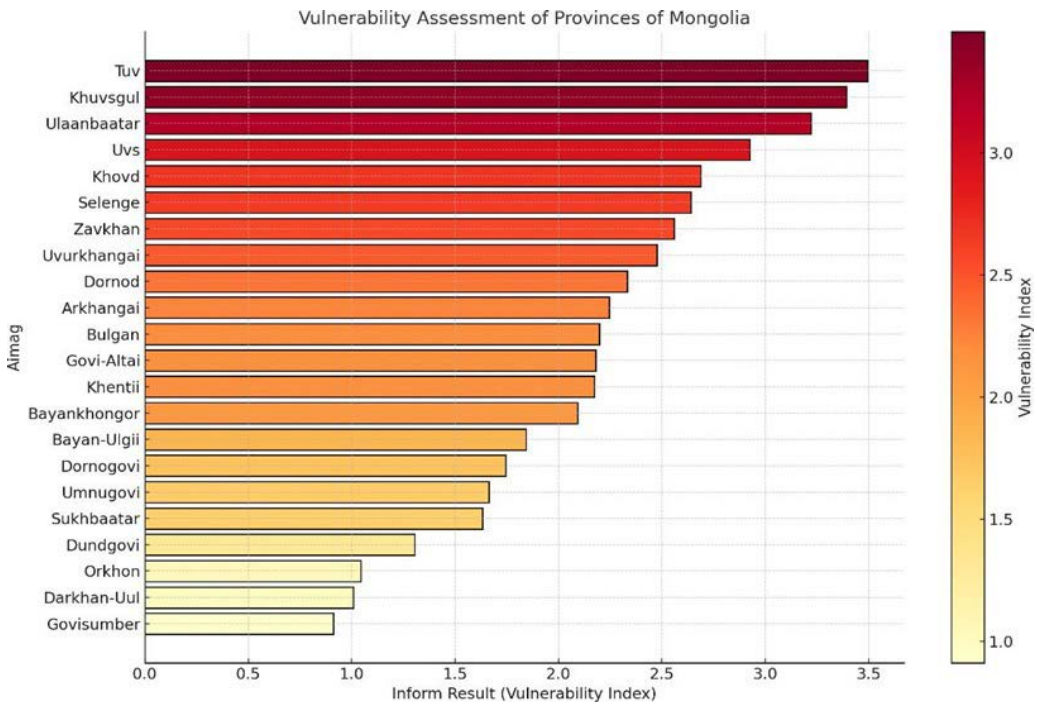


Figure III. 7. Vulnerability Assessment of Provinces of Mongolia

118 INFORM Methodology. (2023). INFORM Risk Index Technical Specifications. https://drmkc.jrc.ec.europa.eu/inform-index

119 National Emergency Management Agency (NEMA). (2023). Dzud Impact Report and Disaster Risk Mapping. Ulaanbaatar.

120 Government of Mongolia. (2021). Vision 2050 – Long-term Development Policy; and Ministry of Environment and Tourism (2022). National Adaptation Plan (NAP).

Metrics illustrate provincial disparities in droughts, dzuds, and flash floods, emphasizing the need for targeted, region-specific adaptation strategies (Figure III.8).

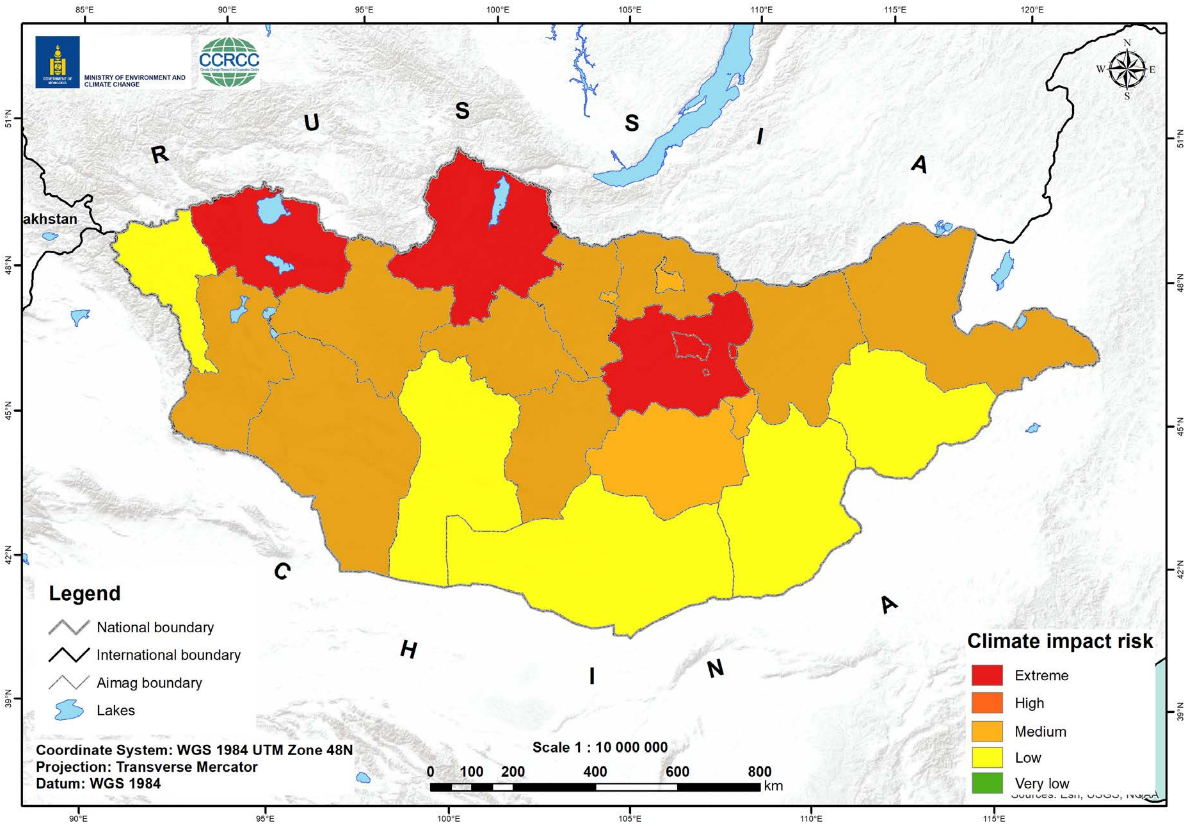


Figure III. 8. Climate change impact and risk (INFORM Subnational risk index used)

Mongolia's climate monitoring and modelling systems are built upon a robust, multi-tiered observational network coordinated by the National Agency for Meteorology and Environmental Monitoring (NAMEM) and the Information and Research Institute of Meteorology, Hydrology and Environment (IRIMHE)[121]. This network integrates ground-based meteorological records, hydrological monitoring, and remote sensing data, enabling systematic tracking of critical climate variables such as temperature, precipitation, river flow, snow cover, soil moisture, and land degradation, including desertification trends[122]. These datasets form the foundation for climate impact assessment and scenario modelling at both national and subnational scales[123].

For assessment methodology, Mongolia employs a multi-dimensional climate impact assessment framework, which integrates the following key analytical components[124]:

- Significance of projected impacts
- Urgency based on temporal manifestation.
- Confidence grounded in observational and modelling evidence.
- The significance of climate impacts is assessed across social, economic, and environmental dimensions[125].

121 NAMEM. (2024). National Climate Monitoring Program Overview. Ulaanbaatar; IRIMHE. (2024). Hydro-meteorological Data Integration Report.
122 Institute of Meteorology, Hydrology and Environment. (2023). National Climate Observations and Desertification Trends. Ulaanbaatar.
123 Ministry of Environment and Tourism (MET). (2024). State of the Environment Report 2021–2023.
124 Government of Mongolia. (2022). Climate Risk and Impact Assessment Framework for Mongolia.
125 UNDP & MET. (2022). Peatland Climate Resilience and Restoration Strategy for Mongolia.

- Social impacts include risks to public health, displacement, and livelihood disruption due to extreme weather events.
- Economic impacts cover agricultural yield reduction, livestock mortality, and infrastructure damage.
- Environmental impacts include permafrost thaw, peatland loss, soil erosion, and ecosystem shifts[126].

Impacts are categorized using a tiered system:

- "Recognized as having particularly significant impacts."
- "Recognized as having impacts

These designations are based on national expert judgement, scientific literature, and official datasets[127].

The urgency dimension evaluates how soon impacts are likely to manifest and the time-sensitive nature of required adaptation interventions[128]. For Mongolia, priority areas such as drought, permafrost degradation, and heatwaves are classified as high urgency, due to their accelerating impacts on pastoral systems, rural water security, and infrastructure stability[129].

Confidence levels reflect the certainty of evidence, informed by long-term climate observations, multi-model ensembles, and peer-reviewed regional analyses[130]. This enhances the robustness of national adaptation planning and ensures that interventions are evidence-based, regionally calibrated, and aligned with national development policies[131].

Overall, Mongolia's climate impact assessment approach is consistent with internationally accepted methodologies such as the IPCC AR6 risk framework and provides a structured basis for prioritizing adaptation actions and informing climate-resilient development planning[132]. It supports Mongolia's commitments under the UNFCCC Enhanced Transparency Framework and strengthens institutional capacities to address climate vulnerabilities in a timely and effective manner.

3.8. ADAPTATION PRIORITIES AND BARRIERS

3.8.1. Domestic Priorities and Progress Towards Those Priorities

Current national adaptation priorities are presented in the Action Plan for implementation of Nationally Determined Contribution (APNDC), which approved by the NCC approved in 2021. Time frame of the APNDC is 2021-2025 and covers both mitigation and adaptation measure. The priorities are:

1. Improvement of Climate change legislations, policies, regulations, and overall implementation systems and framework.
2. Climate change mitigation and reduction of GHG emission.
3. Increase resilience to climate change, build adaptive capacity.

126 IPCC. (2022). Sixth Assessment Report (AR6), WGII – Impacts, Adaptation, and Vulnerability.
127 MET & National Adaptation Working Group. (2023). Expert Judgment Methodology for Climate Impact Classification.
128 Ministry of Finance and MET. (2022). Climate Change and Disaster Risk Financing Strategy.
129 World Bank Group & ADB. (2021). Climate Risk Country Profile: Mongolia.
130 NAMEM. (2023). Climate Data Bulletin, 1990–2022.
131 National Development Agency. (2021). Vision 2050: Long-Term Development Policy of Mongolia.
132 UNFCCC. (2018). Modalities, Procedures and Guidelines (MPGs) for the Enhanced Transparency Framework under the Paris Agreement.

3.8.2. Barriers to Adaptation

During the 2021–2022 period, Mongolia faced several key institutional, financial, and technical constraints that hindered the effective implementation of climate adaptation measures under its national climate policy frameworks and international commitments.

A primary barrier was limited financing for adaptation. Public budget allocations remained insufficient, with climate-related expenditures concentrated on short-term disaster response rather than forward-looking resilience building. Adaptation actions were not fully integrated into the Medium-Term Expenditure Framework (MTEF), and there was no dedicated budget code for adaptation at national or subnational levels. While steps were taken to engage with international climate finance mechanisms, including the Green Climate Fund (GCF), fiduciary readiness and the lack of a bankable project pipeline continued to delay access to sustained external support. Broader fiscal constraints—partly shaped by competing post-COVID recovery priorities—further limited the reallocation of public investment toward long-term adaptation outcomes.

Institutional fragmentation also persisted across sectors and levels of government. Adaptation responsibilities remained dispersed among multiple ministries, with unclear mandates and limited horizontal coordination. Although the Climate Change Research and Cooperation Center (CCRCC) supported technical integration and stakeholder engagement, no centralized oversight mechanism existed to align sectoral adaptation actions with the National Adaptation Plan (NAP). Vertical coordination with subnational governments was similarly weak, contributing to inconsistencies in implementation and duplication of efforts.

Data and information system limitations significantly constrained evidence-based planning. As of 2022, Mongolia lacked an integrated national platform for climate risk and vulnerability data. Climate impact assessments and adaptation planning tools were fragmented by sector, and methodological inconsistencies prevented aggregation across scales. Subnational data—particularly for pasture degradation, water scarcity, and rural livelihoods—remained limited or outdated. This reduced the ability to prioritize actions, assess trade-offs, and monitor effectiveness across adaptation interventions.

The absence of a national monitoring, evaluation, and learning (MEL) framework further impeded progress tracking. No standardized indicators were adopted to measure adaptation outcomes across projects or sectors, and Mongolia had not yet developed a national MEL system aligned with the Enhanced Transparency Framework (ETF) of the Paris Agreement. As a result, it was difficult to evaluate whether implemented measures contributed to resilience, improved adaptive capacity, or reduced vulnerability.

Finally, rural vulnerability remained a persistent challenge. Herder households and remote aimags were among the most exposed to climate hazards—particularly dzuds and prolonged drought—but continued to lack of adequate access to early warning systems, adaptive infrastructure, and targeted financial instruments. These disparities undermined the equitable distribution of adaptation benefits and highlighted the need for more inclusive and community-driven adaptation programming.

Collectively, these barriers during the 2021–2022 reporting period underscore the importance of strengthening institutional coordination, improving adaptation finance readiness, developing interoperable climate information systems, and finalizing Mongolia's national MEL framework. These foundational elements are essential for the operationalization of Mongolia's National Adaptation Plan and for fulfilling adaptation-related transparency requirements under Article 13 of the Paris Agreement.

3.9. ADAPTATION STRATEGIES, POLICIES, PLANS, GOALS, AND ACTIONS TO INTEGRATE ADAPTATION INTO NATIONAL POLICIES AND STRATEGIES.

3.9.1. Implementation of adaptation actions in accordance with the global goal on adaptation as set out in Article 7, paragraph 1, of the Paris Agreement

The implementation of adaptation actions in Mongolia as implementation of adaptation actions in accordance with the global goal on adaptation as set out in Article 7, paragraph 1, of the Paris Agreement can be see improved climate change legislations, policies, regulations and overall implementation systems and framework, and strengthened adaptive capacity and resilience to climate change and ensuring an adequate adaptation response. As mentioned above the national adaptation priorities are presented in the Action Plan for implementation of Nationally Determined Contribution (APNDC). The goals and measures of the APNDC aimed both to mitigate climate change and adapt to changing climate.

3.9.1.1. Adaptation goals, actions, objectives, undertakings, efforts, plans (for priority regions or integrated plans) for water and agriculture to build resilience.

The adaptation objectives of the APNDC are to ensure implementation of United Nations Framework Convention on Climate Change and its Paris Agreement, Mongolia's long-term development policy Vision 2050, Government Action Plan 2020-2024.

The APNDC identified three priority targets, and each target has several goals. For more details provided in Section 3.9.1.8 as the Progress on implementation of adaptation.

3.9.1.2. How best available science, gender perspectives and indigenous, traditional, and local knowledge are integrated into adaptation.

The NAMEM is a key institution for national research for climate change on the base monitored data on water, climate, and environment, and provide the public with preventive information, and to remind of the potential risks of natural disasters.

Risk indicators, including changes in river flows, biodiversity loss, extreme weather events, and vulnerability, mapping based on geographic and climatic factors systematically carried by IRIMHE. Different research and academic institutions conduct climate risk assessments. Climate Risk Assessment usually evaluated the interaction of hazards with the vulnerability, exposure, and adaptive capacity of human and natural systems and risk assessed for both likelihood and severity using national as well as internationally available methodologies.

Global climate models and local meteorological data are the bases for future climate scenarios.

Adaptation measures identified are subject to consultations with local stakeholders, including community leaders, local government officials, and sectoral experts, ensuring the proposed interventions are locally relevant and feasible. The approach is rooted in the belief that adaptation happens locally and that therefore local communities are best equipped to identify and implement solutions that will benefit local people and the environment. But as mentioned above perfect coordination and communication is still lacking.

3.9.1.3. Development priorities related to climate change adaptation and impacts.

APNDC are developed to ensure development priorities under each adaptation goals. These are presented in Section 3.9.1.8 on the Progress on implementation of adaptation.

3.9.1.4. Any adaptation actions and/or economic diversification plans leading to mitigation co-benefits.

Nature based solutions of adaptation measures leading to mitigation co-benefits. Many adaptation measures identified under goals 3,4, and 5 (See Section 3.9.1.9)

3.9.1.5. Efforts to integrate climate change adaptation into development efforts, plans, policies, and programming, including related capacity-building activities.

APNDC are developed to ensure implementation of policy objectives of Vision-2050 Mongolia's long-term development policy, Government Action Plan 2020-2024, State Policy on Forest, the State Policy on Food and Agricultural Sector.

The strategic objectives of the policies shown in Table 5 are in terms of addressing climate change and adaptation:

Table III. 7. Adaptation Policies and their objectives

Policy document	Objectives
Vision 2050, Mongolia's long-term development policy	Strengthen adaptation and resilience to climate change and reduce potential risks
	Continuously strengthen adaptation to climate change and improve sustainable production and consumption
	Update and implement a national program to reduce negative effects of climate change, and reduce disaster risks
	Develop a livable city with a balanced ecosystem, low greenhouse gas emissions and green technologies and ensure a healthy and safe living environment for citizens
	Develop agriculture as a leading economy sector that is environmentally friendly, adaptable to climate change, resilient, responsive to social development trends, needs and requirements, responsible, highly productive, and sustainable
	Support and develop a national green financing system based on public-private partnership, and finance environmentally friendly green projects and programs using international financial instruments
Action Plan of the Government of Mongolia for 2020-2024	Protect the environment, properly use natural resources, introduce advanced techniques and technologies, reduce environmental pollution and degradation, and create conditions for citizens to live in a healthy environment
	Implement the green development policy, introduce. environmentally friendly, resource-saving, and efficient, clean technologies, and build national capacity to mitigate and adapt to climate change

State Policy on Food and Agricultural Sector	The basic model of agricultural development in Mongolia shall be based on legal entities of all forms of ownership and fully self-sustaining farming, adapted to nature and climate change, efficient, reliable, pastoral, and intensive animal husbandry and agriculture
State Policy on the Forest	To increase the area covered by forests by reforestation, afforestation, growing seedlings, and saplings, increasing the amount of high-quality seeds of saplings and seedlings, improving methods and technologies, and creating actual capacity
	Increase financial resources for sustainable forest management

3.9.1.6. Nature-based solutions to climate change adaptation

Implementation of adaptation measures are nature-based solutions when restoring environments for biodiversity protection purposes, such as in the development of forest management. Nature based solutions are also implemented when protecting headwaters of water sources and establishment of rainwater harvesting ponds etc.

3.9.1.7. Stakeholder involvement, including subnational, community-level and private sector plans, priorities, actions and programmes

The line ministries are the climate change adaptation authority in Mongolia and ensure stakeholder engagement and ownership in the planning and implementation of adaptation measures. Processes include stakeholder meetings, consultations with local Governments and people.

3.9.1.8. Progress on implementation of adaptation

This section presents general information on the implementation of APNDC. The priority target of APNDC is "Improvement of Climate change legislations, policies, regulations, and overall implementation systems and framework" which will meet by fulfilling the following the goals:

1. **Goal 1:** Strengthening a policy and legal framework
2. **Goal 2:** Strengthen cross-sectoral coordination and implementation framework

The planned action to be implemented to meet the above goals and their implementation status as of reporting period of BTR1 2011-2022 is shown Table III.8 below:

Table III. 8. Adaptation measures in APNDC, 2021

Measures	Implementation period						
	2021	2022	2023	2024	2025	Implementation entity	Implementation
Target: Improvement of Climate change legislations, policies, regulations, and overall implementation systems and framework							
Goal 1: Strengthening a policy and legal framework							
Develop and approve legal documents on climate change						Line ministries	The law on Climate Changes under development
Develop and approve the National Adaptation Plan (NAP)						Line ministries	NAP preparation was still on going for the period of BTR 1 reporting period (2021-2022). National Adaptation Plan (NAP) supported by the Green Climate Fund (GCF) and UNEP. NAP completed in 2024 and its implementation has not yet started. Therefore, NAP details will be reported in the next report.
Establish professional council under the National Climate Committee						MET	Established and approved by NCC.
Establish sustainable transparency framework						MET	Framework is prepared but not yet approved.
Establish a green financing mechanism to support climate adaptation and mitigation measures, develop financial product that supports green development						MET, MOF	Established, activities are ongoing. Banks are providing green loans.

3.9.1.9. Action Plan for the Implementation of the Nationally Determined Contribution

The Action Plan for the Implementation of the Nationally Determined Contribution (APNDC) covers both mitigation and adaptation measures. Under Target 3 of the APNDC, Mongolia aims to increase resilience to climate change and strengthen adaptive capacity in line with the long-term development framework, Vision 2050. The adaptation measures identified are to integrating climate resilience into key development sectors[133].

Under Target 3: Increasing Resilience to Climate Change and Building Adaptive Capacity eight priority goals guide adaptation implementation insuring development priorities and state policies:

1. Reduce the impact and risks of climate change on the livestock sector by promoting sustainable development and enhancing productivity[134].
2. Develop climate-resilient supply chains for food, livestock fodder, and raw materials for light industry by leveraging positive and mitigating negative climate impacts[135].
3. Improve water resource management through capacity building and optimization of water consumption to increase reserves[136].
4. Enhance forest ecosystems' adaptive capacity and carbon sequestration through sustainable forest management[137].
5. Increase resilience of vulnerable biodiversity through ecosystem-based adaptation approaches[138].
6. Strengthen preparedness for climate-induced natural hazards by reducing disaster risks and enhancing early response systems[139].
7. Improve health services by establishing early warning mechanisms for climate-sensitive health risks and ensuring proactive measures[140].
8. Expand social protection and insurance mechanisms to reduce vulnerabilities and strengthen the resilience of climate-affected social groups[142].

The implementation timeline for these measures spans five years (2021–2025). Given that the current BTR-1 reporting period covers 2011–2022, no quantitative assessment of outcomes has been conducted yet. Progress is presented qualitatively based on available data, with the status of each measure identified as either ongoing or completed[143].

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133 Government of Mongolia. (2020). Action Plan for Implementation of the Nationally Determined Contribution (AP-NDC).
134 MET & MOFALI. (2021). Climate Risk Profile for Mongolia's Livestock Sector
135 FAO & MOFALI. (2022). Climate-Smart Agriculture Strategy for Mongolia.
136 Ministry of Environment and Tourism. (2023). State Water Resources Management Report, 2021–2022.
137 MET. (2022). Sustainable Forest Management Guidelines under Climate Change.
138 Institute of Biology & MET. (2021). National Biodiversity Strategy and Action Plan: Climate Vulnerability Annex.
139 NEMA. (2022). Disaster Risk Reduction Strategy and Climate Impact Scenarios.
140 Ministry of Health. (2022). Climate-Sensitive Health Risk Assessment and Response Plan.
141 NSO & Ministry of Labor and Social Protection. (2022). Social Protection Mapping for Climate Vulnerability.
142 MET. (2023). NAP Monitoring Report Draft: Status of Adaptation Implementation (as of December 2022).

Table III. 9. Implementation of the Action Plan of 'NATIONALLY DETERMINED CONTRIBUTIONS'

Objec-tive	To ensure implementation of United Nations Framework Convention on Climate Change and its Paris Agreement, Mongolia's long-term development policy Vision 2050, Government Action Plan 2020-2024 and the "Nationally Determined Contribution in the implementation of the Paris Convention" (NDC)				
Out-come	Improved climate change legislations, policies, regulations and overall implementation systems and framework, reduced national greenhouse gas emission, and strengthened adaptability and resilience to climate change.				
	Target 3: Increase resilience to climate change, build adaptive capacity				
	Measures	Outcome	Indicator	Responsible organization	Implementation status
Goal 1	Reduce impact and risk of climate change in the livestock sector, ensure sustainable development in the sectoral development and increase production				
3.1.1	Improvement of water resources and fodder production by building irrigation systems and boreholes/groundwater wells	Improved water sources and access	Number of new irrigation systems installed and bore wells	MOFALI, Aimag Governors' Office	Rehabilitation and construction of new irrigation systems are ongoing.
3.1.2	Conduct water resource assessment and survey to increase pastureland and its resources.	Increased pastureland (ha)	Number of water resource assessments reports with	MOFALI, Aimag Governors' Office	This is ongoing work final result will be completed by end of 2024. IRIMHE, Institute of Geo-ecology are the key institutions to conduct the assessment.
3.1.3	Introduction of new technology and equipment for fodder preparation for production to ensure sustainable pastureland use	Equipment for producing hay and fodder	Number of aimags with upgraded equipment for producing of fodder	MOFALI	Ongoing. South-South exchanges are a key means to support and develop these efforts
Goal 2	Establish a sustainable supply chain mechanism of healthy food products, livestock fodder and raw materials for light industry through leveraging positive impacts and mitigation of negative impacts of climate change in agricultural sector				
3.2.1	Introduction of drip and permeable irrigation technology to conserve water and plactic film mulching application to improve yields of potatoes, vegetables, fruits and berries	Increased agriculture products	Increased cropland where introduced new technologies	MOFALI	Crop farmers as well as family farmers are already familiar with using drip irrigation technology and increasing its use but it will take still quite time to be applied in a wide range of farms. Plastic film mulching application started and ongoing.
3.2.2	Establishment of forest wind breack on cropland to reduce soil erossion due to the impacts of climate change and drought	Improved cropland and soil fertility	1. Length of forest wind breack (thousand km)	MOFALI	This is just at the starting stage. This measure is integrated with "billion Tree" initiatives.
Goal 3	Introducing optimal water consumption and build capacity to increase water reserves				
3.3.1	Protection of headwaters of rivers, streams, springs, and mineral springs to ensure sustainable water resources and use,	Improved water resources and access	Number of protected water sources	MET and WA	The headwaters of 203 spring in 2021 and 325 springs in 2022 have been protected.

3.3.2	Expansion of mid-scale hydrological mapping and determine the distribution of water resources	Improved planing on surface water resources	Percentage of total mapped area (by percentage)	MET and WA	Mapping is not yet completed. By 2022 water resources study covered 107 sites and established 12,321,38 l/c water resources availability. The study was approved by the National Water Committee.
3.3.3	Increase groundwater monitoring and analysis using exiting and new borehole sites	Increased knowledge of groundwater resources and impacts of CC	Number of groundwater monitoring and analysis borehole sites (by quantity)	MET and WA	This is ongoing work but not yet assessed quantitively.
3.3.4	Establishment of rain water harvesting ponds leveraging the natural landscapes in order to retain rainwater, snow and ice melt considering seasonal changes and intensity of precipitation	Increased water resources and resielnce to CC	Number of rain water harvesting ponds	MET and WA	Identification of sites where to build the rainwater harvesting pond is ongoing. The plan is to build at least one in each soum.
Goal 4	Create forest ecosystems well adapted to climate change and enhance carbon sequestration by implementing sustainable forest management				
3.4.1	Organize training on climate change resilience, and adaptation of forest ecosystem, accreditation of professional forestry organizations, adopt forest maintenance and cleaning technologies and processes, determining and assessing degrading forest	Improved maintanance and protection of forest and forest ecosystems	Number of accredited professional forestry organizations	MET, MOFALI, MOES	To implement the identified adaptation measures Mongolia is implementing Sustainable Resilient Ecosystem and Agriculture Management in Mongolia (STREAM+) Project. The project forms part of the European Forest Partnership. It provides support with the transition towards a green economy by promoting climate-responsive and future-proof use of agriculture, forestry and the environment, using both political and practical means. It promotes biodiversity, environmentally friendly forestry and the resilience of the population.
3.4.2	Rehabilitation of forest area through improvement of the incentive system to support a protection and sustainable use of forest	Improved forest and forest ecosystems	Amount of rehabilitated forest area (ha)	MET	
3.4.3	Maintenance and improvement of the saxaul forest ecosystem through development of agro-forest industry	Improved saxaul forest	Improved and reforested area of depleted saxaul forest	MET, MOFALI	
Goal 5	Enable adaptation opportunities and adaptive capacities for vulnerable biodiversity to climate change				

3.5.1	Determination and protection of climate change sensitive ecosystems, biodiversity through planting of endangered and vulnerable flora and fauna.	Improved protection of sensitive ecosystems, biodiversity	Planted list of endangered and vulnerable flora and fauna	MET, Research institutions, organization, universities, colleges	As per Environmental outlook of MECC, there are 9 Critically Endangered and 13 Endangered, 83 vulnerable, 97 Near Threatened species of plants accounted in 2022. There are 20 nursery are nursing more than 10 endangered and vulnerable species at 2315 ha area in 7 aimags of Mongolia.
3.5.2	Conduct a resource assessment on plant distribution by the plant geographical range	Improved planning and protection of biodiversity	Number of study report with improved information on plants		The Institute of Botany is conducting various studies in different places. The aimag Departments of Environment are conducting inventory of wildlife.
3.5.3	Conduct a resource assessment on fauna distribution by monitoring in stages	Improved planning and protection of sensitive fauna	Animal species, their distribution and resource research-monitoring work (by quantity)		
3.5.4	Re-develop and approve ecological-economic assessment methodology on flora	Improved Ecological-economic assessment on flora	Approved ecological-economic assessment methodology on flora		Methodology developed and approved on 22 December 2022 by the order NoA/603 of the Environment and Tourism Minister.
Goal 6	Build resilience to natural disasters by reducing the risks and adapting to impacts of climate and weather-related hazards and disasters				
3.6.1	Conduct disaster prevention training for local herders, community groups, environment protection cooperatives.	Improved knowledge of local people on disaster prevention	Number of community groups and cooperatives trained	NEMA, MET, MOFALI; Emergency management departments and divisions of capital city and local administration	NEMA conducts regular training at national as well as at local level. Disaster preparedness campaigns have reached over 771,600 participants, including herders and vulnerable rural populations, equipping them with practical knowledge and resources to mitigate disaster impacts
3.6.2	Develop and adopt early warning system for various climatic, meteorological disasters and catastrophic events.	Improved protection plan	Number of estabished early warning system	NAMEM	NAMEM with collaboration of NEMA established centralized disaster risk information system which strengthened decision-making processes, allowing real-time data dissemination to communities and authorities
Goal 7	Strengthening healthcare services and capacities for early warning of potential health risks, and provision of proactive and response measures through the comprehensive study of climate impacts on public health				

3.7.1	Conduct training on reduction of climate related risks, and its impact on response actions	Improved knowledge of local people on climate impacts	Number of persons trained	MON, Aimag public health departments, Governor's secretariat of capital city and aimags	Health risks assessments have prioritized critical areas such as zoonotic disease prevalence, water quality, and heat stress impacts. Public awareness campaigns, supported by institutional training programs, have enhanced resilience among health professionals and local communities. conducted tailored training for healthcare workers in rural areas has improved early detection and response to climate-induced health risks, including outbreaks of vector-borne diseases. These measures are vital for reducing the health burden of climate change and safeguarding vulnerable populations
3.7.2	Increase number of medical researchers, academia and healthcare workers that trained on methodology of climate change related research.	Improved capacity of climate assessment on health care	Number of personnel trained	MON, Universities, research institutions	
3.7.3	Conduct Research and assessment on impact of climate change on human health and wellbeing.	Improved information and reseach on CC impacts on health	Research and evaluation	MON, Universities, research institutions	
3.7.4	Conduct impact assessment of climate change on food nutrition and food safety.	Improved information and reseach on CC impacts on food nutrition and food safety	Number of Research conducted	MOFALI, MET	Just started
Goal 8	Establish a system providing social safeguard, insurance and prevention measures to reduce the vulnerability of social groups and build their resilience to climate change impacts by identifying groups vulnerable to climate change				
3.8.1.	Develope public awareness campagn plan for reducing climate change and environment pollution	Improved knowledge of public	Approved public awareness campagn plan	MON	Plan is under preparation
3.8.2	Establish Youth network on "Climate change and air",	Improved information exchange and involvement of youth in CC	Number of functional youth networks on CC and air pollution	MET, Department of family, children and youth, National Committee for children, Mongolian Scout association	MET is working actively in to engage yout in climate change and has conducted he 'Climate Change and Youth' international forum in Ulaanbaatar on August 23-24 in collaboration with the specialized agencies of the United Nations, Mongolian Children's Council, Mongolian Red Cross Society, Oyu Tolgoi LLC, Mongolian Sustainable Development Bridge, Caritas Czech Republic in Mongolia, World Vision, and People in Need NGO at the initiative of the President of Mongolia. UNICEF and the Scout Association of Mongolia launched the Youth for Climate and Clean Air Network (YOUCCAN).

The lack of standardized evaluation methods and comprehensive monitoring frameworks further complicates the assessment of progress and hinders accountability. Moreover, gaps in data availability and reliability continue to limit evidence-based planning and decision-making.

To address these challenges, Mongolia is exploring blended financing mechanisms, leveraging international support, and integrating adaptation priorities into the Medium-Term Expenditure Framework (MTEF). Strengthening institutional capacities, particularly at the regional and local levels, is critical to ensuring cohesive and efficient implementation of adaptation actions. Furthermore, efforts to develop robust evaluation methodologies and improve data collection systems will be essential for tracking progress and refining strategies.

3.10. MONITORING AND EVALUATION OF ADAPTATION ACTIONS AND PROCESSES

3.10.1. National Systems for Monitoring and Evaluation of Adaptation Actions

Methods for evaluating the effects of legislation and Common procedures for monitoring[143] and evaluating the implementation of policy documents and the activities of administrative organizations[144] are the methods to monitor and evaluate implementation of legislations, programs and challenges and its positive and negative impacts on society and identify possible alternatives for the proper and effective implementation.

Current evaluation practices based on the above-mentioned methods used to assess national legislation and sectoral policy documents. These include standard procedures for assessing the effectiveness and impact of policy implementation, institutional performance, and the identification of constraints and options for improved outcomes. Such methods are guided by national public administration regulations and oversight frameworks under the Cabinet Secretariat and National Audit Office[145].

During the 2021–2022 reporting period of the BTR1, Mongolia had no officially adopted national Monitoring and Evaluation (M&E) system dedicated specifically to climate change adaptation. However, efforts were initiated to conceptualize an integrated M&E framework aligned with the Adaptation Plan for NDC Implementation (APNDC) and the National Climate Change Program[146].

Adaptation poses distinct challenges to monitoring and evaluation due to its context-specific nature and lack of a globally standardized metric. Unlike mitigation, which relies on quantifiable greenhouse gas reduction metrics, adaptation outcomes are often qualitative, systemic, and temporally diffuse. This makes cross-country verification or comparison difficult, as there is no agreed reference metric or baseline for what constitutes "effective adaptation"[147].

During the reporting period, adaptation-related M&E in Mongolia largely remained

143 The Government of Mongolia. 2016. Approval of methodologies. Annex 6: Methods for evaluating the effects of legislations. Resolution No.59. 15 January 2016.

144 The Government of Mongolia. 2020. Amendment of Procedures. Annex: Common procedures for monitoring and evaluating the implementation of policy documents and the activities of administrative. organizations. Resolution No. 206. 09 December 2020.

145 Cabinet Secretariat of Mongolia (2021). Government Performance Evaluation Guidelines.

146 MET (2022). Draft Framework for Monitoring and Evaluation under the APNDC

147 UNFCCC (2021). Technical Paper on Metrics and Methodologies for Adaptation M&E under the ETF.

project-based and donor-driven, with systems embedded in internationally funded initiatives such as those under the Green Climate Fund (GCF), UNDP, and GIZ. These projects developed standalone logical frameworks, indicators, and progress reporting systems—useful at the subnational level but not yet institutionalized nationally[148].

Technical barriers remain a core constraint. Key challenges include:

- Limited availability of longitudinal and disaggregated datasets across climate-sensitive sectors such as biodiversity, tourism, and pasture management.
- Fragmentation of data storage systems across ministries, academic institutions, and subnational bodies, inhibiting interoperability and shared access.

Weak institutional clarity and mandate overlaps due to the ongoing restructuring of national agencies and the decentralization of environmental governance[149].

Although the Ministry of Environment and Tourism[150] (MET) and the Institute of Research on Meteorology, Hydrology, and Environment (IRIMHE) began baseline indicator development for selected sectors during 2021–2022, these efforts had not yet coalesced into a coherent or approved national system[151]. As a result, no official M&E framework for adaptation has been adopted to date. The current situation limits Mongolia's ability to systematically assess adaptation effectiveness, compare across aimags and sectors, and report adaptation outcomes in a consistent, verifiable manner.

To advance adaptation M&E, the following priorities were identified during the 2021–2022 cycle:

- Establish a centralized M&E coordination unit under MET.
- Develop national adaptation indicators aligned with the ETF MPGs under the Paris Agreement.
- Strengthen the legal basis and budgetary support for integrating M&E into the national adaptation architecture.
- Institutionalize feedback loops from adaptation implementation to policy refinement[152].

3.10.2. Effectiveness and Sustainability of Adaptation Actions

During the 2021–2022 reporting period, Mongolia's ability to implement and sustain adaptation actions remained significantly constrained by persistent resource limitations. A critical challenge was the lack of earmarked budget allocations for adaptation planning and implementation, particularly at the institutional level. The National Climate Committee (NCC) and its sub-committees continued to face structural underfunding, which hampered their ability to coordinate, monitor, and evaluate adaptation interventions at national and subnational scales[153].

These limitations were especially acute in technical domains that require advanced expertise, such as hazard mapping, regional climate modeling, and ecosystem impact assessments, which are foundational for risk-informed adaptation planning[154]. As of 2022, only limited national investment had been made in developing localized climate risk datasets, resulting in continued reliance on donor-funded pilot studies[155].

To promote long-term sustainability, the Government of Mongolia prioritized the

148 UNDP & MET (2022). STREAM+ and NAP Readiness Project Progress Reports.
149 MET (2022). Assessment of Climate Data Management Systems in Mongolia.
150 Current Ministry of Environment and Climate Change was Ministry of Environment and Tourism in 2022.
151 IRIMHE (2022). Indicator Development for Sectoral Adaptation Baselines.
152 Adaptation Coordination Taskforce (2022). Recommendations on M&E System Development under NDC.
153 MET (2022). Internal Budget Review of National Climate Institutions.
154 IRMHE & UNEP (2022). Climate Modeling and Hazard Mapping Capacity Assessment.
155 MET (2022). Mongolia State of Environment Report 2021–2023.

integration of adaptation measures into regional and sectoral budget frameworks. This was operationalized through aligning adaptation goals with the Medium-Term Expenditure Framework (MTEF) and strengthening inter-sectoral planning under the APNDC[156]. The aim was to reduce fragmentation and ensure continuity of funding streams beyond project cycles.

International partners continued to play a catalytic role. Projects supported by the Green Climate Fund (GCF), Adaptation Fund, UNDP, and GIZ during 2021–2022 contributed significantly to local implementation. Key interventions included pastureland rehabilitation in drought-prone soums, sustainable livestock fodder systems, and participatory vulnerability assessments integrated into local development plans[157].

While critiques persisted regarding the overemphasis on training and capacity-building, these activities remained foundational. Over the reporting period, more than 30 local workshops were held to support adaptation planning across aimags. These facilitated practical exchanges between local government officials, herders, women's cooperatives, and technical experts, contributing to the design and rollout of subnational adaptation measures[158].

Recognizing the need for adaptive learning, the Ministry of Environment and Tourism (MET) initiated work to embed feedback and learning mechanism within the APNDC framework. Although still under development as of 2022, the proposed system aimed to draw on implementation evaluations to update indicators, revise targets, and adjust intervention strategies[159]. This iterative learning loop is expected to increase resilience and policy responsiveness despite data and resource constraints.

In summary, while systemic financing and capacity gaps continue to challenge Mongolia's adaptation implementation, important institutional and procedural advances were made in 2021–2022. Embedding adaptation within national planning instruments, strengthening local ownership, and developing mechanisms for feedback and learning are all critical steps toward achieving more sustainable and impactful adaptation outcomes.

3.11 AVERTING, MINIMIZING, AND ADDRESSING LOSS AND DAMAGE

During the 2021–2022 period, Mongolia undertook targeted interventions to avert, minimize, and address climate-induced loss and damage (L&D), with a primary emphasis on disaster risk reduction (DRR) and livelihood protection in climate-vulnerable regions. These efforts were implemented under constrained institutional and financial conditions, relying heavily on external technical support and pilot-based approaches.

3.11.1. Disaster Risk Reduction and Infrastructure Adaptation

Mongolia scaled up the deployment of early warning systems and hazard mapping tools to enhance preparedness for extreme weather events, particularly droughts, dzud, and floods. These systems were supported by GIZ and UNDP projects focused on localized risk forecasting and community-based disaster response training[160]. Notably, early warning

156 Ministry of Finance (2022). Guidelines for Climate-Responsive Budgeting in Mongolia.
157 UNDP-GCF Project Report (2022). STREAM+ Mid-Term Evaluation.
158 GIZ (2022). Subnational Adaptation Planning Support Activities.
159 MET (2022). Draft Framework for Monitoring and Feedback under the APNDC.
160 UNDP & GIZ (2022). "Strengthening Community Resilience through Risk-informed Early Warning Systems in Mongolia."

dissemination mechanisms were piloted in drought-prone aimags such as Dornod and Govi-Altai, reaching over 18,000 herder households by the end of 2022[161].

In parallel, climate-resilient infrastructure investments progressed in collaboration with development partners. Projects included:

- Flood control infrastructure in Selenge and Bulgan aimags;
- Drought-resilient water supply systems, such as deep-well construction and rainwater harvesting pilots in Umnugovi;
- Energy-efficient housing prototypes implemented under UN-Habitat guidance in peri-urban ger areas of Ulaanbaatar[162].

These physical measures were effective in mitigating localized risks but remained limited in geographic scale and institutional uptake due to insufficient public co-financing.

3.11.2. Livelihood Protection and Risk Pooling

Livelihood protection remained a critical L&D strategy, particularly for the pastoralist economy, which constitutes over 80% of methane emissions and is highly sensitive to climate variability. In 2021–2022, the government and FAO piloted the "New Herder Cooperatives" program, which supported:

- Herd diversification (e.g., camel and yak promotion in arid zones),
- Sustainable pasture rotation schemes,
- Animal health extension services[163].

These efforts, implemented in five western aimags, improved resilience and economic diversification for over 2,000 herding households.

At the same time, Mongolia's Index-Based Livestock Insurance Program (IBLIP) continued as the principal financial instrument to mitigate pastoral loss. However, coverage rates declined in 2021 due to increasing premium costs and institutional challenges within the Financial Regulatory Commission[164]. The lack of real-time loss assessment tools and limited risk stratification further constrained payout efficiency during dzud emergencies.

3.11.3. Gaps in L&D Assessment and Institutional Response

Despite progress, systemic weaknesses persisted:

- No national L&D assessment was conducted in 2021–2022, leaving gaps in understanding the scale of both economic losses (e.g., livestock mortality, housing, public infrastructure) and non-economic losses (e.g., traditional knowledge, sacred sites, mental health impacts)[165].
- Institutional arrangements to coordinate L&D responses across sectors (e.g., agriculture, infrastructure, health) remained fragmented, with unclear mandates between MET, NEMA, and MOFALI[166].
- Gender and social vulnerability dimensions of L&D—particularly impacts on women-headed households and internal migrants—were not systematically assessed.

[161] National Emergency Management Agency (NEMA). (2022). Annual Disaster Preparedness and Response Report.
[162] UN-Habitat (2022). "Climate-Resilient Housing Pilot in Ger Areas of Ulaanbaatar."
[163] FAO & MOFALI (2022). "Evaluation Report: New Herder Cooperative Model for Livelihood Resilience."
[164] Financial Regulatory Commission (2022). Index-Based Livestock Insurance Annual Performance Summary.
[165] UNEP (2021). "Guidance on Assessing Non-Economic Losses in the Asia-Pacific Region."
[166] MET & NEMA (2022). "Review of Interagency Coordination Mechanisms for Climate-Induced Disaster Response."

3.11.4. Emerging Measures and Strategic Alignment

Recognizing these gaps, the Ministry of Environment and Tourism (MET) began the design of a national L&D assessment methodology in late 2022, aligned with guidance under the Warsaw International Mechanism[167]. The approach aims to include:

- A typology of economic and non-economic losses.
- Community-level data collection tools.
- Integration of L&D into the National Adaptation Plan and Medium-Term Expenditure Framework (MTEF).

Additionally, MET and MOF began discussions to expand IBLIP coverage, improve livestock zoning criteria, and diversify risk financing mechanisms. Partnerships with UNDP and the Green Climate Fund were initiated to explore parametric insurance models and loss tracking registries at the soum level.

In summary, during 2021–2022, Mongolia made modest but essential strides in DRR and livelihood resilience while acknowledging systemic gaps in comprehensive L&D response. Scaling up these efforts will require legal, institutional, and budgetary reforms, as well as access to the Loss and Damage Fund, Adaptation Fund, and Green Climate Fund for sustainable financing of future L&D actions.

3.12. COOPERATION, GOOD PRACTICES, AND LESSONS LEARNED

Mongolia's adaptation efforts are bolstered by strong cooperation at both domestic and international levels, fostering the exchange of knowledge, resources, and innovative practices to enhance climate resilience. These collaborative efforts are essential for addressing Mongolia's unique climate challenges and for continuously improving its adaptation strategies.

3.12.1. International Cooperation

During the reporting period, Mongolia maintained strategic partnerships with major global climate financing mechanisms. This included:

- The Green Climate Fund (GCF) and Adaptation Fund, which supported national projects focused on climate-resilient agriculture, integrated water management, and local infrastructure resilience;[168]
- Continued collaboration with UNDP, FAO, and GIZ in implementing capacity development programs in pastoral risk management and biodiversity adaptation planning;[169]
- Asian Development Bank (ADB) and World Bank investments in subnational adaptation infrastructure and city-level flood resilience in Ulaanbaatar[170].

Mongolia also engaged in regional climate diplomacy, focusing on transboundary challenges such as:

- Desertification control and dust storm monitoring along the southern border through cooperation with China and Kazakhstan;[171]

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[167] UNFCCC (2022). "Technical Guide on National Loss and Damage Assessment Approaches.
[168] Green Climate Fund (2022). Mongolia Country Portfolio. Retrieved from https://www.greenclimate.fund
[169] UNDP Mongolia & GIZ (2022). Capacity Building for Climate Adaptation: Implementation Report.
[170] World Bank (2022). Mongolia Resilient Cities Program: Project Brief.
[171] UNEP (2022). Dust Storm Risk Monitoring in Northeast Asia: Mongolia-China Coordination Framework.

- Shared basin management for transboundary rivers (e.g., Kherlen, Onon) under the Central Asia Water Framework[172].

These cooperative frameworks enhanced Mongolia's ability to mobilize both technical expertise and funding, while fostering peer learning and policy alignment.

3.12.2. Good Practices

The period saw a notable increase in community-driven and integrated adaptation practices. Among these:

- Community-Based Adaptation (CBA) projects demonstrated scalability and cost-effectiveness. For example, the UNDP-GEF Small Grants Programme funded localized projects on pasture rotation, rainwater harvesting, and biodiversity monitoring in six aimags;[173]
- Reforestation and ecosystem restoration continued under the STREAM+ initiative and MET's (now MECC) Forest Sector Strategy, with over 800 ha of degraded land rehabilitated in 2022;[174]
- Innovative blended finance models were deployed, combining public investments with private sector participation (e.g., local banks providing green loans to herders for water-efficient infrastructure)[175].

These practices not only reduced vulnerability and ecosystem degradation but also enhanced social capital through participatory approaches.

3.12.3. Lessons Learned

Mongolia's adaptation experience in 2021–2022 revealed several insights critical for advancing more robust and inclusive policy and planning:

- Data-Driven Decision-Making: The lack of long-term, disaggregated climate and socio-economic datasets remains a barrier. Efforts were made to strengthen data-sharing protocols among institutions, though gaps persist in real-time pasture degradation and dzud-risk monitoring[176].
- Inclusive Engagement: Successful pilots emphasized the importance of involving herders, youth groups, and women's cooperatives in all stages of planning. These groups contributed context-specific insights and strengthened implementation ownership.
- Institutional Coordination: While some coordination platforms (e.g., Climate Change Coordination Council) improved alignment between MECC, MOFALI, and local administrations, institutional overlap and unclear mandates remain in sectoral adaptation governance. Continued support for integrated multi-stakeholder governance is essential[177].

[172] Ministry of Environment and Tourism (2022). Mongolia Water Diplomacy Progress Update.
[173] UNDP-GEF SGP (2022). Community-Based Climate Resilience Initiatives.
[174] MET (2022). Forest Sector Progress Report.
[175] Mongolian Bankers Association (2022). Annual Green Finance Report.
[176] National Statistics Office & MET (2022). Integrated Climate Data Gaps Assessment.
[177] MET (2022). Institutional Review of Adaptation Governance Architecture.

CHAPTER FOUR: INFORMATION ON FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER AND CAPACITY-BUILDING SUPPORT RECEIVED AND NEEDED

4.1. OVERVIEW

Mongolia's climate ambition, articulated in its updated Nationally Determined Contribution (NDC), Vision 2050, and the New Recovery Policy, requires timely and sustained access to adequate finance, climate-compatible technologies, and institutional capacity. The strategic frameworks are in place, but operational success depends heavily on international partnerships, long-term technical cooperation, and predictable financial flows[178].

The COVID-19 pandemic significantly affected Mongolia's climate financing trajectory. Public resources were redirected toward emergency response and economic stabilization, constraining national budget allocations for long-term climate action. Pandemic-related border closures, supply chain disruptions, and fiscal tightening delayed climate-related project implementation. In response, the New Recovery Policy (2021–2025) integrated a green recovery agenda, linking economic revitalization to decarbonization and resilience-building[179].

Between 2021 and 2022, Mongolia mobilized approximately USD 301.96 million in international climate finance. This included USD 116.8 million in grants, USD 179 million in concessional loans, and USD 6.2 million in technical assistance, primarily from partners such as the Asian Development Bank (ADB), Green Climate Fund (GCF), Japan, and the World Bank[180]. These funds supported programs across energy, agriculture, water resource management, and infrastructure sectors.

According to sectoral investment modeling conducted in 2021, Mongolia's implementation of its Nationally Determined Contribution (NDC) will require an estimated USD 11.5 billion by 2030. This figure underscores the scale of financial resources necessary to achieve low-carbon development and climate resilience and highlights the urgent need to scale up both domestic and international climate finance, aligned with Articles 9–11 of the Paris Agreement.

In the area of technology development and transfer, Mongolia has focused on climate-compatible solutions across priority sectors. Initiatives include grid modernization, geothermal district heating, solar and wind energy systems, smart irrigation, and cleaner mining technologies. Feasibility assessments supported by bilateral and multilateral partners are underway to evaluate scalability and cost-effectiveness[181].

During the reporting period, development partners received a total of USD 93.6 million in capacity-building support to strengthen Mongolia's institutional framework for greenhouse gas (GHG) inventory development, NDC progress tracking, and local-level adaptation planning. However, the pledged funding had not been disbursed to Mongolia as of the reporting

178 Government of Mongolia. (2019). Updated Nationally Determined Contribution. Ulaanbaatar. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mongolia%20First/NDC-Mongolia-2019%20Update.pdf

179 Ministry of Economy and Development. (2022). New Recovery Policy – Post-COVID Green and Inclusive Recovery Framework. Government of Mongolia, Ulaanbaatar.

180 Ministry of Environment and Tourism & Ministry of Finance. (2023). Climate Finance in Mongolia: Tracking Flows and Priorities 2010–2022. Ulaanbaatar.

181 MET & GIZ. (2023). Technology Needs Assessment for Climate Mitigation and Adaptation in Mongolia. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Ulaanbaatar.

date. Despite this, the Ministry of Environment and Tourism (MET), in coordination with relevant sectoral ministries and local governments, has continued to lead efforts to institutionalize climate-related capacity across public sector systems[182].

Mongolia's projected needs for climate finance, technology cooperation, and institutional development through 2028 remain substantial. Recent assessments have helped identify key support areas, enabling development partners to target their assistance. However, challenges persist, including a limited pipeline of bankable projects, fragmented data systems, underdeveloped MRV frameworks, and insufficient domestic co-financing[183].

To address these barriers, Mongolia is advancing climate governance reforms. This includes the preparation and submission of the draft Climate Change Framework Law to the State Great Khural (Parliament) of Mongolia. the development of a national MRV system, and the piloting of a climate budget tagging (CBT) mechanism with UNDP support. The government is also exploring innovative financial instruments such as sovereign green bonds, results-based finance, and cooperative mechanisms under Article 6 of the Paris Agreement[184].

International cooperation remains essential particularly through concessional finance, climate-smart technology partnerships, and long-term capacity development. In parallel, domestic reforms in public investment management, budget transparency, and interagency coordination will be key to ensuring impact, accountability, and resilience in the face of future shocks.

4.2. NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

4.2.1. National Circumstances

Mongolia's updated Nationally Determined Contribution (NDC), Vision 2050, and the New Recovery Policy lay out an ambitious agenda to achieve low-emission, climate-resilient development. The implementation of this agenda requires sustained access to international climate finance, advanced technologies, and long-term institutional capacity support. While Mongolia has made notable progress in aligning its policy and legal frameworks with the goals of the Paris Agreement, successful implementation remains heavily dependent on predictable financial flows, technical partnerships, and governance reforms[185].

The total cost of implementing Mongolia's updated NDC through 2030 is estimated at approximately USD 11.5 billion, based on sectoral investment modeling conducted in 2021[186]. This cost estimate reflects 6.3 billion USD for mitigation and 5.2 billion USD for adaptation interventions across the energy, agriculture, transport, water, and urban infrastructure sectors. Approximately 73% of these needs are

[182] Ministry of Environment and Climate Change. (2023). National Climate Capacity Development Plan 2022–2026. Ulaanbaatar

[183] GCF & MET. (2022). Readiness Needs Assessment Report: Enhancing Access to Climate Finance in Mongolia. Ulaanbaatar.

[184] UNDP & Ministry of Finance. (2023). Climate Budget Tagging Pilot Report for Mongolia. UNDP Mongolia. https://www.mn.undp.org

[185] Government of Mongolia. (2020). Vision 2050: Long-Term Development Policy of Mongolia. *Ulaanbaatar:* State Great Khural.

[186] Ministry of Environment and Tourism (MET) & Ministry of Finance (MOF). (2021). Updated Nationally Determined Contribution of Mongolia: Technical Report and Investment Needs Assessment.

expected to be mobilized through international climate finance, with the remainder through domestic co-financing[187].

The COVID-19 pandemic significantly disrupted Mongolia's climate finance trajectory. Emergency social spending and pandemic recovery priorities diverted domestic resources away from climate programs. Fiscal deficits expanded, and climate project pipelines were delayed due to logistical disruptions and constrained capacity. In response, the Government of Mongolia introduced the New Recovery Policy (2021–2025), embedding climate resilience, afforestation, and renewable energy goals into the broader post-pandemic economic recovery strategy[188].

Between 2021 and 2022, Mongolia received approximately USD 301.96 million from international climate finance. This included:

- USD 116.8 million in grant financing,
- USD 179 million in concessional loans, and
- USD 6.2 million in technical assistance[189].

Key contributors included the Asian Development Bank (ADB), the Green Climate Fund (GCF), the Japan International Cooperation Agency (JICA), and the World Bank. These funds supported priority investments in energy transition, water security, sustainable agriculture, and resilient infrastructure.

In terms of technology development and transfer, Mongolia prioritized solutions identified in its Technology Needs Assessment (TNA), including geothermal and solar-based heating, smart irrigation systems, dust control and clean mining technologies, and decentralized renewable energy systems[190]. Feasibility studies were conducted with support from bilateral and multilateral partners to assess scalability and cost-effectiveness across these technologies.

However, as of the end of 2022, the pledged capacity-building support had not yet been disbursed to Mongolia. Despite this, the Ministry of Environment and Tourism (MET), in collaboration with the Ministry of Finance (MOF), sectoral ministries, and local governments, continued to advance institutional development through national programs, donor coordination platforms, and integration into public administration systems.

Several structural challenges continue to constrain the scale-up of climate finance and implementation effectiveness, including:

- A limited pipeline of investment-ready, climate-aligned projects.
- Fragmented data systems and lack of a centralized MRV platform.
- Weak coordination between ministries and low retention of technical expertise.
- Absence of a unified climate investment strategy or climate budget tagging system.

In response, Mongolia has launched a series of institutional reforms to address these barriers:

- The Climate Change Framework Law (2022) initiated to provide the legal basis for MRV, transparency, and climate finance coordination.
- A national MRV system is under development with GCF Readiness support to operationalize Article 13 of the Paris Agreement.
- The Climate Budget Tagging (CBT) pilot, launched by MOF and UNDP in 2022, integrates climate priorities into public finance management.

[187] United Nations Development Programme (UNDP) Mongolia. (2022). Financing Mongolia's Climate Commitments: Summary of NDC Implementation Costs and Financial Gap Assessment.
[188] Government of Mongolia. (2021). New Recovery Policy 2021–2025. Ulaanbaatar: Cabinet Secretariat.
[189] Ministry of Environment and Tourism (MET). (2023). Climate Finance Tracking Report (2021–2022): Support Received and Sectoral Allocation Overview. Ulaanbaatar.
[190] MET. (2022). Technology Needs Assessment (TNA) and Action Plan for Climate Technologies in Mongolia. Ulaanbaatar: MET and UNFCCC TNA Programme.
[191] Green Climate Fund (GCF). (2023). Institutional Capacity Assessment for Enhanced Transparency Framework (ETF) Alignment – Mongolia Readiness Project Report. Songdo: GCF Secretariat.

- Mongolia is exploring participation in Article 6.2 and 6.4 mechanisms, including sovereign green bonds and results-based climate finance schemes[192].

These reforms are foundational to enhancing the effectiveness, efficiency, and accountability of Mongolia's climate finance architecture. Continued international cooperation—especially through concessional finance, technology partnerships, and sustained capacity support—will be critical to fully realize Mongolia's NDC targets and long-term development goals.

4.3. INSTITUTIONAL ARRANGEMENTS

Effective coordination and institutional readiness are essential for mobilizing and managing support under Articles 9, 10, and 11 of the Paris Agreement. Mongolia's institutional arrangements in 2021–2022 reflect an evolving system built around lead ministries, implementing agencies, and emerging support tracking mechanisms.

4.3.1. Coordinating Ministries and Roles (MPG para. 65a–c)

Ministry of Environment and Tourism (MET) acts as the national climate authority, responsible for overseeing implementation of the NDC, developing the National Adaptation Plan (NAP), and coordinating support mobilization. In 2021–2022, MET led the operationalization of the Climate Change Framework Law and advanced readiness for Article 6 carbon market participation (see Chapter 3)[193].

Ministry of Finance (MOF) manages the financial governance of climate support. Through the Official Development Assistance Management Information System (ODAMIS), MOF tracks concessional loans and grants and ensures integration of development finance into the national budget process. This aligns with the support tracking mechanisms described in Section 4.2[194].

Ministry of Economy and Development (MED) ensures that climate priorities are embedded into national development frameworks such as Vision 2050 and the New Recovery Policy (Chapter 1). MED also collaborates with MET and MOF in coordinating strategic investment planning.

4.3.2. Sectoral and Subnational Implementing Entities

Sectoral ministries lead climate action in their respective domains:

- **MOE** supports renewable energy transitions and grid decarbonization (Chapter 3).
- **MCUD** manages building efficiency and urban climate resilience programs.
- **MOFALI** leads on methane reduction, livestock resilience, and sustainable land management (see Chapter 3).

192 Ministry of Finance (MOF) & United Nations Development Programme (UNDP). (2023). Climate Budget Tagging Pilot and Public Financial Management Reform Progress Report. Ulaanbaatar.
193 MET. *Climate Change Framework Law and Article 6 Readiness Program Overview.* 2024.
194 MOF. *ODAMIS System Manual and 2021–2022 Financial Flow* Report.

Local governments implement region-specific adaptation and mitigation projects, although many remain under-resourced.

4.3.3. Financial Regulators and Private Sector Engagement

The Bank of Mongolia (BoM) and Financial Regulatory Commission (FRC) play emerging roles in mainstreaming green finance. In 2021–2022, they began developing policies for sustainable banking, ESG standards, and green bonds—critical enablers for attracting private capital into climate sectors.

4.4. UNDERLYING ASSUMPTIONS, DEFINITIONS AND METHODOLOGIES

In preparing this Biennial Transparency Report (BTR), Mongolia applied a structured, transparent methodology to report on climate-related financial, technological, and capacity-building support received and needed, consistent with the requirements of the Enhanced Transparency Framework (ETF) under Article 13 of the Paris Agreement[195]. The applied methods ensure data consistency, accuracy, and alignment with national climate priorities, particularly Mongolia's Nationally Determined Contribution (NDC)[196].

4.4.1. Scope and Methodology

All financial data are presented in United States dollars (USD), using OECD Development Assistance Committee (DAC) exchange rates[197] to ensure consistency and comparability. The reporting period covers 2021–2022, in line with the ETF biennial cycle.

Mongolia's estimated climate finance need for full NDC implementation through 2030 is USD 11.5 billion, covering priority mitigation and adaptation measures across key sectors. This estimate is based on national investment plans and sectoral costings reflected in the NDC and related policy frameworks.

The primary data sources used for tracking support include:

- OECD Creditor Reporting System (CRS)[198],
- ODAMIS (Official Development Assistance Management Information System) maintained by the Ministry of Finance, and
- National planning and investment documents.
- Support is classified and disaggregated as follows:
- By sector: energy, agriculture, water, and mining;
- By financial instrument: grants, concessional loans, and technical assistance;
- By thematic objective: mitigation, adaptation, or cross-cutting;
- By delivery channel: bilateral, multilateral, or regional;

[195] UNFCCC (2019). Modalities, Procedures and Guidelines for the Transparency Framework under the Paris Agreement (Decision 18/CMA.1).
[196] Government of Mongolia (2020). Updated Nationally Determined Contribution (NDC).
[197] OECD DAC (2022). Exchange Rates for DAC Statistics. Retrieved from: https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/dac-exchange-rates.htm
[198] OECD (2023). Creditor Reporting System (CRS) Aid Activities. Retrieved from: https://stats.oecd.org/Index.aspx?DataSetCode=CRS1

- By status: planned (committed but not yet implemented), ongoing (implementation underway), or completed (fully delivered and disbursed), using the OECD Rio Marker methodology[199].

A four-step sequential approach was applied:

- Data Compilation: Extracted from OECD CRS, ODAMIS, and public investment plans;
- Evaluation: Assessed by type of contribution, sectoral alignment, and relevance to NDC targets;
- Aggregation and Disaggregation: Organized by sector, delivery channel, and modality;
- Gap Analysis: Identified underfunded areas, particularly in adaptation, technology deployment, and institutional capacity-building.

The report avoids double-counting by verifying information across national and international platforms, especially for transparency-related support. Where project documentation includes elements of technology development or institutional strengthening, these are noted; however, due to limited outcome-tracking mechanisms, effectiveness and impact evaluations are deferred for future reporting cycles[200].

Table IV. 1. Key assumptions, classifications, and methodological steps applied.

Category	Enhanced Description
Currency and Units	All financial data are presented in United States dollars (USD), using OECD DAC exchange rates, to ensure cross-source consistency and enable comparability with international reports[201].
Estimated Amount of Support Needed	Mongolia's total estimated climate finance need for full NDC implementation is USD 11.5 billion, covering priority mitigation and adaptation actions across all sectors through 2030[202]. The total climate-related financing requirement, which extends beyond the scope of the NDC to include measures under national policies, strategies, and sectoral programmes, is estimated at USD 22.47 billion.
Timeframe Covered	This report covers climate-related financial, technological, and capacity-building support mobilized and received during the biennial period 2021–2022, consistent with ETF reporting cycles[203].
Data Sources	Primary data were obtained from the OECD Creditor Reporting System (CRS), ODAMIS (national aid management platform), and official national planning documents (e.g., NDC, investment plans)[204].
Sectoral and Instrumental Classification	Support is disaggregated by: (i) economic sector (e.g., energy, agriculture), (ii) financial instrument (grants, loans, technical assistance), (iii) service provider or executing agency, and (iv) thematic purpose (e.g., mitigation, adaptation, capacity-building)[205].
Classification by Commitment Status	"Received" refers to support that has been disbursed or initiated; "needed" indicates quantified requirements not yet supported. Commitment status reflects formal funding agreements and disbursement levels[206].

199 OECD DAC (2021). Rio Markers for Climate: Handbook.
200 OECD (2023). Creditor Reporting System (CRS) Aid Activities. Retrieved from: https://stats.oecd.org/Index.aspx?DataSetCode=CRS1
201 OECD DAC Statistics. (2023). Exchange Rate Methodology. https://www.oecd.org/dac
202 Government of Mongolia. (2020). Updated Nationally Determined Contribution (NDC).
203 UNFCCC. (2019). Modalities, Procedures and Guidelines for the ETF (Decision 18/CMA.1).
204 Ministry of Finance. (2022). Development Cooperation Annual Report.
205 UNDP & MOF. (2023). Climate Finance Readiness Assessment Report – Mongolia.
206 OECD DAC Handbook. (2016). Climate-Related Development Finance Classification.

Activity Status Reporting	Activities are categorized as: planned (committed but not yet underway), ongoing (implementation in progress), or completed (fully delivered with all funds disbursed and outputs delivered)[207].
Delivery Channels	Resources are channeled through multilateral institutions (e.g., GCF, ADB, WB), bilateral development agencies (e.g., Japan, Germany), or regional mechanisms[208].
Support Type	Based on Rio Marker classification: mitigation, adaptation, or cross-cutting (targeting both). Classification is based on project documentation and OECD CRS coding[209].
Types of Support Tracked	Includes: (i) financial support (grants, concessional loans), (ii) technology development and transfer, and (iii) capacity-building initiatives aligned with Articles 9–11 of the Paris Agreement[210].
Sector and Subsector Coverage	Tracked sectors include energy, agriculture, water, and mining, consistent with Mongolia's climate priority sectors outlined in its NDC and national adaptation planning framework[211].
Reporting on Use and Impact	Due to current data limitations, this BTR does not assess the full utilization or outcome-level impact of received support. It reports only on documented delivery status per project record[212].
Reporting on Technology and Capacity	Where available, the report identifies whether support contributed to technology deployment or institutional capacity-building, based on documentation in project submissions[213].
Avoiding Double Counting	Support data are verified across national and international platforms to prevent duplication, especially in reporting on transparency-related capacity-building support under Article 13[214].

This consolidated methodology supports the integrity and comparability of Mongolia's reporting under the ETF, while also identifying critical funding gaps and institutional needs for effective NDC implementation.

4.5. TRANSPARENCY AND TRACKING SYSTEMS

Using ODAMIS and international climate finance databases such as ADB, WB, and OECD, Mongolia made the efforts to track mitigation and adaptation outcomes, and support received. These systems are supported to build the ETF reporting tables.

The collaborative mechanisms between MET, MED, MOF, sectoral ministries, and regulators form the core institutional structure for implementing and managing international support under Articles 9–11 of the Paris Agreement.

4.6. CHALLENGES AND STRATEGIC OUTLOOK

Despite notable progress in strengthening its climate policy and institutional frameworks, Mongolia continues to face interlinked institutional, technical, financial, and policy-

207 Adapted from OECD-DAC activity status definitions, updated for ETF alignment.
208 ADB, GCF, WB. (2022). Mongolia Project Portfolios and Financial Flows.
209 OECD. (2016). Rio Marker Handbook for Climate Mitigation and Adaptation.
210 UNFCCC (2022). Biennial Transparency Report – Technical Expert Review Guidelines.
211 MET & FAO. (2023). Forest Carbon Partnership Facility – Sectoral Needs Assessment.
212 Mongolia Climate Finance Coordination Unit. (2022). Progress Monitoring Dashboard.
213 UNEP/UNITAR. (2023). Capacity-building Strategy for Enhanced Transparency in Mongolia.
214 UNFCCC. (2023). CTF Table 7 – Support Needed and Received: Reporting Guidance.

related constraints that limit its ability to access, absorb, and scale international support for climate finance, technology transfer, and capacity-building.

Institutional Challenges. Mongolia's Measurement, Reporting, and Verification (MRV) system remains under development, particularly with respect to tracking climate finance and support received. The lack of standardized indicators, sectoral reporting protocols, and integrated data management systems impedes full compliance with the Enhanced Transparency Framework (ETF) under Article 13 of the Paris Agreement[215]. Coordination across ministries remains weak, with overlapping mandates, delayed project approval processes, and limited institutional accountability on support registration mechanisms.

Project and Technical Capacity Gaps. The pipeline of climate-relevant and adaptation-specific projects—especially in sectors such as livestock, pastureland, water resource management, and rural livelihoods—remains underdeveloped. Public entities often lack the technical, fiduciary, and operational capabilities required by international climate funds[216]. The absence of robust feasibility assessments, safeguards systems, and gender-responsive project designs limit the bankability of proposals.

Financial and Market Constraints. Fiscal constraints continue to hinder Mongolia's capacity to provide the co-financing required by most concessional funding mechanisms. The debt-to-GDP ratio (48.5% in 2023)[217], coupled with growing exposure to non-concessional loans, poses risks to long-term debt sustainability. Moreover, market-based climate financing remains limited due to an underdeveloped green finance ecosystem, lack of ESG (environmental, social, and governance) disclosure frameworks, and weak incentives for private sector participation[218].

Strategic and Policy Misalignment. Although climate objectives are reflected in multiple sectoral plans (e.g., the Energy Master Plan, National Livestock Program, and Water Sector Strategy), they are not fully embedded in national investment planning, medium-term fiscal strategies, or budgeting cycles. This misalignment weakens resource allocation efficiency and overall implementation. Subnational governments—critical for adaptation delivery—lack legal mandates, technical capacity, and fiscal autonomy to design and lead locally tailored climate responses[219].

Geographical and Environmental Barriers. Mongolia's extreme geography and climate vulnerability further exacerbate implementation challenges. With over 76% of its land area affected by desertification and growing exposure to dzuds and droughts, large-scale adaptation efforts require investment volumes well beyond the domestic budget envelope. Infrastructure limitations also pose logistical barriers to technology deployment and service delivery in remote areas.

Integrated Risk Environment. Emerging global risks—including energy insecurity, climate-induced migration, and geopolitical tensions—amplify exposure to systemic shocks. Recognizing these threats, the Government of Mongolia is adopting contingency planning, legal reforms, and institutional preparedness strategies to safeguard developmental gains.

[215] UNFCCC (2019). Modalities, Procedures and Guidelines for the Transparency Framework under Article 13 of the Paris Agreement.
[216] GCF (2023). Readiness Programme Mongolia Country Report.
[217] Ministry of Finance of Mongolia (2024). Macroeconomic Overview Q1 2024
[218] MSFA & FRC (2023). Mongolian Green Finance Progress Report..
[219] UNDP Mongolia (2023). Climate Budget Tagging and Local Government Capacity Study.

4.6.1. Strategic Recommendations

In response to the above challenges, Mongolia is advancing key strategic interventions, which reinforce and build on frameworks in the coming years.

Institutional Reform and Policy Coherence: Expedite the development of the 2022 Climate Change Framework Law to establish clear mandates for climate governance, including institutional reporting responsibilities, sectoral mainstreaming, and coordination under the National Climate Committee[220].

Finance Innovation and Market Development: Scale up efforts to issue sovereign green bonds, operationalize Article 6 cooperation mechanisms, and engage in structured blended finance arrangements. These tools will be essential for mobilizing long-term, low-cost capital and incentivizing private sector participation.

Decentralized Capacity-Building: Establish national training curricula and fiscal transfer mechanisms to build technical and managerial capacity at the aimag and soum levels, enabling subnational governments to independently develop, implement, and monitor climate projects.

Private Sector Engagement and ESG Integration: Strengthen collaboration with the Bank of Mongolia, Financial Regulatory Commission (FRC), and Mongolian Sustainable Finance Association (MSFA) to introduce ESG standards, green taxonomy alignment, and credit enhancement schemes for climate investments in SMEs and cooperatives[221].

4.7. INFORMATION ON FINANCIAL SUPPORT RECEIVED AND NEEDED UNDER ARTICLE 9 OF THE PARIS AGREEMENT

4.7.1. Overview of financial support received (2021–2022)

During the biennial reporting period, Mongolia received USD 301.92 million in climate-related development finance from external sources, according to OECD and national data repositories[222]. This financing supported the implementation of mitigation and adaptation measures identified in Mongolia's Nationally Determined Contribution (NDC), and aligns with national planning priorities and sectoral investment strategies (see Section 3.1).

Support was disbursed through a combination of modalities:

- Multilateral sources accounted for USD 236.89 million, or 78.5% of the total.
- Bilateral sources contributed USD 65.03 million, or 21.5%[223]. By financial instrument:
- Grants constituted USD 116.81 million (38.7%),
- Concessional loans amounted to USD 178.97 million (59.3%), and
- Technical assistance totaled USD 6.16 million (2%)[224].

This financial inflow targeted priority sectors such as energy, water resource management, sustainable agriculture, and ecosystem restoration, supporting both mitigation and adaptation objectives as classified under OECD Rio Marker methodology[225].

220 Ministry of Environment and Climate Change (2024). Climate Change Framework Law.
221 Asian Development Bank (2023). Private Sector Assessment for Climate Finance in Mongolia.
222 OECD (2023). *Climate-related Development Finance, CRS Dataset 2021–2022*. Available at: https://stats.oecd.org/Index.aspx?DataSetCode=CRS1
223 Ministry of Finance of Mongolia (2023). ODAMIS Database: *Climate and Environmental Project Disbursements*, 2021–2022.
224 Government of Mongolia (2024). *Preliminary Climate Finance Needs and Flows Analysis*. Internal document, Ministry of Environment and Tourism.
225 OECD DAC Rio Marker Methodology for Climate-related Development Finance, 2021 Revision.

4.7.2. Key Contributors of Climate Finance

Climate-related support was provided by 17 international public entities, including multilateral development banks and bilateral donors. The top six contributors during the 2021–2022 period was:

Table IV. 2. Support received providers.

№	Provider (Official Name)	Support Received (USD)	Share (%)
1	European Bank for Reconstruction and Development (EBRD)	120,789,675.08	39.99%
2	International Bank for Reconstruction and Development (World Bank)	52,644,551.00	17.44%
3	Green Climate Fund (GCF)	47,803,881.52	15.83%
4	Government of Japan	40,349,307.92	13.36%
5	Government of the Republic of Korea	15,217,122.37	5.04%
6	Asian Development Bank (ADB)	11,727,173.00	3.88%
7	Global Environment Facility (GEF)	3,340,657.32	1.11%
8	Global Green Growth Institute (GGGI)	3,308,440.10	1.10%
9	Government of the Federal Republic of Germany	3,042,625.47	1.01%
10	Government of the United States of America	867,602.58	0.29%
11	Government of Australia	860,214.49	0.28%
12	Government of Switzerland	602,424.16	0.20%
13	Food and Agriculture Organization of the United Nations (FAO)	587,130.23	0.19%
14	Government of the United Kingdom of Great Britain and Northern Ireland	388,958.45	0.13%
15	Government of Canada	242,009.23	0.08%
16	Government of the Czech Republic	179,667.61	0.06%
17	Government of the French Republic	6,586.14	0.002%
	Total	301,958,026.70	100.00%

Additional financial and technical assistance was received from the Global Environment Facility (GEF), Global Green Growth Institute (GGGI), Government of Germany (GIZ/KfW), and other OECD Development Assistance Committee (DAC) members, contributing the remaining 4.45%[226].

The significant share from multilateral institutions highlights their central role in Mongolia's climate finance landscape. However, the current distribution indicates a reliance on concessional loans over grants, emphasizing the importance of strengthening project bankability, increasing absorptive capacity, and diversifying sources—especially for technology deployment and institutional capacity-building[227].

[226] OECD CRS (2023). Bilateral and Multilateral Provider Breakdown by Recipient Country – Mongolia, 2021–2022.
[227] MET and UNDP (2022). Technology Needs Assessment and Capacity Building for Climate Finance Access – Mongolia. Ulaanbaatar.

4.7.3. Main types of financial support

Table IV.2. illustrates the distribution across various sectors. The largest share, 29.72% (USD 89.77 million), was allocated to "Other" activities, covering multi-sectoral and unspecified initiatives that support environmental and policy reforms. The energy sector accounted for 24.48% (USD 73.90 million), emphasizing renewable energy and efficiency. Agriculture received 20.99% (USD 63.41 million), focusing on climate resilience in rural livelihoods.

Transport (13.58%, USD 41.01 million) and infrastructure (6.63%, USD 20 million) supported sustainable development and emissions reduction. Smaller investments were directed to manufacturing (0.99%, USD 3 million), industry (0.57%, USD 1.73 million), and water and sanitation (0.33%, USD 0.99 million), highlighting emerging areas for green transformation. Cross-cutting programs, integrating adaptation, mitigation, and capacity building, represented 2.70% (USD 8.15 million). This distribution indicates a balanced yet sector-specific approach, with notable gaps in critical areas like water and waste management.

Table IV. 3. Support received by sector.

№	Sector	Support Received (USD)	Share (%)
1	Agriculture	63,411,702.92	20.99%
2	Other (unspecified or multi-sectoral)	89,767,613.86	29.72%
3	Energy	73,902,805.18	24.48%
4	Transport	41,007,922.78	13.58%
5	Infrastructure (general)	20,000,000.00	6.63%
6	Cross-cutting (multi-sectoral programs)	8,148,534.68	2.70%
7	Manufacturing	3,000,000.00	0.99%
8	Industry (non-manufacturing)	1,730,184.14	0.57%
9	Water and Sanitation	989,263.15	0.33%
	Total	301,958,026.70	100.00%

In 2021–2022, climate-related support for Mongolia was dominated by debt-based financing, accounting for 59.29% (USD 178.97 million), mainly through concessional loans for clean energy and climate infrastructure. Grants made up 38.69% (USD 116.82 million), focusing on adaptation, capacity building, and projects in agriculture and rural development. Technical assistance, though smaller at 2.04%, was vital for institutional capacity and policy implementation. Increasing grants and technical support, particularly for feasibility studies and technology assessments, could enhance Mongolia's capacity to meet its climate commitments.

Table IV. 4. Support received by financial instrument

№	Financial Instrument	Support Received (USD)	Share (%)
1	Grant	116,817,227.60	38.69%
2	Debt Instrument (Loan)	178,974,451.10	59.29%
3	Technical Assistance	6,166,948.00	2.04%
	Total	301,958,026.70	100.00%

Source: OECD Development Finance for Climate and Environment[228]

[228] OECD temporary archive

Between 2021 and 2022, nearly half of Mongolia's climate-related funding (49.46%) focused on mitigation, supporting emissions reduction in energy, transport, and industry. Cross-cutting initiatives, integrating adaptation and mitigation, accounted for 39.84%, reflecting a preference for comprehensive approaches. However, adaptation-specific financing was only 10.70%, highlighting the need to increase funding for vulnerable sectors like agriculture, water, and rural livelihoods to strengthen climate resilience against extreme weather, desertification, and water scarcity.

Table IV. 5. Support received by type of support.

№	Type of Support	Support Received (USD)	Share (%)
1	Adaptation	32,296,363.90	10.70%
2	Mitigation	149,308,552.95	49.46%
3	Cross-cutting	120,353,709.84	39.84%
	Total	301,958,026.70	100.00%

Source: OECD Development Finance for Climate and Environment[229]

The largest share 59.59% (USD 179.9 million) was dedicated to technology development and transfer. This reflects growing recognition of the critical role of clean technologies in supporting Mongolia's green transition, particularly in sectors such as energy, agriculture, and water.

Capacity building accounted for 31%, essential for strengthening institutional and human resource capabilities for effective climate action. The remaining 9.40% supported other objectives like partnerships and policy innovation. This balanced allocation reflects a strategic investment in systems and tools critical for Mongolia to achieve its climate goals effectively.

Table IV. 6. Contribution to technology and capacity development and transfer objectives

№	Objective	Support Received (USD)	Share (%)
1	Technology Development and Transfer	179,935,388.30	59.59%
2	Capacity-Building	93,624,843.88	31%
3	Other Cross-Cutting Objectives	28,397,794.52	9.40%
	Total	301,958,026.70	100.00%

Source: OECD Development Finance for Climate and Environment[230]

4.8. INFORMATION ON FINANCIAL SUPPORT NEEDED

This chapter outlines Mongolia's projected financial needs for 2024–2028, as detailed in the Government Action Plan, aligned with Vision 2050 and the New Recovery Policy.

The financial needs to realize these priorities are substantial and span both mitigation and adaptation actions. These requirements are closely linked to the country's NDC targets

[229] OECD temporary archive
[230] OECD temporary archive

and long-term strategies for low-emission development. As Mongolia seeks to scale up its climate ambition, securing adequate financial resources both domestic and international will be critical to bridging the implementation gap.

The estimated financial requirement of USD 11.5 billion refers exclusively to the climate-specific financing needs identified under Mongolia's Nationally Determined Contribution (NDC) for the implementation of mitigation and adaptation actions in accordance with the Paris Agreement.

This amount does not represent Mongolia's total climate-related financing needs. The broader financing requirement associated with addressing climate change across national policies, sectoral strategies, and development programmes is estimated at USD 22.47 billion, reflecting the scale of investment needed beyond the scope of the NDC alone.

Environmental commitments are being strengthened through initiatives like the "Billion Trees" National program and carbon credit systems to attract green finance and support a low-emission development pathway[231]. Energy sector reforms are finally advancing, enabling large-scale industrial and urban projects while integrating climate resilience and sustainability into Mongolia's growth strategy[232].

Mongolia is implementing a comprehensive economic reform agenda aimed at fostering sustainable growth, enhancing national competitiveness, and ensuring long-term economic resilience. Key strategic initiatives include increasing coal export capacity to 100 million tons annually, completing critical cross-border railway infrastructure, and modernizing port operations through digitization. These efforts are complemented by structural reforms in the energy sector, which are essential for driving industrialization, regional development, and the establishment of new urban centers.

To support this transformation, Mongolia is advancing economic liberalization through the revision of foundational legal frameworks, including the Laws on Investment, Trade, and Bankruptcy. These reforms are designed to establish a more transparent, predictable, and business-friendly environment. Concurrently, the government is reducing state involvement in competitive markets, improving the efficiency of public investment planning through the application of big data and artificial intelligence, and fostering greater private sector engagement. These measures are expected to strengthen fiscal discipline, enhance the quality of public service delivery, and accelerate economic diversification[233].

A cornerstone of these reforms is the long-anticipated restructuring of the energy sector—an essential step toward modernizing Mongolia's infrastructure and supporting broader development objectives. This transformation will be accompanied by several high-impact mega projects aimed at accelerating industrial development, enhancing regional connectivity, and fostering sustainable urbanization."

Table IV.7 outlines the distribution of financial support required across different sectors. The energy sector, accounting for 48.57% of the total, reflects the significant investment needed to transition from fossil fuels to renewable energy sources. Mining (29.29%) and water and sanitation (12.58%) together represent over 41% of the total support, underscoring the challenge of decarbonizing key economic sectors through cleaner technologies and minimizing environmental impacts. Water and sanitation (12.58%) and urban planning (5.89%) emphasize the crucial link between climate adaptation and access to public services,

231 Government of Mongolia. Zero Carbon City International Forum 2023. Synergies Of Decarbonization and Resilience PowerPoint Presentation

232 Institute for Strategic Studies. January 25, 2024. Mongolia's One Billion Trees Campaign: A Bold Step Against Climate Change and Desertification

233 Hanns Seidel Foundation. Promoting The Rule of Law in Mongolia. Democracy and Law in Constant Change. 2023-05_Factsheet_Law_en.pdf

particularly in urban and rapidly developing areas. Lower levels of support are projected for forestry (0.60%), agriculture (0.41%), biodiversity (0.0002%), and waste management (0.0053%). However, targeted investments in these nature-based sectors could deliver substantial environmental benefits over the long term. Strategic investments are urgently needed in underfunded areas such as climate-resilient infrastructure (0.61%), GHG monitoring (0.0114%), and ecosystem.

Table IV. 7. Support needed by sector.

№	Provider (Official Name)	Support Needed (USD)	Share (%)
1	Energy	10,918,488,652.72	48.5731
2	Mining	6,583,470,309.00	29.2879
3	Water and sanitation	2,826,824,388.81	12.5757
4	Urban planning	1,323,228,557.00	5.8866
5	Transport	219,779,086.89	0.9777
6	Multi sector	185,186,980.85	0.8238
7	Infrastructure	138,171,899.85	0.6147
8	Forestry	134,683,122.00	0.5992
9	Agriculture	91,978,733.43	0.4092
10	Industry	47,278,350.52	0.2103
11	Other (Environmental protection)	5,590,574.00	0.0249
12	Other (GHG)	2,562,592.00	0.0114
13	Other (Waste)	1,192,931.00	0.0053
14	Other (Biodiversity)	44,183.00	0.0002
	Total	22,478,480,361.07	100.00%

4.9. INFORMATION ON SUPPORT FOR TECHNOLOGY DEVELOPMENT AND TRANSFER RECEIVED AND NEEDED UNDER ARTICLE 10 OF THE PARIS AGREEMENT

This section addressed Mongolia's progress in mobilizing and utilizing technological support and need in accordance with Articles 10 of the Paris Agreement.

4.9.1. Technology development and transfer need

Technology Development and Transfer. Mongolia has clearly outlined its needs for technology development and transfer to support a green transition across key sectors—namely energy, agriculture, water resources, and mining. These priorities are rooted in national planning frameworks, including Vision 2050 and the New Recovery Policy.

Currently, feasibility studies are underway to identify the most suitable technologies for the country's context. Although specific cost estimates are not yet available, Mongolia anticipates that substantial investments will be required to introduce, absorb, and sustain advanced technologies. Moreover, the success of this transition will depend heavily on international cooperation, particularly for facilitating technological access, knowledge sharing, and technical assistance during this early planning stage.

In the area of technology development and transfer, Mongolia has prioritized low-carbon technologies in the energy, water, agriculture, and mining sectors. Initiatives include grid modernization, geothermal heating, solar and wind energy, smart irrigation, and clean mining technologies. Feasibility studies are ongoing to assess cost-effectiveness and applicability, with further support needed for scaling.

4.9.1.1. Energy sector

Coal is the primary energy source in Mongolia, accounting for most of the power and heating, and resulting in significant air pollution and GHG emissions. In 2021, coal comprised 70.8% of total energy supply and 96.3% of electricity generation[234]. Over 70% of the population relies on coal or wood stoves for heating, contributing to severe health impacts[235].

Space heating, essential due to long, harsh winters, makes up 35% of final energy demand. District heating (DH) is limited, and the infrastructure is outdated. Power generation is largely domestic, supplemented by imports from Russia and China, with regional grids operating independently. Major mines in the South Gobi remain off-grid and rely on power from China[236].

There is an urgent need to modernize energy infrastructure, reduce coal use, and scale up renewables. Mongolia has vast wind and solar potential, but development is constrained by limited transmission capacity. Up to 50% of heat pipelines are in poor condition, requiring significant investment. Future energy planning must align with climate goals to avoid stranded assets and ensure long-term sustainability.

Technological solutions and actions needed for the Energy sector.

1. Promote Energy Efficiency and Heat Pumps Implement energy efficiency measures—including reducing grid and network losses—and promote heat pumps to lower energy demand and emissions. A well-planned relocation of ger residents to energy-efficient apartments can maximize gains. Energy efficiency must be integrated into national development strategies, with a focus on building installation capacity for new technologies.
2. Enhance Grid Capacity and Integrate Energy
   Storage Strengthening grid infrastructure and flexibility to enable renewable energy deployment, particularly in the south. Mines could serve as anchor clients for renewables. Distributed generation and smart grids can help manage supply variability and seasonal stress on the energy system.
3. Adopt Long-Term Net-Zero Energy Planning
   Develop systematic, adaptive, and continuous energy system planning aligned with net-zero goals. This requires capacity building for institutions and adopting international best practices for scenario-based planning.
4. Reform Tariffs to Ensure Cost Recovery and Protect Vulnerable Groups
   Gradually increase electricity and heating tariffs to achieve full cost recovery by 2030. Design subsidy mechanisms to be more progressive, with targeted support for low-income households using cross-subsidies and geographical targeting where needed.

234 IEA. Mongolia - Countries & Regions - IEA
235 ADB. 02 June 2020. Unlocking Mongolia's Rich Renewable Energy Potential
236 Climate Scope by Bloomberg NEF. Leaning on coal despite abundant renewable resources. Climatescope 2024 | Leaning on coal despite abundant renewable resources.

5. Clarify Public and Private Sector Roles in Renewable Energy
   Government should focus on enabling private investment in generation, while public finance and PPPs support network expansion and modernization. Strengthen the commercial viability of utilities through improved performance.

6. Creating an Enabling Market Environment for Private Investment. Attract private and climate finance through competitive procurement, regulatory transparency, and transitioning from a single-buyer model to a competitive electricity market. Improve licensing, dispute resolution, and investor confidence.

7. Invest in R&D and Monitor Technological Trends
   Support pilot projects and invest in research to identify context-specific clean energy solutions—especially for high-emission areas like ger districts. Track global trends to scale technologies as costs fall and effectiveness improves[237].

Table IV. 8. Technological solutions for the Energy sector

№	Solutions
1	Passive house, Hybrid house
2	Energy-Efficient Insulation: Utilizing high-performance materials to reduce energy use
3	Sustainable Building Materials
4	Agricultural Waste Utilization: Transforming organic waste into compost and biofuels
5	Hybrid Solar-Wind Systems: Combining solar PV and wind turbines to ensure energy resilience
6	Battery Storage: Supporting consistent energy supply during outages or extreme weather
7	Biofuel Production: Utilizing organic materials to generate renewable energy and reduce carbon emissions
8	Hydroelectricity
9	Geothermal Heat Pumps
10	Waste to energy technologies

4.9.1.2. Agriculture sector

The agrifood system is important for Mongolia's economy but is characterized by a vicious cycle of low productivity and high vulnerability to climate extremes. Approximately one-third of Mongolia's labor force is employed in the country's agrifood system (FAO 2024b), which accounts for 13 percent of GDP (World Bank 2024a), and livestock accounts for about 80 percent of gross agricultural output and one-quarter of all jobs (FAO 2024c). The country's harsh, cold, and dry continental climate; extreme weather condition; short growing seasons; and long snowy winters impose severe limitations on farmers and herders.

Under the predominant extensive pastoral system, with long winter months and extreme cold conditions, large ruminants like cattle take an average of two to three years longer than global meat producers to reach the culling weight (UNCTAD 2021). This is because of weight loss during winters, cultural reluctance to cull young animals, and the need for regular income flows from animal products such as milk and wool. Moreover, culling is limited to a single season unlike in nontraditional systems, resulting in greater accumulation of animals. Current livestock numbers vastly exceed carrying capacity of Mongolia's rangelands,

[237] http://www.energy.gov.mn/

and herd sizes are further increasing. As a result, overgrazed pastures, reduced fodder availability, and poor animal health and hygiene have contributed to deteriorating nutritional status and productivity of livestock[238].

Meanwhile, Mongolia's sizable forests have been and continue to have the potential to act as powerful carbon sinks, but this will require strengthened management[239].

Technological solutions and actions needed for the Agricultural sector:

1. Reform agricultural incentives and taxes. There are three key priorities here. First is to condition the program of subsidized loans on the uptake of climate-smart practices, improved stocking management and planning, sustainable grassland management, and enhanced product quality while strengthening investment in public goods, such as research and development (R&D) and agriculture extension services. Second is to reorient other direct subsidies toward less distorting government support measures, such as decoupled income support or payments for eco-services. Third is a redesign of the livestock head tax to better mobilize resources at the local level and internalize the environmental costs of overgrazing. A redesigned tax would include simple and science-based criteria for setting the taxation rate. Compliance and enforcement of the tax could be enhanced by improving local governance capacity and raising awareness among taxpayers on the benefits. Small-scale herders need special consideration and support to minimize negative impacts and tax avoidance. The herders could be compensated through income support schemes or by way of payment vouchers.
2. Provide technical assistance and investments to enhance productivity and increase product commercial offtake rates of dominant livestock production systems. Productivity can be improved through selective breeding strategies (climate-resilient breeds and low CH_4 emitting animals), ration balancing (grazing with feed supplementation), and nutritional diet for livestock. Nutritious diets can be implemented through a network of fodder, forage, and hay production storage sites and strategically located feed-hubs in aimags, which can promote good animal husbandry, particularly around winter herding practices, and enhanced animal health and hygiene management.
3. Improve the cooperation between the development of combined forestry and pasture user groups to foster agreement on how forest areas can be restored. Unless overgrazing is controlled in forest regeneration and plantation areas, the planted areas will fail. When the plantations are new and newly fenced, the initial plantings will survive but over time the fences might be cut, or the plantations burned to increase the amount of pasture available. If the overgrazing and fire can be kept out of forest areas, it is likely that reforestation would occur through natural regeneration, avoiding costly replanting. At the same time, there are significant opportunities to improve forest conditions through silvicultural thinning and maintenance. This can provide income-generating activities for local communities and opportunities for private sector investment in processing capacity.
4. Identify cost-effective locations for tree planting, landscape-level forest restoration, and fire management and mobilize private sector finance. Large-scale tree planting and reforestation programs are expensive and complex undertakings that require many years to implement and long-term maintenance. If unplanned, planting may occur where

238 Agricultural sector introduction. 2022
239 https://www.mofa.gov.mn/

it is easiest but not where it is most appropriate or needed. Key issues to be addressed, under the leadership of the country's forestry administration, include enhancing forest fire early warning detection and prevention systems, improving forest extension services particularly with respect to managing the nexus between rangeland and forests, as well as implementing Mongolia's reforestation and afforestation plans.

5. Enhance seed processing capacity. Appropriate tree species, quality seeds/ saplings, and planting techniques are underdeveloped, as are demonstration plots and resources for training forest agencies and FUGs. Reafforestation requires good quality planting stock and this needs to be raised from seeds of known origin, sourced from good quality or plus trees. Seeds, once collected, need to be treated, stored, and tested correctly. The traceability of the origin of seed sources is increasingly important with the changing climate. It is necessary to plant good quality seedlings of the right species with the right provenance in the right location. It is therefore important that seed processing capacity is enhanced.

Table IV. 9. Technological solutions for the Agricultural sector

№	Solutions
1	On-Grid, Off-Grid Solar energy system
2	Solar-powered drip irrigation
3	Dust suppression systems and vegetative barriers to reduce dust emissions and enhance air quality
4	Climate-Resilient Crops: Development and use of crop varieties that can withstand extreme weather conditions
5	Community Seed Banks: Preservation of local seed varieties to enhance food security.
6	Artificial insemination (AI) and crossbreeding
7	Advanced forest fire detection systems
8	Drone reforestation
9	Blockchain for Carbon Credits
10	Sustainable farming techniques that promote biodiversity and soil health.

4.9.1.3. Water sector

Mongolia's varied geography presents a wide spectrum of water availability from the Gobi Desert to glaciers and grassland. Precipitation within Mongolia is nonuniform, ranging from a yearly average of 350 mm in the north to 80 mm in the south[240]. While overall the country has a high-water endowment, there are important spatial heterogeneities that lead to local hotspots of water insecurity in the country's key economic centers: UB and the Gobi region. Two specificities set Mongolia apart. First, the country relies heavily on groundwater for both household (99 percent of drinking water comes from groundwater) and industrial use, despite having plentiful surface water. This heavy reliance on groundwater stems from the spatial mismatch between where surface water is available and where it is needed and the extreme climate through the year (permafrost, seasonal freezing, and droughts) which makes surface

[240] Overview Of Mongolia's Water Resources System and Management A Country Water Security Assessment. July 2020

water a less reliable source. Second, Mongolia has set itself high requirements for maintaining ecological flows the amount of water that needs to be retained in the environment to maintain ecosystem services. However, these need to be updated and prioritized and require improved enforcement[241].

With a changing climate, existing pressures on Mongolia's water resources are likely to increase with a growing mismatch between water needs and availability. Water use in agriculture will likely increase, especially if overgrazing continues unchecked while a booming mining industry in the south and eastern parts of the country is going to increasingly involve greater water withdrawals and water pollution risks. Measures to maintain and improve water quality are critical as climate change and growth increase the pressure on ground and surface waters. Water is insufficiently valued across its uses, compromising the sector's financial sustainability and climate-resilient water resource management. Water quality is recognized as a priority but, despite the legal introduction of a water pollution fee, implementation has faced hurdles[242].

Technological solutions and actions needed for water sector.

1. Improve agricultural water use efficiency by rehabilitating existing irrigation infrastructure, implementing demand management instruments, integrating livestock water points with livestock extension, and involving herders in the management of rangelands.
2. Conduct a review of options to improve the management of water usage fees and the implementation of the water pollution fee.
3. Manage climate risks across the drought to flood spectrum starting with ensuring that environmental flows are sufficiently considered ahead of irrigation and storage infrastructure expansion.
4. Increase use of treated wastewater in urban industries and extend water kiosks in rural areas to help increase access to water for domestic use.
5. For the mining sector, reducing pressures on freshwater sources by augmenting wastewater in operations and improving efficiency in water use while gradually reducing freshwater water use in mining over time constitute low-risk options and their feasibility should be explored.

Table IV. 10. Technological solutions and actions for the Water sector

№	Solutions
1	Solar-Powered Drip Irrigation
2	Desalination Systems: Solar-powered desalination to provide potable water from saline sources
3	Solar Water Pumps: Centrifugal or submersible pumps for irrigation.
4	Greywater treatment systems
5	Biochar Production: Enriches soil quality, retains water, and supports carbon sequestration
6	Satellite and Remote Sensing Technology
7	Light Detection and Ranging for Peatland
8	Satellite Monitoring for Peatland
9	Biochar Production: Enriches soil quality, retains water, and supports carbon sequestration

[241] Esha Zaveri and Rochi Khemka. Seeing the invisible: Disrupting groundwater monitoring in Mongolia April 06, 2022
[242] Water Authority. Official website https://water.gov.mn/

4.9.1.4. Mining sector

Mining plays a critical role in the Mongolian economy, and its significance has steadily increased since the mid-2000s. The prospects for Mongolia's mining sector depend on the pace of the global and especially China's low-carbon transition. While about three-quarters of Mongolia's domestic coal production is exported to China, Mongolia's exports of high-quality coking coal make up a small share of China's total consumption. Coking coal is used mostly in steel production.

A lack of technological alternatives means that coal will be needed for steel production into the 2030s, but demand could decline thereafter. Steel demand in China will likely continue to grow in the medium term, even so at a slower pace as recent demand reductions from the Chinese property sector are being offset by higher demand for steel for car manufacturing (EV) and infrastructure investment, including in the power sector (wind turbines, grid, and so on), flood protection and urban infrastructure, and higher steel exports. For now, the most additional demand will be met using coal-based technology. However, if China is to meet its own carbon neutrality goals, electricity and, potentially, hydrogen-based technologies will gradually displace coal-based production over time. Model projections based on China's stated projections suggest that, by 2050, decarbonization could reduce coal use in Chinese steel production by 45 percent, with a more pronounced decline following. In such a scenario, current coal production levels in Mongolia would surpass long-term capacity needs by 30 percent. New (and forthcoming) infrastructures connecting coal mines to trading routes thus face the risk of becoming stranded assets. It is also possible that China would prioritize domestic production if demand for coking coal started to decline[243].

A loss of coal exports would have a substantial impact on GDP and employment in Mongolia. A global low-carbon transition would increase demand for other minerals, some of which Mongolia could exploit, contingent upon its ability to effectively transport its products to market. Model projections suggest that the low-carbon transition could increase demand for a range of valuable minerals by factors of 2 to 5. If lithium remains the dominant chemical in batteries, its demand could increase by even more. There is therefore an opportunity for Mongolia to expand non-energy mining production if it can match its domestic supply to global demand.[244, 245]

The largest opportunity for increased mining production in Mongolia is in copper. Copper is already Mongolia's second-largest mineral industry, and it is poised for significant expansion. Expansion of the OT copper mine, one of the world's largest, from open-pit mining to underground operations could more than double its 2023 annual production by 2025 and continue expanding henceforth[246]. The OT operation is anticipated to continue until at least 2055. Transporting copper is easier than transporting coal, but water scarcity could hamper further production expansion[247]. Increased copper exports could offset some of the production value lost from coal. Initial investment in uranium could boost the Mongolian economy, but long-term production will not offset the potential loss of coal exports without further policy reform. Growth in other critical mineral extraction will make at most a small contribution to Mongolia's economy. The potential for developing rare earth extraction in Mongolia is tempered by uncertainties regarding the quality and commercial viability of deposits. Regulatory uncertainty may be deterring external investment. New mining

[243] Global Energy Monitor. March 18, 2024. Shift in how China uses and develops its steel capacity can cut sector emissions 11%. Report

[244] International Roundable Of Mining Associations. Concept Paper. Mongolian National Mining Association. May 21, 2024

[245] Dagva Myagmarsuren. Advancing Critical Mineral Development in Mongolia

[246] Rio Tinto Official website. Oyu Tolgoi | Global

[247] Resource Governance Institute. 2025. Copper Sector Expansion in Mongolia: Opportunities and Challenges Report

operations must be sustainable and in line with global environmental and social standards[248].

Technological solutions and actions for the Mining sector

1. Prepare for an eventual reduction in demand for coking coal and position the country as a global supplier of other minerals and related services. The prospects for coal demand depend on China and preparations for an eventual coal phase-out should begin now. Expanded copper production could offset some of the losses from coal, as could the development of a mining services industry. Prospects for expanding production of other minerals are less clear but could attract FDI into the country.
2. Accelerate mineral exploration to reduce uncertainties for investors. The quality of deposits of several important minerals, including rare earths, remains unclear. Until commercial viability is established, it will be difficult to attract private sector investment. Delaying exploration risks missing the opportunity to set up operations while demand and prices are high.

Table IV. 11. Technological solutions and actions for the Mining sector

№	Solutions
1	Dust lock
2	Electric Vehicles in Mining
3	Dry fog system
4	Coal liquefaction technology
5	Altering the mechanical properties of soil through the use of lake mud
6	Converting methane into electricity
7	Carbon Dioxide Fixation Technology Using the Weathering Process of Mining By-products – CO_2 FIX

4.10. INFORMATION ON CAPACITY-BUILDING SUPPORT RECEIVED AND NEEDED UNDER ARTICLE 11 OF THE PARIS AGREEMENT

4.10.1. Capacity Building Needs

Capacity building remains a fundamental pillar of Mongolia's climate strategy. Effective implementation of its NDCs, development goals, and resilience plans hinges on addressing persistent institutional and technical capacity gaps. These challenges are present at multiple levels of governance from central ministries to provincial administrations and local communities. To ensure a whole-of-society response to climate change, Mongolia requires sustained support for capacity development. This includes strengthening institutional frameworks, enhancing data, and monitoring systems, building sectoral expertise, and empowering civil society to contribute to climate action.

Information on financial support needed in the areas of technology development and transfer, and capacity-building is summarized and can be further reviewed in Table 1 of Appendix 4.

[248] Ministry of Mining and Heavy Industry. Sector Policy. https://mmhi.gov.mn/

4.10.2. Capacity-building support received

In accordance with Article 11 of the Paris Agreement, Mongolia prioritizes capacity-building as a cornerstone of its sustainable development and climate resilience agenda. The government has implemented diverse measures across human development and governance sectors, aligned with national development policies and the 2024–2028 Action Plan. These initiatives aim to strengthen institutional performance, human capital, digital governance, and public service delivery while addressing climate and socio-economic challenges.

The information on capacity building support received is summarized and can be further reviewed in Table 2 of Appendix 4.

Mongolia's capacity-building initiatives underscore its commitment to integrating sustainable development with institutional reform and human capital investment. With sustained international support and strategic national leadership, the country is poised to strengthen its adaptive capacity and fulfill its obligations under the Paris Agreement. These efforts not only build resilience to climate change but also establish a foundation for a more inclusive, knowledge-based, and responsive governance system.

4.10.3. Human Development Policy Measures

Under Mongolia's human development policy, several initiatives have been launched to improve education, healthcare, and youth empowerment:[249]

- A national education program is being developed to align with digital transformation goals while reinforcing Mongolian language, history, culture, and civic values.
- The education system is being restructured to enhance soft skills, scientific competencies, and problem-solving abilities among students.
- Big data is utilized to forecast labor market trends, enabling targeted workforce development[250].
- Mobile-based awareness campaigns and digital health promotion aim to reduce major public health risks, such as noncommunicable diseases and unhealthy lifestyles.
- Health services are being digitized through artificial intelligence, telemedicine, and electronic health records.
- The pharmaceutical sector is being reformed with a national integrated system for medicines and medical devices, aligned with international standards.
- The "Year of Youth" in 2025 will focus on legal and institutional reforms to enhance youth employment, innovation, and civic engagement.
- E-Systems are being developed to monitor physical development, improve access to sports and wellness infrastructure, and promote healthy lifestyles[251].

249 Parliament of Mongolia. "Vision-2050" Long-Term Development Policy of Mongolia. Annex 1 to Resolution 52, 2020
250 WB. Agenda for Action: Key Policy Recommendations for Mongolia's Sustainable Development Vision Aug 28, 2024
251 Government of Mongolia. Action plan 2024-2028

4.10.4. Governance Policy and Institutional Strengthening

Mongolia is advancing a rights-based governance approach, emphasizing transparency, digital public services, anti-corruption, and institutional reform:

- National legislation is being harmonized with international human rights treaties, while redundant or outdated regulations are being streamlined.
- Anti-corruption measures include simplified reporting systems and enhanced protections for whistleblowers.
- Judicial processes are being digitized to improve efficiency, transparency, and public trust in the legal system[252].
- The "E-Mongolia" platform and AI-driven public service delivery are expanding to reduce human discretion in administrative processes[253].
- Governance of state and local-owned enterprises is being reformed to ensure operational independence and alignment with international practices.
- International technical assistance supports civil service reform through Design, Monitoring, and Evaluation (DME) frameworks and performance-based assessments.
- Civil servant capacity-building includes advanced foreign language training and scholarships abroad for high-performing employees.
- Government funding mechanisms are being digitized to enhance transparency and fairness in the disbursement of special-purpose funds[254].

4.11. INFORMATION ON SUPPORT NEEDED AND RECEIVED BY DEVELOPING COUNTRY PARTIES FOR THE IMPLEMENTATION OF ARTICLE 13 OF THE PARIS AGREEMENT AND TRANSPARENCY-RELATED ACTIVITIES, INCLUDING FOR TRANSPARENCY-RELATED CAPACITY-BUILDING.

Mongolia has been receiving technical and financial support from international organizations to strengthen its national climate transparency capacity. These efforts cover the following areas: improving the monitoring, reporting, and verification (MRV) system for the national greenhouse gas (GHG) inventory and mitigation/adaptation measures; establishing a monitoring mechanism for the implementation of the Nationally Determined Contribution (NDC) in line with the Enhanced Transparency Framework (ETF); and building institutional capacity to regularly prepare and report Biennial Transparency Reports (BTRs) at the international level [255].

In addition, Mongolia recognizes the need to establish a digital climate information platform that integrates data from key sectors such as energy, environment, and water resources to support climate data access and decision-making[256].

With support from the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF), Mongolia is preparing its First Biennial Transparency Report (BTR1) and Fourth National Communication (NC4), scheduled for submission to the UNFCCC by the end of 2024. These efforts have improved the country's capacity to consolidate, and report

252 Generis Global. Recent Legal Reforms in Mongolia: A Comprehensive Review. Nov 23, 2024. A Comprehensive Review
253 Generis Global. Recent Legal Reforms in Mongolia: A Comprehensive Review. Nov 23, 2024. A Comprehensive Review
254 Delegation of the European Union to Mongolia. Mongolia: Overview of the human rights and democracy situation. 01.08.2023 EEAS
255 UNFCCC. (2018). Modalities, Procedures and Guidelines for the Enhanced Transparency Framework. Decision 18/CMA
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detailed information on GHG inventories, mitigation measures, and adaptation strategies.

With support from GIZ, preliminary steps have been taken to strengthen the MRV system and to develop an integrated, cross-sectoral climate information database. However, these systems are not yet fully operational and remain in the pilot or development phase[257]. The MRV methodology for the transport sector has been developed and approved, while methodologies for other key sectors such as energy, land use, and agriculture are currently under development and testing.

Through the European Union's SECCA initiative, training and technical recommendations have been provided to improve climate data integration and reporting in the energy sector[258]. Regional collaboration with CAREC and the Initiative for Climate Action Transparency (ICAT) is underway to align reporting methodologies and information-sharing systems[259]. Under the SPACES project, UNEP, UNDP, and national research institutions are jointly conducting analysis, methodology development, and training on integrated climate and biodiversity reporting[260].

Going forward, additional support is needed to:

- Develop methodologies and technical documentation for MRV and ETF implementation;[261]
- Conduct training and capacity-building programs for national and local experts on data processing, analysis, and reporting;
- Establish a centralized digital climate information platform and regional climate training centers;
- Carry out public outreach and awareness campaigns to enhance the participation of citizens, NGOs, the private sector, and local communities.

257 GIZ & Ministry of Environment and Tourism. (2021). Strengthening Climate MRV in Mongolia.
258 European Union. (2023). SECCA Project Technical Support Reports.
259 CAREC & Initiative for Climate Action Transparency (ICAT). (2022). Regional MRV Systems Development.
260 SPACES Project Partners. (2023). Integrated Climate-Biodiversity Reporting Toolkit.
261 Ministry of Environment and Tourism. (2024). Draft Guidelines for MRV and ETF Implementation

NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

Appendix I. 1. *Methodological tiers used in the national GHG inventory.*

№	Categories	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6		NF_3	
		Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
1	**ENERGY**														
1.A.1.	**ENERGY INDUSTRIES**														
1.A.1.a.	Main activity electricity and heat production	NA		NA		NA									
1.A.1.a.i.	Electricity generation	T1, T2	D,CS	T1	D	T1	D								
1.A.1.a.ii.	Combined heat and power generation	T1, T2	D,CS	T1	D	T1	D								
1.A.2.	**MANUFACTURE OF SOLID FUELS AND OTHER ENERGY INDUSTRIES**														
1.A.1.c.ii.	Other energy industries	T1, T2	D,CS	T1	D	T1	D								
1.A.3.	**TRANSPORT**														
1.A.3.a.	Civil aviation														
1.A.3.a.ii.	Domestic aviation	T1	D	T1	D	T1	D								
1.A.3.b.	Road transportation														
1.A.3.b.i.	Cars	T1	D	T1	D	T1	D								
1.A.3.c.	Railways	T1	D	T1	D	T1	D								
1.A.4.	Other sectors														
1.A.4.a.	Commercial/Institutional	T1, T2	D,CS	T1	D	T1	D								
1.A.4.b.	Residential	T1, T2	D,CS	T1	D	T1	D								
1.A.4.c.	Agriculture/Forestry/Fishing/Fish farms	NA		NA		NA									
1.A.4.c.i.	Stationary	NA		NA		NA									
2	**INDUSTRIAL PROCESSES AND PRODUCT USE**														
2.A.	**MINERAL INDUSTRY**														
2.A.1.	Cement production	T1	D												
2.A.2.	Lime production	T1	D												
2.C.	**METAL INDUSTRY**														

2.C.1.	Iron and steel production	T1	D														
2.D.	Non-energy products from fuels and solvent use																
2.D.1.	Lubricant use	T1	D														
2.F.	**Product uses as substitutes for ozone depleting substances**																
2.F.1.	Refrigeration and air conditioning									IE, NE, NO		IE, NE, NO		NO		NO	
2.F.1.a.	Refrigeration and stationary air conditioning									T1	D						
2.F.1.b.	Mobile air conditioning									IE, NO				NO		NO	
2.F.2.	Foam blowing agents									T1	D						
2.F.3.	Fire protection									T1	D						
2.F.4.	Aerosols									T1	D						
3	**AGRICULTURE, FORESTRY AND OTHER LAND USE**																
3.A.	**LIVESTOCK**																
3.A.1.	**ENTERIC FERMENTATION**																
3.A.1.a.	Cattle			T1	D												
3.A.1.a.ii.	Other cattle			T1	D												
3.A.1.c.	Sheep			T1	D												
3.A.1.d.	Goats			T1	D												
3.A.1.e.	Camels			T1	D												
3.A.1.f.	Horses			T1	D												
3.A.1.h.	Swine			T1	D												
3.A.2.	**MANURE MANAGEMENT**																
3.A.1.a.	Cattle			T1	D												
3.A.1.a.ii.	Other cattle			T1	D												
3.A.1.c.	Sheep			T1	D												
3.A.1.d.	Goats			T1	D												
3.A.1.e.	Camels			T1	D												
3.A.1.f.	Horses			T1	D												
3.A.1.h.	Swine			T1	D												
3.A.1.i.	Poultry			T1	D												
3.B.	**LAND**																
3.B.1.	FOREST LAND																

3.B.1.a.	Forest land remaining forest land			T1	D										
3.B.1.b.ii.	Grassland converted forest land			T1	D										
3.B.3.	**GRASSLAND**														
3.C.	**AGGREGATE SOURCES AND NON-CO2 EMISSIONS SOURCES ON LAND**														
3.C.1.	**BURNING**														
3.C.1.a.	Burning in forest land			T1	D										
3.C.1.b.	Burning in cropland			T1	D										
3.C.4.	Direct N2O emissions from managed soils														
Key: T1, T2=Levels of Tiers, EF=Emission Factor, D=Default IPCC methodology and Emission Factor, CS=Country Specific															

Appendix I. 2. *Summary table of Mongolia's 2022 GHG inventory.*

Inventory Year: 2022														
	Emissions (Gg)			Emissions CO2 Equivalents (Gg)						Emissions (Gg)				
Categories	Net CO2 (1) (2)	CH4	N2O	HFCs	PFCs	SF6	NF3	Other halogenated gases with CO2 equivalent conversion factors (3)	Other halogenated gases without CO2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO2
Total National Emissions and Removals	-5347.98	717.07	29.51	122.17	0	0	0	0	0	8E-04	0.027	0	0
1 - Energy	19899.67	3.91	1.46	0	0	0	0	0	0	0	0	0	0
1.A - Fuel Combustion Activities	19850.02	3.91	1.46	0	0	0	0	0	0	0	0	0	0
1.A.1 - Energy Industries	13096.72	0.15	0.2							0	0	0	0
1.A.2 - Manufacturing Industries and Construction	364.86	0.04	0.006							0	0	0	0
1.A.3 - Transport	5041.64	0.95	1.21							0	0	0	0
1.A.4 - Other Sectors	851.82	2.77	0.03							0	0	0	0
1.A.5 - Non-Specified	494.98	0.005	0.008							0	0	0	0
1.B - Fugitive emissions from fuels	49.65	0	0	0	0	0	0	0	0	0	0	0	0

1.B.1 - Solid Fuels	32.483	0	0							0	0	0	0
1.B.2 - Oil and Natural Gas	17.17	0	0							0	0	0	0
1.B.3 - Other emissions from Energy Production	0	0	0							0	0	0	0
1.C - Carbon dioxide Transport and Storage	0	0	0	0	0	0	0	0	0	0	0	0	0
1.C.1 - Transport of CO2	0									0	0	0	0
1.C.2 - Injection and Storage	0									0	0	0	0
1.C.3 - Other	0									0	0	0	0
2 - Industrial Processes and Product Use	587.76	0	0	122.17	0	0	0	0	0	0	0	0	0
2.A - Mineral Industry	585.75	0	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	535.87									0	0	0	0
2.A.2 - Lime production	49.88									0	0	0	0
2.A.3 - Glass Production	0									0	0	0	0
2.A.4 - Other Process Uses of Carbonates	0									0	0	0	0
2.A.5 - Other (please specify)	0	0	0							0	0	0	0
2.B - Chemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0
2.B.1 - Ammonia Production	0									0	0	0	0
2.B.2 - Nitric Acid Production			0							0	0	0	0
2.B.3 - Adipic Acid Production			0							0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			0							0	0	0	0
2.B.5 - Carbide Production	0	0								0	0	0	0
2.B.6 - Titanium Dioxide Production	0									0	0	0	0

2.B.7 - Soda Ash Production	0									0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	0	0								0	0	0	0
2.B.9 - Fluorochemical Production				0					0	0	0	0	0
2.B.10 - Hydrogen Production	0	0	0							0	0	0	0
2.B.11 - Other (Please specify)	0	0	0							0	0	0	0
2.C - Metal Industry	2	0	0	0	0	0	0	0	0	0	0	0	0
2.C.1 - Iron and Steel Production	2	0								0	0	0	0
2.C.2 - Ferroalloys Production	0	0								0	0	0	0
2.C.3 - Aluminium production	0				0				0	0	0	0	0
2.C.4 - Magnesium production	0									0	0	0	0
2.C.5 - Lead Production	0									0	0	0	0
2.C.6 - Zinc Production	0									0	0	0	0
2.C.7 - Rare Earths Production	0									0	0	0	0
2.C.8 - Other (please specify)	0	0	0							0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	0.015	0	0	0	0	0	0	0	0	0	0	0	0
2.D.1 - Lubricant Use	0.015									0	0	0	0
2.D.2 - Paraffin Wax Use	0									0	0	0	0
2.D.3 - Solvent Use										0	0	0	0
2.D.4 - Other (please specify)	0	0	0							0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0	0

2.E.1 - Integrated Circuit or Semiconductor			0							0	0	0	0
2.E.2 - TFT Flat Panel Display			0							0	0	0	0
2.E.3 - Photovoltaics										0	0	0	0
2.E.4 - Heat Transfer Fluid										0	0	0	0
2.E.5 - Other (please specify)	0	0	0		0	0			0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	122.17	0	0	0	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning				119.71					0	0	0	0	0
2.F.2 - Foam Blowing Agents				1.42					0	0	0	0	0
2.F.3 - Fire Protection				1.04					0	0	0	0	0
2.F.4 - Aerosols										0	0	0	0
2.F.5 - Solvents										0	0	0	0
2.F.6 - Other Applications (please specify)										0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	0	0	0	0	0	0	0	0
2.G.1 - Electrical Equipment										0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses						0			0	0	0	0	0
2.G.3 - N2O from Product Uses			0							0	0	0	0
2.G.4 - Other (Please specify)	0	0	0							0	0	0	0
2.H - Other	0	0	0	0	0	0	0	0	0	0	0	0	0
2.H.1 - Pulp and Paper Industry	0	0	0							0	0	0	0

2.H.2 - Food and Beverages Industry	0	0	0							0	0	0	0
2.H.3 - Other (please specify)	0	0	0							0	0	0	0
3 - Agriculture, Forestry, and Other Land Use	-25835.41	691.3	27.942	0	0	0	0	0	0	8E-04	0.027	0	0
3.A - Livestock	0	686.89	0	0	0	0	0	0	0	0	0	0	0
3.A.1 - Enteric Fermentation		669.14								0	0	0	0
3.A.2 - Manure Management		17.75	0							0	0	0	0
3.B - Land	-28940.87	0	0	0	0	0	0	0	0	0	0	0	0
3.B.1 - Forest land	-31975.88									0	0	0	0
3.B.2 - Cropland	0									0	0	0	0
3.B.3 - Grassland	0									0	0	0	0
3.B.4 - Wetlands	0									0	0	0	0
3.B.5 - Settlements	0									0	0	0	0
3.B.6 - Other Land	0									0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	0	4.45	27.94	0	0	0	0	0	0	8E-04	0.027	0	0
3.C.1 - Burning	0	4.45	7E-05							8E-04	0.027	0	0
3.C.2 - Liming	0									0	0	0	0
3.C.3 - Urea application	0									0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils			20.25							0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils			7.69							0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management			0							0	0	0	0

3.C.7 - Rice cultivation		0								0	0	0	0
3.C.8 - CH4 from Drained Organic Soils		0								0	0	0	0
3.C.9 - CH4 from Drainage Ditches on Organic Soils		0								0	0	0	0
3.C.10 - CH4 from Rewetting of Organic Soils		0								0	0	0	0
3.C.11 - CH4 Emissions from Rewetting of Mangroves and Tidal Marshes		0								0	0	0	0
3.C.12 - N2O Emissions from Aquaculture			0							0	0	0	0
3.C.13 - CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils		0								0	0	0	0
3.C.14 - Other (please specify)	0	0	0							0	0	0	0
3.D - Other	70.45	0	0	0	0	0	0	0	0	0	0	0	0
3.D.1 - Harvested Wood Products	70.45									0	0	0	0
3.D.2 - Other (please specify)	0	0	0							0	0	0	0
4 - Waste	0	21.82	0.12	0	0	0	0	0	0	0	0	0	0
4.A - Solid Waste Disposal		15.61								0	0	0	0
4.B - Biological Treatment of Solid Waste		0	0							0	0	0	0
4.C - Incineration and Open Burning of Waste	0	0	0							0	0	0	0
4.D - Wastewater Treatment and Discharge		6.21	0.12							0	0	0	0
4.E - Other (please specify)	0	0	0							0	0	0	0
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0	0

5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3			0							0	0	0	0
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	0									0	0	0	0
5.C - Other	0	0	0					0	0	0	0	0	0
Memo Items (5)													
International Bunkers	0	0	0	0	0	0	0	0	0	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers)	0	0	0							0	0	0	0
1.A.3.a.i - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOX and NH3			0										
1.A.3.a.i - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	0												
1.A.3.d.i - International water-borne navigation (International bunkers)	0	0	0							0	0	0	0
1.A.3.d.i - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOX and NH3			0										
1.A.3.d.i - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	0												
1.A.5.c - Multilateral Operations	0	0	0	0	0	0	0	0	0	0	0	0	0

Total	SUM(C):-7640.846	SUM(D):136805.066		SUM(H):35.213		SUM(M):63240.348
				Uncertainty in total inventory:5.934		Trend uncertainty:251.476

Appendix I. 3. *Uncertainty assessment 1990–2022, including LULUCF.*

2006 IPCC Categories	Gas	1990 emissions (Gg CO_2 eq)	2022 emissions (Gg CO_2 eq)	AD Uncertainty (%)	EF Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in 2022	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in trend in national emissions introduced by emission factor uncertainty (%)	Uncertainty in trend in national emissions introduced by activity data uncertainty (%)	Uncertainty introduced into the trend in total national emissions (%)
1.A - Fuel Combustion Activities												
1.A.1.a.i - Electricity Generation - Liquid Fuels	CO_2	129.37	348.205	5	6.13	7.9153	0.02	0.10166227	0.0498	0.624	0.352	0.513
1.A.1.a.i - Electricity Generation - Liquid Fuels	CH4	0.005	0.0140	5	228.78	228.843	2.724E-08	4.1151E-06	2.018E-06	0.0009	1.426E-05	8.866E-07
1.A.1.a.i - Electricity Generation - Liquid Fuels	N2O	0.00104	0.003	5	228.78	228.843	1.089E-09	8.2302E-07	4.036E-07	0.0002	2.853E-06	3.546E-08
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	CO2	196.998	6.253	5	6.13	7.915	6.414E-06	0.07980157	0.0009	0.489	0.006	0.234
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	CH4	0.0076	0.0002	5	228.78	228.843	8.054E-12	3.0922E-06	3.47E-08	0.0007	2.453E-07	5.005E-07
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	N2O	0.0015	0.00004	5	228.78	228.843	3.222E-13	6.1844E-07	6.939E-09	0.0001	4.907E-08	2.002E-08
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	CO2	6043.193	12729.79	5	12.46	13.426	76.461	4.279	1.822	53.316	12.884	3008.577

1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	CH4	0.0622	0.133	5	200	200.0624	1.879E-06	4.409E-05	1.917E-05	0.009	0.0001	7.777E-05
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	N2O	0.0933	0.201	5	222.22	222.278	5.218E-06	6.613E-05	2.875E-05	0.0147	0.0002	0.0002
1.A.4.a - Commercial/ Institutional - Solid Fuels	CO2	2.908	0	5	12.46	13.426	0	0.001	0	0.0145	0	0.0002
1.A.4.a - Commercial/ Institutional - Solid Fuels	CH4	0.0002	0	5	200	200.062	0	1.153E-07	0	2.306E-05	0	5.32E-10
1.A.4.a - Commercial/ Institutional - Solid Fuels	N2O	0.00004	0	5	217.77	217.835	0	1.729E-08	0	3.767E-06	0	1.419E-11
1.A.4.b - Residential - Solid Fuels	CO2	774.663	805.93	5	12.46	13.4258	0.306	0.426	0.115	5.308	0.8157	28.843
1.A.4.b - Residential - Solid Fuels	CH4	2.436	2.739	5	200	200.062	0.0008	0.001	0.0004	0.274	0.003	0.075
1.A.4.b - Residential - Solid Fuels	N2O	0.012	0.0136	5	222.22	222.278	2.427E-08	6.838E-06	1.961E-06	0.0015	1.386E-05	2.309E-06
1.A.4.c.i - Stationary - Solid Fuels	CO2	231.249	6.05	5	12.46	13.426	1.729E-05	0.093	0.0009	1.165	0.006	1.357
1.A.4.c.i - Stationary - Solid Fuels	CH4	0.686	0.024	5	200	200.062	6.294E-08	0.0003	3.508E-06	0.056	2.481E-05	0.003
1.A.4.c.i - Stationary - Solid Fuels	N2O	0.003	0.0001	5	222.22	222.278	1.942E-12	1.393E-06	1.754E-08	0.0003	1.24E-07	9.579E-08
1.A.5.a - Stationary - Solid Fuels	CO2	686.535	494.97	5	5	7.071	0.032	0.346	0.071	1.730	0.501	3.246
1.A.5.a - Stationary - Solid Fuels	CH4	0.007	0.005	5	5	7.071	3.401E-12	3.561E-06	7.296E-07	1.780E-05	5.159E-06	3.436E-10
1.A.5.a - Stationary - Solid Fuels	N2O	0.011	0.008	5	5	7.071	7.652E-12	5.341E-06	1.094E-06	2.671E-05	7.739E-06	7.732E-10
1.A.1.c.ii - Other Energy Industries - Solid Fuels	CO2	2.536	12.47	5	12.46	13.426	7.343E-05	0.003	0.002	0.035	0.013	0.001
1.A.1.c.ii - Other Energy Industries - Solid Fuels	CH4	5.71E-05	0.0003	5	200	200.062	8.271E-12	6.309E-08	4.022E-08	1.262E-05	2.844E-07	1.593E-10
1.A.1.c.ii - Other Energy Industries - Solid Fuels	N2O	5.71E-06	2.81E-05	5	222.22	222.278	1.021E-13	6.309E-09	4.022E-09	1.402E-06	2.844E-08	1.966E-12
1.A.2.m - Non-specified Industry - Solid Fuels	CO2	1483.789	364.862	5	12.46	13.426	0.063	0.648	0.052	8.071	0.369	65.278

1.A.2.m - Non-specified Industry - Solid Fuels	CH4	0.165	0.039	5	200	200.062	1.611E-07	7.182E-05	5.612E-06	0.0144	3.969E-05	0.0002
1.A.2.m - Non-specified Industry - Solid Fuels	N2O	0.025	0.005	5	222.22	222.278	4.474E-09	1.078E-05	8.419E-07	0.002	5.953E-06	5.731E-06
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CO2	311.01	0	5	4.209	6.536	0	0.125	0	0.524	0	0.275
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CH4	0.002	0	5	100	100.125	0	8.896E-07	0	8.896E-05	0	7.913E-09
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	N2O	0.008	0	5	150	150.083	0	3.558E-06	0	0.0005	0	2.849E-07
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	CO2	10.405	144.729	5	4.209	6.536	0.002	0.025	0.021	0.105	0.147	0.032
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	CH4	0.00007	0.001	5	100	100.125	2.688E-11	1.74E-07	1.449E-07	1.74E-05	1.024E-06	3.038E-10
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	N2O	0.0002	0.004	5	150	150.083	9.664E-10	6.96E-07	5.795E-07	0.0001	4.08E-06	1.092E-08
1.A.3.b.i - Cars - Liquid Fuels	CO2	1181.086	2397.45	5	3.068	5.866	0.518	0.817	0.343	2.508	2.426	12.179
1.A.3.b.i - Cars - Liquid Fuels	CH4	0.407	0.814	5	244.69	244.744	0.0001	0.0003	0.0001	0.068	0.0008	0.005
1.A.3.b.i - Cars - Liquid Fuels	N2O	0.132	0.266	5	209.937	209.997	8.202E-06	9.123E-05	3.815E-05	0.019	0.0003	0.0004
1.A.3.c - Railways - Liquid Fuels	CO2	194.364	419.95	5	2.024	5.394	0.013	0.138	0.0602	0.278	0.425	0.259
1.A.3.c - Railways - Liquid Fuels	CH4	0.0108	0.023	5	150.602	150.685	3.288E-08	7.725E-06	3.366E-06	0.001	2.38E-05	1.354E-06
1.A.3.c - Railways - Liquid Fuels	N2O	0.075	0.162	5	200	200.063	2.753E-06	5.324E-05	2.32E-05	0.011	0.0002	0.0001
1.A.3.c - Railways - Solid Fuels	CO2	196.848	72.13	5	24.245	24.756	0.008	0.089	0.01	2.162	0.073	4.6798
1.A.3.c - Railways - Solid Fuels	CH4	0.0041	0.0014	5	200	200.062	2.334E-10	1.866E-06	2.137E-07	0.0004	1.511E-06	1.393E-07
1.A.3.c - Railways - Solid Fuels	N2O	0.003	0.0011	5	233.333	233.387	1.787E-10	1.4E-06	1.603E-07	0.0003	1.133E-06	1.067E-07
1.A.3.e.ii - Off-road - Liquid Fuels	CO2	669.123	2007.36	5	3.874	6.325	0.422	0.556	0.287	2.153	2.032	8.764

1.A.3.e.ii - Off-road - Liquid Fuels	CH4	0.0374	0.112	5	150.219	150.302	7.474E-07	3.11E-05	1.609E-05	0.0047	0.0001	2.183E-05
1.A.3.e.ii - Off-road - Liquid Fuels	N2O	0.258	0.774	5	200	200.062	6.289E-05	0.0002	0.0001	0.043	0.0008	0.002
1.A.4.c.ii - Off-road Vehicles and Other Machinery - Liquid Fuels	CO2	20.392	39.828	5	3.874	6.325	0.0002	0.014	0.006	0.054	0.04	0.005
1.A.4.c.ii - Off-road Vehicles and Other Machinery - Liquid Fuels	CH4	0.0011	0.0022	5	150.219	150.302	2.942E-10	7.766E-07	3.193E-07	0.0001	2.258E-06	1.362E-08
1.A.4.c.ii - Off-road Vehicles and Other Machinery - Liquid Fuels	N2O	0.008	0.0153	5	200	200.062	2.476E-08	5.352E-06	2.2E-06	0.001	1.556E-05	1.146E-06
1.B.1 - Fugitive Emissions from Fuels - Solid Fuels												
1.B.1.a.ii.1 - Mining	CO2	5.788	29.984	5	5	7.071	0.0001	0.007	0.004	0.033	0.03	0.002
1.B.1.a.ii.2 - Post-mining seam gas emissions	CO2	0.479	2.498	5	5	7.071	8.172E-07	0.0005	0.0004	0.003	0.003	1.395E-05
1.B.2 - Fugitive Emissions from Fuels - Oil and Natural Gas												
1.B.2.a.ii - Flaring	CO2	0	17.169	5	5	7.071	3.858E-05	0.0024	0.002	0.012	0.0174	0.0005
2.A - Mineral Industry												
2.A.1 - Cement production	CO2	171.97	535.871	78.26	10	78.899	4.679	0.146	0.0767	1.456	8.489	74.186
2.A.2 - Lime production	CO2	77.25	49.875	51.75	2	51.798	0.017	0.038	0.007	0.0762	0.523	0.2789
2.C - Metal Industry												
2.C.1 - Iron and Steel Production	CO2	0	2	26.457	25	36.4	1.387E-05	0.0003	0.0003	0.007	0.011	0.0002
2.D - Non-Energy Products from Fuels and Solvent Use												
2.D.1 - Lubricant Use	CO2	12.892	0.015	10	50.09	51.078	1.469E-09	0.005	2.099E-06	0.2587	2.969E-05	0.067
2.F - Product Uses as Substitutes for Ozone Depleting Substances												
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2F2	0	4.224	15	39.96	42.683	8.51E-05	0.0006	0.0006	0.024	0.013	0.0007

2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF2CF3	0	21.392	15	44.36	46.827	0.003	0.003	0.003	0.136	0.064	0.023
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2FCF3	0	14.798	15	53.16	55.236	0.002	0.002	0.002	0.113	0.05	0.015
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CHF2	0	0.408	15	35	38.079	6.338E-07	5.849E-05	5.849E-05	0.002	0.001	5.73E-06
2.F.1.b - Mobile Air Conditioning	CH2FCF3	0	78.88	35	71.96	80.02	0.104	0.011	0.011	0.8125	0.559	0.973
2.F.2 - Foam Blowing Agents	CH3CHF2	0	1.42	0	0	0	0	0.0002	0.0002	0	0	0
2.F.3 - Fire Protection	CHF2CF3	0	1.0399	0	0	0	0	0.0001	0.0001	0	0	0
3.A - Livestock												
3.A.1.a.ii - Other Cattle	CH4	3748.88	7254.89	10	30	31.623	137.777	2.553	1.038	76.599	14.685	6082.999
3.A.1.c - Sheep	CH4	2111.62	4584.675	10	40	41.231	93.537	1.506	0.656	60.253	9.281	3716.563
3.A.1.d - Goats	CH4	717.878	3859.716	10	40	41.231	66.294	0.841	0.552	33.631	7.813	1192.094
3.A.1.e - Camels	CH4	692.3	605.965	10	40	41.231	1.634	0.364	0.087	14.573	1.227	213.862
3.A.1.f - Horses	CH4	1140.048	2429.819	10	40	41.231	26.273	0.806	0.348	32.224	4.918	1062.608
3.A.1.h - Swine	CH4	3.771	0.974	10	30	31.623	2.485E-06	0.002	0.0001	0.049	0.002	0.002
3.A.2.a.ii - Other cattle	CH4	79.763	154.359	10	14	17.205	0.018	0.054	0.022	0.757	0.312	0.6
3.A.2.c - Sheep	CH4	42.232	91.693	10	14	17.205	0.007	0.03	0.013	0.421	0.186	0.211
3.A.2.d - Goats	CH4	15.793	84.913	10	14	17.205	0.006	0.018	0.012	0.259	0.172	0.096
3.A.2.e - Camels	CH4	19.264	16.861	10	14	17.205	0.0002	0.01	0.002	0.142	0.034	0.021
3.A.2.f - Horses	CH4	69.036	147.139	10	14	17.205	0.017	0.049	0.021	0.682	0.298	0.554
3.A.2.h - Swine	CH4	7.542	1.948	10	39	40.262	1.611E-05	0.0033	0.0003	0.129	0.004	0.017
3.A.2.i - Poultry	CH4	0.015	0.069	10	39	40.262	2.065E-08	1.6E-05	9.985E-06	0.0006	0.0001	4.092E-07
3.C - Aggregate sources and non-CO2 emissions sources on land												
3.C.1.a - Burning in Forest Land	CH4	0.096	0.032	21.21	98.99	101.242	2.92E-08	4.316E-05	4.722E-06	0.004	0.0001	1.828E-05
3.C.1.a - Burning in Forest Land	N2O	0.0502	0.017	21.21	98.99	101.242	8.005E-09	2.26E-05	2.472E-06	0.002	7.417E-05	5.011E-06

3.C.1.c - Burning in Grassland	CH4	34.08	124.57	33.54	98.99	104.523	0.444	0.031	0.018	3.116	0.846	10.426
3.C.4 - Direct N2O Emissions from managed soils	N2O	2118.203	5366.136	43.59	400	402.368	12203.533	1.621	0.768	648.472	47.348	422757.756
3.C.5 - Indirect N2O Emissions from managed soils	N2O	775.101	2038.445	61.64	699.59	702.308	5364.986	0.603	0.292	421.725	25.437	178499.612
3.B - Land												
3.B.1.a - Forest land Remaining Forest land	CO2	-31996.6	-31975.8	24.49	83.71	87.219	20360.139	16.628	4.577	1391.903	158.514	1962521.281
3.B.3.a - Grassland Remaining Grassland	CO2	830.31	3035.01	50	81.73	95.811	221.344	0.768	0.434	62.753	30.718	4881.49
3.D - Other												
3.D.1 - Harvested Wood Products	CO2	-85.84	70.45	30	60.21	67.27	0.0588	0.024	0.01	0.859	0.428	0.92
4.A - Solid Waste Disposal												
4.A.1 - Managed Waste Disposal Sites	CH4	0	332.769	51.96	129.83	139.842	5.669	0.048	0.048	6.183	3.5	50.49
4.A.2 - Unmanaged Waste Disposal Sites	CH4	0	137.041	51.96	129.83	139.842	0.961	0.02	0.02	2.547	1.441	8.563
4.D - Wastewater Treatment and Discharge												
4.D.1 - Domestic Wastewater Treatment and Discharge	CH4	270.996	540.827	63.64	59.16	86.89	5.781	0.186	0.077	11.003	6.967	169.619
4.D.1 - Domestic Wastewater Treatment and Discharge	N2O	0.361	0.833	14.14	188.36	188.89	6.489E-05	0.0003	0.0001	0.05	0.002	0.002
4.D.2 - Industrial Wastewater Treatment and Discharge	CH4	11.274	27.04	63.64	59.16	86.89	0.0145	0.008	0.004	0.496	0.348	0.367
Total												
		-7641.846	136805.066				35.213					63240.348
							Uncertainty in total inventory:5.934					Trend uncertainty: 251.476

Appendix I. 4. *2022-year Key Category Tier 1 Analysis – Level Assessment, with LULUCF.*

IPCC Category code	IPCC Category	Gas	2022 estimate (Gg CO_2 Eq)	Level assessment %	Cumulative total %
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-31975.88	40%	40%
3.A.1	Enteric Fermentation	METHANE (CH4)	18736.05	23%	63%
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	12742.27	16%	79%
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	5366.136	7%	85%
3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	3035.011	4%	86%
1.A.3.b	Road Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	2397.454	3%	88%
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	2038.445	2%	91%
1.A.3.e	Other Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	2007.369	2%	94%
1.A.4	Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	811.9869	1%	95%
2.A.1	Cement production	CARBON DIOXIDE (CO2)	535.871	1%	95%
3.A.2	Manure Management	METHANE (CH4)	496.9859	1%	96%
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	494.977	1%	96%
4.A	Solid Waste Disposal	METHANE (CH4)	437.0212	1%	97%
1.A.3.c	Railways - Liquid Fuels	CARBON DIOXIDE (CO2)	419.9543	1%	97%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	364.8628	0%	98%
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	354.4592	0%	98%
1.A.3.e	Other Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	205.3151	0%	99%
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	173.8753	0%	99%
1.A.3.a	Civil Aviation - Liquid Fuels	CARBON DIOXIDE (CO2)	144.7296	0%	99%
3.C.1	Burning	METHANE (CH4)	124.6058	0%	99%
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	119.7115	0%	99%
1.A.4	Other Sectors - Solid Fuels	METHANE (CH4)	77.39332	0%	99%
1.A.3.c	Railways - Solid Fuels	CARBON DIOXIDE (CO2)	72.13008	0%	99%

1.A.3.b	Road Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	70.63731	0%	100%
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	70.45155	0%	100%
1.A.1	Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	53.23723	0%	100%
2.A.2	Lime production	CARBON DIOXIDE (CO2)	49.875	0%	100%
1.A.3.c	Railways - Liquid Fuels	NITROUS OXIDE (N2O)	42.95322	0%	100%
1.A.4	Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	39.82875	0%	100%
1.B.1.a	Coal mining and handling	CARBON DIOXIDE (CO2)	32.48368	0%	100%
4.D	Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	31.22683	0%	100%
1.A.3.b	Road Transportation - Liquid Fuels	METHANE (CH4)	22.81476	0%	100%
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	17.169	0%	100%
1.A.4	Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	4.073713	0%	100%
1.A.1	Energy Industries - Solid Fuels	METHANE (CH4)	3.757386	0%	100%
1.A.4	Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	3.662362	0%	100%
1.A.3.e	Other Transportation - Liquid Fuels	METHANE (CH4)	3.147858	0%	100%
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	2.026296	0%	100%
2.C.1	Iron and Steel Production	CARBON DIOXIDE (CO2)	2	0%	100%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	1.558633	0%	100%
2.F.2	Foam Blowing Agents	HFCs (HFCs)	1.423125	0%	100%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	1.097905	0%	100%
1.A.3.a	Civil Aviation - Liquid Fuels	NITROUS OXIDE (N2O)	1.072821	0%	100%
2.F.3	Fire Protection	HFCs, PFCs	1.039746	0%	100%
1.A.1	Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	0.760008	0%	100%
1.A.3.c	Railways - Liquid Fuels	METHANE (CH4)	0.658552	0%	100%
1.A.1	Energy Industries - Liquid Fuels	METHANE (CH4)	0.401514	0%	100%

1.A.3.c	Railways - Solid Fuels	NITROUS OXIDE (N2O)	0.296694	0%	100%
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0.142733	0%	100%
1.A.4	Other Sectors - Liquid Fuels	METHANE (CH4)	0.062458	0%	100%
1.A.3.c	Railways - Solid Fuels	METHANE (CH4)	0.041798	0%	100%
1.A.3.a	Civil Aviation - Liquid Fuels	METHANE (CH4)	0.028339	0%	100%
3.C.1	Burning	NITROUS OXIDE (N2O)	0.017272	0%	100%
2.D	Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	0.014667	0%	100%

Appendix I. 5. *2022 year Key Category Tier 1 Analysis – Trend Assessment, with LULUCF.*

IPCC Category code	IPCC Category	Gas	1990 Estimate (Gg CO2 Eq)	2022 Estimate (Gg CO2 Eq)	Trend Assessment Tx,t	Contribution to Trend %	Cumulative Total %
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-31996.57117	-31975.88452	2.084207974	66%	66%
3.A.1	Enteric Fermentation	METHANE (CH4)	8414.506492	18736.04762	0.366844701	10%	76%
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	6045.729805	12742.26573	0.276213954	8%	85%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	1483.789224	364.862775	0.116329089	4%	88%
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	2118.203624	5366.136079	0.080931467	2%	93%
1.A.4	Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	1008.821664	811.986915	0.069183082	2%	92%
1.A.3.b	Road Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	1181.08605	2397.45402	0.055574845	2%	94%
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	686.53584	494.97696	0.048093526	1%	95%
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	775.101787	2038.445488	0.028299649	1%	96%
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	326.3686326	354.4591566	0.020769273	1%	97%
1.A.3.e	Other Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	669.123	2007.369	0.020079054	1%	97%

3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	830.3148	3035.011468	0.015356358	0%	98%
1.A.3.c	Railways - Solid Fuels	CARBON DIOXIDE (CO2)	196.84836	72.13008	0.01501604	0%	98%
3.A.2	Manure Management	METHANE (CH4)	233.6471542	496.9859252	0.010594967	0%	98%
1.A.3.c	Railways - Liquid Fuels	CARBON DIOXIDE (CO2)	194.3643	419.95434	0.008698976	0%	99%
4.A	Solid Waste Disposal	METHANE (CH4)	0	437.0212449	0.007678851	0%	99%
1.A.4	Other Sectors - Solid Fuels	METHANE (CH4)	87.450048	77.393316	0.005874058	0%	99%
2.A.2	Lime production	CARBON DIOXIDE (CO2)	77.25	49.875	0.005513824	0%	99%
2.A.1	Cement production	CARBON DIOXIDE (CO2)	171.97812	535.871025	0.004810417	0%	99%
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	-85.84016683	70.4515471	0.002846285	0%	100%
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	0	119.7115308	0.002103438	0%	100%
1.A.3.e	Other Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	68.43837	205.31511	0.0020537	0%	100%
1.A.3.a	Civil Aviation - Liquid Fuels	CARBON DIOXIDE (CO2)	10.405395	144.729585	0.001682286	0%	100%
1.A.3.b	Road Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	35.1237095	70.6373135	0.001664297	0%	100%
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	50.7589959	173.875307	0.001143675	0%	100%
1.A.1	Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	24.74064192	53.23722699	0.001111137	0%	100%
2.D	Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	12.892	0.014666667	0.001066177	0%	100%
1.A.4	Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	20.39232	39.82875	0.00098704	0%	100%
1.A.3.c	Railways - Liquid Fuels	NITROUS OXIDE (N2O)	19.879717	42.9532246	0.000889737	0%	100%
3.C.1	Burning	METHANE (CH4)	34.17648152	124.6058002	0.000637667	0%	100%

1.A.3.b	Road Transportation - Liquid Fuels	METHANE (CH4)	11.4078664	22.8147556	0.000542791	0%	100%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	6.5724558	1.558633275	0.000516291	0%	100%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	4.6296544	1.0979052	0.000363677	0%	100%
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	0	17.169	0.000301675	0%	100%
1.A.4	Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	4.1493276	3.662362275	0.000278884	0%	100%
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	2.810484	2.026296	0.000196881	0%	100%
4.D	Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	8.591234106	31.22682604	0.00016199	0%	100%
1.A.4	Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	2.0857408	4.0737125	0.000100955	0%	100%
1.A.1	Energy Industries - Solid Fuels	METHANE (CH4)	1.74423001	3.757386136	7.82633E-05	0%	100%
1.A.3.c	Railways - Solid Fuels	NITROUS OXIDE (N2O)	0.8202015	0.296694	6.26344E-05	0%	100%
1.B.1.a	Coal mining and handling	CARBON DIOXIDE (CO2)	6.2681006	32.4836837	5.22656E-05	0%	100%
1.A.1	Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	0.682282674	0.760008234	4.30849E-05	0%	100%
2.C.1	Iron and Steel Production	CARBON DIOXIDE (CO2)	0	2	3.51418E-05	0%	100%
1.A.3.e	Other Transportation - Liquid Fuels	METHANE (CH4)	1.049286	3.147858	3.1487E-05	0%	100%
2.F.2	Foam Blowing Agents	HFCs (HFCs)	0	1.423125	2.50056E-05	0%	100%
1.A.1	Energy Industries - Liquid Fuels	METHANE (CH4)	0.360451224	0.401513784	2.27618E-05	0%	100%
2.F.3	Fire Protection	HFCs, PFCs	0	1.039746169	1.82693E-05	0%	100%
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0.1979712	0.1427328	1.38684E-05	0%	100%
1.A.3.c	Railways - Liquid Fuels	METHANE (CH4)	0.3047926	0.65855188	1.36413E-05	0%	100%

1.A.3.a	Civil Aviation - Liquid Fuels	NITROUS OXIDE (N2O)	0.0771309	1.0728207	1.24701E-05	0%	100%
1.A.3.c	Railways - Solid Fuels	METHANE (CH4)	0.1155504	0.0417984	8.82397E-06	0%	100%
3.C.1	Burning	NITROUS OXIDE (N2O)	0.050262196	0.017272345	3.85423E-06	0%	100%
1.A.4	Other Sectors - Liquid Fuels	METHANE (CH4)	0.03197824	0.0624575	1.54783E-06	0%	100%
1.A.3.a	Civil Aviation - Liquid Fuels	METHANE (CH4)	0.00203742	0.02833866	3.29399E-07	0%	100%

Appendix I. 6. *GHG emissions from the energy sector by subsector, Gg CO2-eq.*

Year	1.A.1 Energy industries	1.A.2 Manufacturing industries and construction	1.A.3 Transport	1.A.4 Other sectors	1.A.5 Non-specified	1.B.1 Solid fuels	1.B.2 Oil and natural gas
1990	6399.62	1494.422	2389.049	1122.93	689.54846	6.27	0
1991	6957.46	1912.034	1435.92	1831.20	171.33752	6.13	0
1992	6655.00	1387.004	1207.281	620.91	603.8747	5.44	0
1993	6117.25	1124.476	1451.209	940.88	232.56466	4.89	0
1994	5650.50	936.2544	954.2891	893.48	248.57451	4.49	0
1995	5726.92	1029.579	1115.81	365.93	469.05648	4.37	0
1996	5663.02	781.9991	1246.06	265.15	518.21094	4.45	0
1997	5314.72	793.0345	1155.34	335.35	171.33752	4.29	0
1998	6036.55	657.4629	1139.59	309.19	162.91076	4.4	0.34
1999	5929.42	493.3087	1223.45	359.41	351.0918	4.32	0.49
2000	6356.25	264.0601	1392.98	617.69	138.75537	4.52	0.44
2001	6190.12	266.2744	1387.04	515.09	449.4007	4.48	0.49
2002	6739.86	223.3086	1523.08	672.25	191.82698	4.83	0.92
2003	6273.47	144.3038	1545.46	723.14	322.44681	4.94	1.21
2004	6424.23	150.5619	1783.61	771.41	265.28743	5.98	1.46
2005	5682.46	170.1314	1814.45	1140.11	294.49492	6.55	1.31
2006	5766.24	1244.41	2036.43	621.82	378.456	7.03	2.23
2007	6176.03	717.9095	2517.65	774.52	261.20966	8.05	5.63
2008	6269.81	520.5867	2569.56	926.15	28.504382	8.77	7.81
2009	6500.42	599.8166	2342.83	1062.37	342.66504	12.58	12.42
2010	7287.66	599.8224	2445.57	1088.73	351.0918	21.92	14.5
2011	6569.61	649.9283	3009.75	1115.07	309.23277	27.9	16.93
2012	6935.13	847.9288	3422.91	1105.76	408.25118	26.07	24.15
2013	9515.01	650.0207	3627.13	1342.60	612.30146	26.24	34.1
2014	9904.00	567.8832	3413.07	990.30	530.70547	22.03	49.18
2015	9933.92	312.9518	3381.02	888.85	338.45666	21.08	58.25

2016	9958.90	339.2197	2918.58	1269.54	702.1836	30.94	54.81
2017	11022.22	294.126	3749.98	1179.56	502.06047	41.93	50.63
2018	11707.26	379.8474	3913.39	1324.50	840.93897	44.77	42.44
2019	11588.48	466.6265	4929.10	936.49	1197.9265	48.6	40.35
2020	11119.14	296.8413	4874.13	956.27	795.94792	38.19	27.45
2021	12429.70	391.5136	4832.33	1004.66	904.41592	29.35	31.23
2022	13155.18	367.5165	5388.60	937.01	497.14903	32.48	17.17
Key: NO: Not Occurring							

Appendix I. 7. *GHG emissions from the IPPU sector by subsector, Gg CO2-eq.*

Year	2.A. Mineral industry	2.C. Metal industry	2.D. Non-energy products from fuels and solvent use	2.F. Product uses as substitutes for ozone depleting substances
1990	249.23	NA	12.89	NA
1991	145.71	NA	2.46	NA
1992	102.54	NA	7.38	NA
1993	70.51	NA	6.15	NA
1994	83.27	NA	3.08	NA
1995	81	1.25	0.62	NA
1996	82.39	1.54	0.62	NA
1997	86.74	1.82	0.62	NA
1998	84.38	1.3	1.23	NA
1999	77.58	1.05	1.85	NA
2000	63.53	1.04	1.23	NA
2001	48.99	0.8	1.85	NA
2002	89.45	1.27	3.68	NA
2003	94.9	3.14	1.85	NA
2004	46.65	4.39	1.23	NA
2005	104.56	5.24	1.23	NA
2006	100.23	5.6	1.23	NA
2007	102.63	6.46	1.85	0.2535
2008	146.17	6.51	1.85	0.7049
2009	123.94	4.01	1.85	1.3271
2010	163.47	5.14	1.85	2.0973
2011	200.11	4.8	3.08	2.9962
2012	187.43	5.45	0.62	39.686
2013	143.5	4.48	0.62	65.5682
2014	203.97	5.15	0.62	90.5199
2015	199.23	3.5	0.62	99.6712
2016	204.4	1.34	0.62	104.4149
2017	305.58	1.68	0.31	107.8708
2018	408.35	2.34	0.23	115.747

2019	486.36	2.29	0.06	118.6559
2020	513.88	1.22	0.01	119.8936
2021	542.61	2.87	0.01	120.6161
2022	585.75	2	0.01	122.1683
NA: Not Available				

Appendix I. 8. *GHG emissions from the agriculture sector by subsector, Gg CO2-eq.*

Year	3.A. Enteric fermentation	3.B. Manure management	3.D. Agricultural soils	3.C.1 Burning
1990	8414.51	233.65	2893.30	865.68
1991	8263.74	227.09	2857.84	816.33
1992	8191.44	221.99	2856.85	152.10
1993	8115.56	218.99	2906.13	346.39
1994	8585.03	233.01	3026.47	464.58
1995	9305.74	253.96	3279.35	2.73
1996	9609.88	261.89	3381.02	1055.65
1997	10091.16	274.64	2681.87	1312.19
1998	10510.52	286.79	2829.86	608.98
1999	10757.87	294.14	3845.79	689.86
2000	9214.25	250.82	4403.56	58.38
2001	7210.02	198.86	2800.98	39.87
2002	6576.38	181.19	2094.24	37.83
2003	6679.97	183.19	2147.69	473.74
2004	7114.61	193.34	2911.23	1041.49
2005	7596.07	204.24	3123.59	548.27
2006	8483.59	225.42	3526.40	703.42
2007	9605.03	251.72	4045.19	108.45
2008	10107.05	260.96	3719.26	71.59
2009	10347.38	266.46	3781.62	33.32
2010	8150.29	213.91	3322.41	33.08
2011	8930	234.72	3678.30	282.70
2012	9968.95	261.62	4116.88	635.91
2013	11065.66	291.26	4555.35	757.49
2014	12784.99	334.96	5248.03	419.27
2015	13905.81	364.03	4936.48	892.64
2016	15201.03	398.17	6225.00	392.33
2017	16364.81	429.03	5822.40	113.74
2018	16419.05	430.09	6714.44	5.79
2019	17602.53	460.34	7187.39	35.41
2020	16988.21	445.33	6858.93	31.73
2021	17430.46	459.17	6943.35	29.94
2022	18736.05	496.99	7404.58	124.62

Appendix I. 9. *CH4 emissions from enteric fermentation by livestock, Gg CH4.*

Year	3.A.1.b Other Cattle	3.A.2 Sheep	3.A.4.d. Goat	3.A.4.b. Camel	3.A.4.e. Horse	3.A.3 Swine	Total
1990	133.89	75.42	25.63	24.73	40.72	0.13	300.52
1991	132.63	73.6	26.25	21.9	40.67	0.08	295.13
1992	132.5	73.29	28.01	19.1	39.6	0.05	292.55
1993	128.33	68.93	36.21	16.91	39.43	0.03	289.84
1994	141.24	68.93	36.21	16.84	43.36	0.02	306.6
1995	155.9	68.59	42.6	16.9	48.32	0.02	332.33
1996	163.38	67.8	45.67	16.46	49.87	0.02	343.2
1997	169.8	70.83	51.33	16.35	52.08	0.02	360.41
1998	175.11	73.47	55.31	16.4	55.06	0.02	375.37
1999	179.76	75.96	55.17	16.36	56.94	0.02	384.21
2000	145.59	69.38	51.35	14.85	47.89	0.01	329.07
2001	97.27	59.69	47.96	13.12	39.45	0.01	257.5
2002	88.56	53.18	45.67	11.64	35.8	0.01	234.86
2003	84.26	53.78	53.26	11.81	35.44	0.01	238.56
2004	86.56	58.43	61.19	11.8	36.1	0.02	254.1
2005	92.29	64.42	66.34	11.69	36.52	0.02	271.28
2006	101.89	74.08	77.26	11.66	38.07	0.03	302.99
2007	114.01	84.95	91.74	11.99	40.31	0.04	343.04
2008	117.66	91.81	99.85	12.25	39.36	0.03	360.96
2009	122.17	96.37	98.26	12.74	39.98	0.03	369.55
2010	102.27	72.4	69.42	12.4	34.57	0.02	291.08
2011	109.97	78.34	79.67	12.88	38.03	0.03	318.92
2012	121.48	90.71	87.79	14.07	41.95	0.04	356.04
2013	136.74	100.33	96.14	14.79	47.15	0.05	395.2
2014	160.45	116.07	110.04	16.07	53.92	0.05	456.6
2015	177.68	124.72	117.96	16.93	59.32	0.03	496.64
2016	191.8	139.28	127.87	18.46	65.44	0.03	542.88
2017	206.26	150.55	136.73	19.97	70.92	0.03	584.46
2018	205.9	152.77	135.62	21.15	70.92	0.03	586.39
2019	223.4	161.34	146.31	21.73	75.87	0.02	628.67
2020	222.4	150.25	138.6	21.75	73.69	0.02	606.71
2021	236.04	155.43	132.28	20.89	77.84	0.03	622.51
2022	259.1	163.74	137.85	21.64	86.78	0.03	669.14

Appendix I. 10. *Breakdown of the N2O emissions from indirect N2O emissions from managed soils (3.C.5) within 1990-2022 periods.*

Year	3.C.5 - Indirect N2O emissions from managed soils	3.C.5 - Indirect N2O emissions from managed soils
	Gg N_2O	Gg CO_2-eq
1990	2.925	775.125
1991	2.888	765.320
1992	2.887	765.055
1993	2.953	782.545
1994	3.057	810.105
1995	3.305	875.825
1996	3.401	901.265
1997	3.018	799.770
1998	3.185	844.025
1999	3.883	1028.995
2000	4.119	1091.535
2001	2.912	771.680
2002	2.357	624.605
2003	2.811	744.915
2004	3.062	811.430
2005	3.287	871.055
2006	3.717	985.005
2007	4.258	1128.370
2008	2.399	635.735
2009	2.435	645.275
2010	3.486	923.790
2011	3.868	1025.020
2012	4.333	1148.245
2013	4.788	1268.820
2014	5.509	1459.885
2015	3.151	835.015
2016	6.531	1730.715
2017	3.721	986.65
2018	7.047	1867.455
2019	7.536	1997.040
2020	7.169	1899.785
2021	7.23	1915.950
2022	7.692	2038.380

Appendix I. 11. *CH4 emissions from manure management by livestock subcategories, Gg CH4.*

Year	3.B.1.b. Other Cattle	3.B.2. Sheep	3.B.4.d. Goat	3.B.4.b. Camel	3.B.4.e. Horses	3.A.3. Swine	3.B.4.g. Poultry	Total
1990	2.85	1.51	0.56	0.69	2.47	0.27	0.00054	8.35
1991	2.82	1.47	0.58	0.61	2.46	0.17	0.00037	8.11
1992	2.82	1.47	0.62	0.53	2.4	0.1	0.0003	7.94
1993	2.73	1.38	0.8	0.47	2.39	0.06	0.00022	7.83
1994	3.01	1.38	0.8	0.47	2.63	0.05	0.00012	8.34
1995	3.32	1.37	0.94	0.47	2.93	0.05	0.00016	9.08
1996	3.48	1.36	1	0.46	3.02	0.04	0.0001	9.36
1997	3.61	1.42	1.13	0.45	3.15	0.04	0.00011	9.80
1998	3.73	1.47	1.22	0.46	3.33	0.04	0.00011	10.25
1999	3.82	1.52	1.21	0.46	3.45	0.04	0.00013	10.50
2000	3.1	1.39	1.13	0.41	2.9	0.03	0.00015	8.96
2001	2.07	1.19	1.06	0.37	2.39	0.03	0.00009	7.11
2002	1.88	1.06	1	0.32	2.17	0.03	0.0001	6.46
2003	1.79	1.08	1.17	0.33	2.15	0.03	0.00015	6.55
2004	1.84	1.17	1.35	0.33	2.19	0.03	0.00029	6.91
2005	1.96	1.29	1.46	0.33	2.21	0.05	0.00023	7.30
2006	2.17	1.48	1.7	0.32	2.31	0.07	0.00035	8.05
2007	2.43	1.7	2.02	0.33	2.44	0.07	0.00049	8.99
2008	2.5	1.84	2.2	0.34	2.38	0.06	0.00059	9.32
2009	2.6	1.93	2.16	0.35	2.42	0.05	0.00066	9.51
2010	2.18	1.45	1.53	0.35	2.09	0.05	0.00074	7.65
2011	2.34	1.57	1.75	0.36	2.3	0.06	0.00098	8.38
2012	2.58	1.81	1.93	0.39	2.54	0.08	0.00077	9.33
2013	2.91	2.01	2.12	0.41	2.86	0.1	0.0008	10.41
2014	3.41	2.32	2.42	0.45	3.27	0.09	0.00131	11.96
2015	3.78	2.49	2.6	0.47	3.59	0.07	0.00132	13.00
2016	4.08	2.79	2.81	0.51	3.96	0.06	0.00118	14.21
2017	4.39	3.01	3.01	0.56	4.29	0.06	0.00116	15.32
2018	4.38	3.06	2.98	0.59	4.29	0.06	0.00146	15.36
2019	4.75	3.23	3.22	0.6	4.59	0.04	0.00148	16.43
2020	4.73	3	3.05	0.61	4.46	0.05	0.00164	15.90
2021	5.02	3.11	2.91	0.58	4.71	0.06	0.0019	16.39
2022	5.51	3.27	3.03	0.6	5.25	0.07	0.00054	17.73

Appendix I. 12.*Total GHG emissions from biomass burning (3.C.1) within 1990-2022 periods.(Unit - Gg)*

3.C.1.a Burning in Forest Land					3.C.1.c Burning in Grassland				
Year	CH_4	N_2O	NOx	CO	Year	CH_4	N_2O	NOx	CO
1990	0.003	0.0002	0.002	0.078	1990	12.18	0.11	20.66	344.25
1991	0.0004	0.00002	0.0002	0.009	1991	29.15	2.66	49.43	823.79
1992	0.001	0.00003	0.0003	0.011	1992	5.43	0.50	9.20	153.33
1993	0.001	0.00006	0.0007	0.024	1993	12.37	1.13	20.97	349.58
1994	0.001	0.00005	0.0006	0.022	1994	16.59	1.51	28.13	468.88
1995	0.001	0.00004	0.0005	0.018	1995	0.10	0.01	0.16	2.73
1996	0.018	0.001	0.011	0.414	1996	37.67	3.44	63.88	1064.70
1997	0.009	0.0005	0.006	0.196	1997	46.85	4.28	79.44	1324.05
1998	0.01	0.0005	0.006	0.218	1998	3.38	1.91	5.73	95.55
1999	0.003	0.0002	0.002	0.075	1999	0.12	2.24	0.20	3.41
2000	0.005	0.0003	0.003	0.121	2000	3.19	0.19	5.41	90.09
2001	0.006	0.0003	0.004	0.132	2001	0.42	0.13	0.71	11.88
2002	0.006	0.0003	0.003	0.128	2002	2.81	0.12	4.77	79.44
2003	0.009	0.0005	0.006	0.213	2003	1.55	1.54	2.62	43.68
2004	0.004	0.0002	0.002	0.081	2004	0.48	3.39	0.82	13.65
2005	0.003	0.0002	0.002	0.077	2005	1.45	1.78	2.46	40.95
2006	0.004	0.0002	0.003	0.097	2006	1.45	2.29	2.46	40.95
2007	0.006	0.0003	0.004	0.143	2007	2.42	0.35	4.10	68.25
2008	0.008	0.0004	0.005	0.172	2008	2.37	0.23	4.02	67.02
2009	0.007	0.0004	0.005	0.177	2009	0.78	0.11	1.32	21.98
2010	0.002	0.0001	0.001	0.048	2010	1.18	0.11	1.99	33.31
2011	0.001	0.00007	0.0008	0.028	2011	10.09	0.92	17.12	285.28
2012	0.007	0.0004	0.004	0.153	2012	22.70	2.07	38.49	641.55
2013	0.004	0.0002	0.002	0.084	2013	27.04	2.47	45.86	764.40
2014	0.001	0.00004	0.005	0.017	2014	14.97	0.46	25.39	423.15
2015	0.001	0.00007	0.0008	0.029	2015	31.88	2.91	54.05	900.90
2016	0.003	0.0002	0.002	0.075	2016	14.01	1.28	23.75	395.85
2017	0.003	0.0002	0.002	0.075	2017	4.06	0.37	6.88	114.66
2018	0.003	0.0001	0.002	0.057	2018	0.20	0.02	0.34	5.73
2019	0.003	0.0001	0.002	0.059	2019	1.26	0.12	2.14	35.63
2020	0.002	0.0001	0.002	0.051	2020	1.13	0.10	1.92	31.94
2021	0.0002	0.00001	0.0001	0.004	2021	1.07	0.10	1.81	30.22
2022	0.001	0.00007	0.0007	0.027	2022	4.45	0.41	7.54	125.73

Appendix I. 13. *GHG emissions and removals from Land (3.B) by source categories.*

Year	4.A.1 Forest land remaining forest land	Year	4.A.1 Forest land remaining forest land
1990	-31997.748	2007	-31904.064
1991	-31998.633	2008	-31904.064
1992	-31998.594	2009	-31904.064
1993	-31998.767	2010	-31924.024
1994	-31998.767	2011	-31923.415
1995	-31998.767	2012	-31923.415
1996	-32038.13	2013	-31923.415
1997	-31001.088	2014	-31923.415
1998	-31001.088	2015	-31923.415
1999	-31001.088	2016	-31891.551
2000	-31909.126	2017	-31921.535
2001	-31905.694	2018	31921.535
2002	-31933.948	2019	-31921.535
2003	-31904.064	2020	-31995.978
2004	-31904.064	2021	-31998.755
2005	-31904.064	2022	-31975.885
2006	-31904.064		

Appendix I. 14. *Breakdown of the direct and indirect N2O emissions from managed soils within 1990-2022 periods, Gg CO2-eq.*

Year	3.D.1 Direct N_2O Emissions from managed soils (CO_2-eq)	3.D.1 Indirect N_2O Emissions from managed soils (CO_2-eq)
1990	2118.2036	775.101
1991	2092.4938	765.348
1992	2091.7147	765.139
1993	2123.5608	782.57
1994	2216.479	809.994
1995	2403.549	875.798
1996	2479.804	901.218
1997	1882.014	799.856
1998	1985.867	843.993
1999	2816.705	1029.087
2000	3312.084	1091.477
2001	2029.396	771.582
2002	1469.645	624.599
2003	1402.674	745.016
2004	2099.739	811.493
2005	2252.52	871.066

2006	2541.493	984.905
2007	2916.76	1128.431
2008	3083.654	635.604
2009	3136.383	645.238
2010	2398.593	923.817
2011	2653.388	1024.914
2012	2968.71	1148.167
2013	3286.424	1268.927
2014	3788.066	1459.968
2015	4101.543	834.932
2016	4494.219	1730.78
2017	4836.287	986.109
2018	4846.935	1867.508
2019	5190.306	1997.086
2020	4959.155	1899.779
2021	5027.341	1916.008
2022	5366.136	2038.445

NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTSUSE GASES

INTRODUCTION

Mongolia is fully committed to the international climate action. Mongolia signed the United Nations Framework Convention on Climate Change (UNFCCC) on June 12, 1992, and ratified on September 30, 1993. Ratified the Kyoto protocol in 1999 and the Paris Agreement in 2016.

Mongolia has prepared five national GHG inventories as part of the Mongolia's first National Communication (NC) Report (1990-1998), the Second NC (1990-2006)[262], the Third NC (1990-2014)[263], the Initial Biennial Update Report (iBUR) (1990-2014)[264], and Second Biennial Update Report (BUR2) (1990-2020)[265]. Each report demonstrates improvements in data quality, methodologies, and adherence to IPCC guidelines.

The recent GHGI has been compiled following the 2006 Guidelines of the Intergovernmental Panel on Climate Change (IPCC) as part of the first BTR and used the GHG Inventory Software[266] and prepared the common reporting tables (CRT) in line with Decision 5/ CMA.3. Global Warming Potential (GWP) values are taken from the IPCC Fifth Assessment Report (AR5)[267].

In accordance with paragraph 64(a) of the Modalities, Procedures and Guidelines (MPGs) adopted under Decision 18/CMA.1 of the Paris Agreement, this section presents Mongolia's national circumstances relevant to the implementation and achievement of its Nationally Determined Contribution (NDC). The analysis covers political-institutional structures, demographic and spatial dynamics, and governance mechanisms relevant to transparency, accountability, geographical profile, and climate action.

GOVERNMENT AND ADMINISTRATIVE SYSTEM (2022)

Mongolia is a unitary, sovereign state governed by the Constitution adopted in 1992, which established a parliamentary democracy with an independent judiciary and clear separation of powers among the legislative, executive, and judicial branches[268]. The State's governance framework is the legal foundation for executing climate-related obligations under the UNFCCC and the Paris Agreement.

The State Great Khural (SGK) is Mongolia's unicameral legislature, consisting of 76 members elected for four-year terms[269]. It exercises authority to enact legislation, approve the state budget, ratify international treaties, and oversee executive performance.

262 Mongolia. National Communication (NC). NC 2. | UNFCCC, https://unfccc.int/documents/125547
263 Mongolia. National Communication (NC). NC 3. | UNFCCC, https://unfccc.int/documents/66255
264 https://unfccc.int/sites/default/files/resource/20231112_BUR_II_MGL_Final.pdf
265 Mongolia. Biennial Update Report (BUR). BUR 2. | UNFCCC, https://unfccc.int/documents/633382
266 https://www.ipcc-nggip.iges.or.jp/software/index.html
267 https://www.ipcc.ch/assessment-report/ar5/
268 Constitution of Mongolia, 1992 (as amended).
269 State Great Khural Secretariat. Parliamentary Structure and Functions. Retrieved from https://www.parliament.mn/.

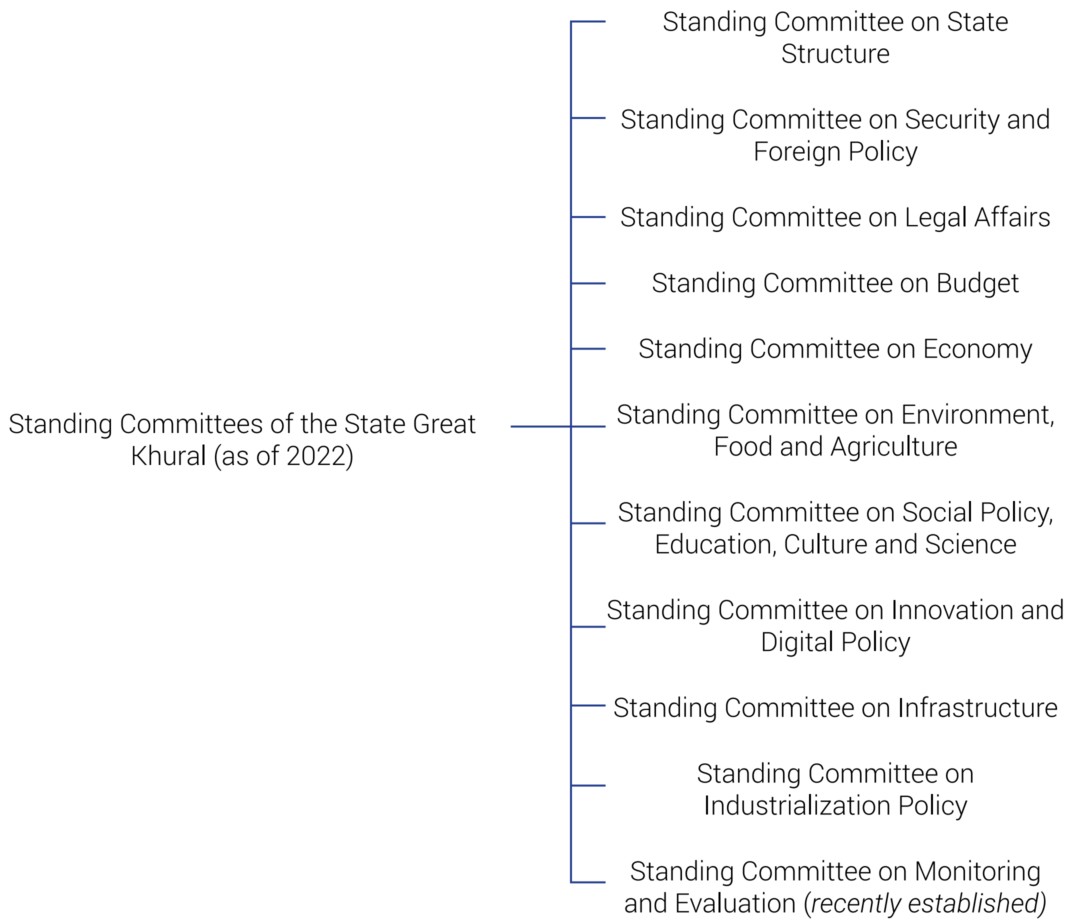

Figure A.1.Structure of the State Great Khural (2020–2023)

As of 2022, discussions on electoral reform were ongoing to transition from a majoritarian system to a mixed-member proportional system, intended to strengthen parliamentary inclusiveness[270]. The Parliament of Mongolia adopts national policies relevant to the NDC, including Mongolia's Vision 2050 strategy[271], the Green Development Policy[272], and others.

The executive authority is vested in the Government of Mongolia, led by the Prime Minister, who is appointed by the Parliament and formally designated by the President. The Prime Minister chairs the Cabinet and ensures the implementation of laws and national strategies across ministries. As of January 2021, Prime Minister L.Oyun-Erdene assumed office, emphasizing digital governance, green recovery, and long-term development[273].

In August 2022, institutional reforms expanded the Cabinet from 14 to 16 ministries. Two new ministries were established:

- The Ministry of Economy and Development (MED), tasked with long-term macroeconomic planning, public investment policy, and development financing[274];
- The Ministry of Digital Development and Communications (MDDC), mandated to lead digital transformation, integrated data infrastructure, and e-governance systems[275] .As part of the same reform

270 UNDP Mongolia. (2022). Electoral Reform Assessment Report.
271 Government of Mongolia. (2020). Vision 2050 Long-Term Development Policy.
272 Government Resolution No. 294 of 2014, National Green Development Policy.
273 Prime Minister's Office. (2021). "New Revival Policy" Speech and Agenda.
274 Ministry of Economy and Development. (2022). Strategic Planning Mandates and Annual Budget.
275 Ministry of Digital Development and Communications. (2022). Digital Governance Reform Strategy.

package, constitutional amendments allowed for a broader overlap between legislative and executive functions. A restructured Cabinet was introduced, comprising 22 members, of whom 16 concurrently served as Members of Parliament. This configuration facilitated improved policy coherence and institutional alignment for cross-sectoral climate governance and NDC implementation[276].

The President of Mongolia, elected by universal suffrage for a single six-year term, holds constitutionally defined responsibilities, including the appointment of judges, limited veto powers, and leadership of the National Security Council. The incumbent President, Ukhnaa Khurelsukh (elected in 2021), has initiated several national climate resilience campaigns, including the "One Billion Trees" program and the Presidential Green Movement[277].

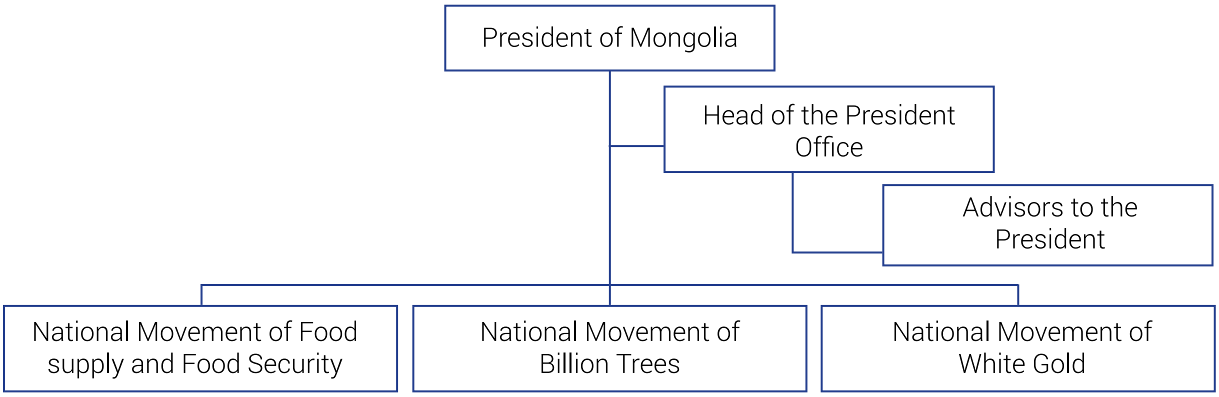

Figure A. 2. Institutional Role of the President

The judiciary operates independently through a three-tiered system comprising district courts, appellate courts, the Supreme Court, and the Constitutional Court. It serves to uphold legal integrity, rule of law, and environmental justice in climate governance.

At the subnational level, Mongolia is divided into 21 aimags (provinces) and the capital city of Ulaanbaatar, which has aimag-equivalent status. These are further divided into 329 soums (districts) and 1,560 bags (subdistricts)[278]. Ulaanbaatar, hosting nearly 50% of the national population, is organized into 9 duuregs (urban districts) and 132 khoroos (urban subdistricts) and functions as the administrative and economic center of the country[279].

276 Mongolian Legal Information Center. (2022). Amendments to the Law on Government Structure and Composition
277 Office of the President of Mongolia. (2021). "One Billion Trees" National Campaign Brief
278 Office of the President of Mongolia. (2021). "One Billion Trees" National Campaign Brief.
279 National Statistics Office of Mongolia. (2023). Population and Administrative Division Data.

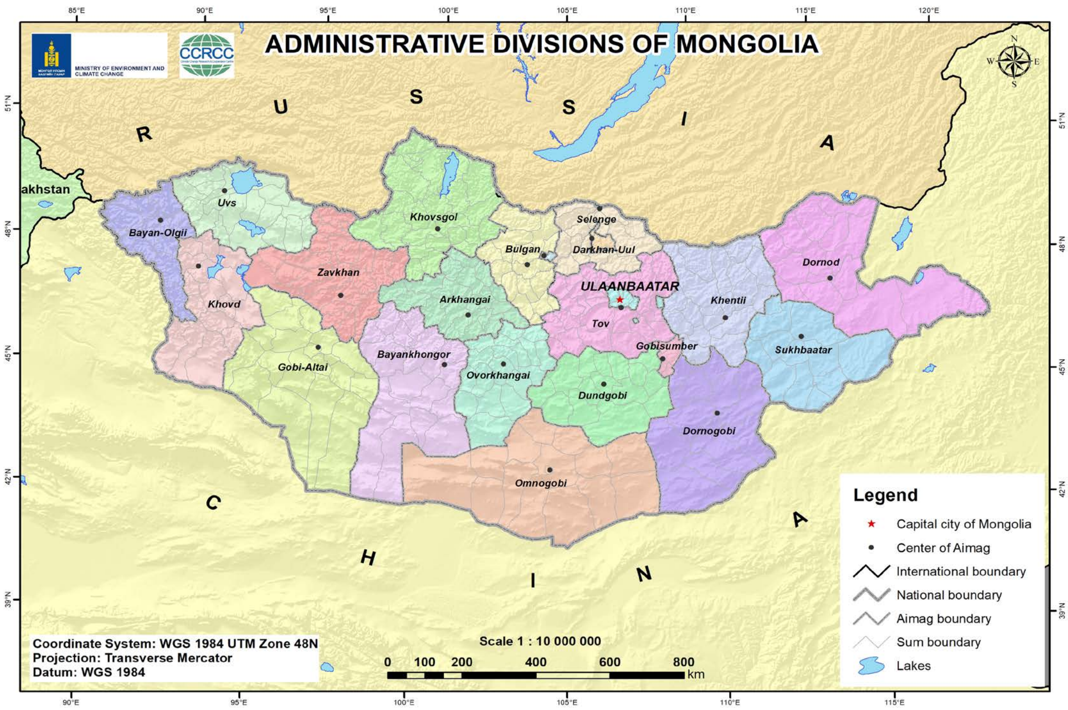

Figure A. 3. Administrative and Governance Layers of Mongolia

Local governance is carried out through Citizens' Representative Khurals (CRKs) at the aimag and soum levels, which are responsible for approving local development policies, budgets, and plans aligned with national climate and development priorities. Executive authority at the local level rests with Governors, who are jointly nominated by the CRKs and appointed by the central government. This system promotes vertical coordination in climate policy implementation, including in adaptation and subnational MRV systems[280].

At the national level, climate governance is coordinated through the National Committee on Climate Change (NCCC), chaired by the Minister of Environment and Tourism and composed of Director Generals of the line ministries. The NCCC provides inter-ministerial oversight of NDC implementation and national climate strategy development[281].

As of 2021 and 2022, the Ministry of Environment and Tourism (MET) acts as the national focal point to the UNFCCC and leads the coordination of NDC implementation and reporting. It works in close partnership with sectoral ministries, including:

- The Ministry of Energy (MOE), responsible for energy efficiency, renewable deployment, and fossil fuel phase-down;
- The Ministry of Food, Agriculture and Light Industry (MOFALI), responsible for AFOLU-related mitigation and adaptation measures;
- The Ministry of Construction and Urban Development (MCUD), which addresses climate-resilient infrastructure and urban adaptation[282].
- Climate-related legal and policy instruments supporting NDC implementation include:
- The Law on Air Pollution Reduction (2011)[283];

280 Capital City Governor's Office. (2023). Ulaanbaatar Development and Planning Dashboard.
281 MET. (2023). Terms of Reference of the National Committee on Climate Change.
282 MET. (2023). Inter-ministerial Coordination for NDC Implementation. National Climate Governance Brief.
283 Government of Mongolia. (2011). Law on Air Pollution Reduction.

- The National Green Development Policy (2014)[284];
- Localized adaptation and mitigation strategies developed in alignment with Vision 2050 and the National Adaptation Plan (NAP)[285].

These legal, institutional, and administrative arrangements enable the country to deliver on its commitments under Article 4 and Article 13 of the Paris Agreement while ensuring adherence to the TACCC principles: Transparency, Accuracy, Consistency, Comparability, and Completeness.

Population and urbanization

Demographic and spatial dynamics in Mongolia are not only descriptive indicators of national circumstances but are also determinants of institutional capability, climate vulnerability, and policy effectiveness. These trends intersect directly with Mongolia's GHG emission drivers, adaptive capacity, and the distributional equity of climate interventions. This section provides a critical analysis of population structure and urbanization processes, in line with MPG 64(a–b) and 65(a–c), highlighting structural opportunities and systemic barriers to effective NDC implementation.

Population Trends and Structure

As of 2022, Mongolia's total population stood at approximately 3.43 million, having grown from 2.2 million in 1990[286]. While the population trajectory reflects stability, the demographic structure is undergoing a profound transition. The median age of 31.6 years signals a shift toward a more mature population, characterized by a declining dependency ratio but a rising share of older adults[287].

Critically, the working-age cohort (15–64 years) constitutes over 65% of the population—suggesting a time-bound demographic dividend. However, labor force participation among youth, women, and rural populations remains below potential due to structural unemployment, skill mismatches, and underinvestment in green vocational pathways. Without targeted policy interventions, this demographic advantage may be lost before it yields transformative socioeconomic benefits.

Simultaneously, the projected doubling of the elderly population by 2050 (from 5% to over 10%) will significantly alter health service demand, social welfare burdens, and vulnerability profiles particularly under climate-related health risks such as heatwaves, respiratory stress, and infectious disease outbreaks[288]. Yet current health system preparedness remains limited, especially in rural and peri-urban areas.

Furthermore, Mongolia's gender-disaggregated life expectancy (75.5 years for women, 69.2 for men) raises additional considerations for gendered climate vulnerability, labor availability, and access to adaptation services[289]. Despite these dynamics, institutional use of disaggregated population data in climate planning remains ad hoc and under-integrated in sectoral policies and national adaptation strategies.

Urbanization Trends and Spatial Concentration

Urbanization in Mongolia has proceeded rapidly and unevenly. As of 2022, 69.5% of the population lived in urban areas—up from 57% in 2000—with Ulaanbaatar alone housing 48.1% of the population[290]. This urban dominance has transformed Mongolia's emissions profile and introduced new climate governance challenges.

[284] Government Resolution No. 294 of 2014, National Green Development Policy
[285] Government of Mongolia. (2020). Vision 2050 Long-Term Development Policy.
[286] National Statistics Office of Mongolia (NSO). Statistical Yearbook 2022.
[287] United Nations Population Division. World Population Prospects: Mongolia. 2022 Revision.
[288] NSO & UNFPA. "Demographic Projections of Mongolia, 2020–2050." Technical Report, 2021.
[289] WHO Mongolia Country Profile. Global Health Observatory Data, 2022.
[290] World Bank. Urban Population (% of total), Mongolia. World Development Indicators, 2022.

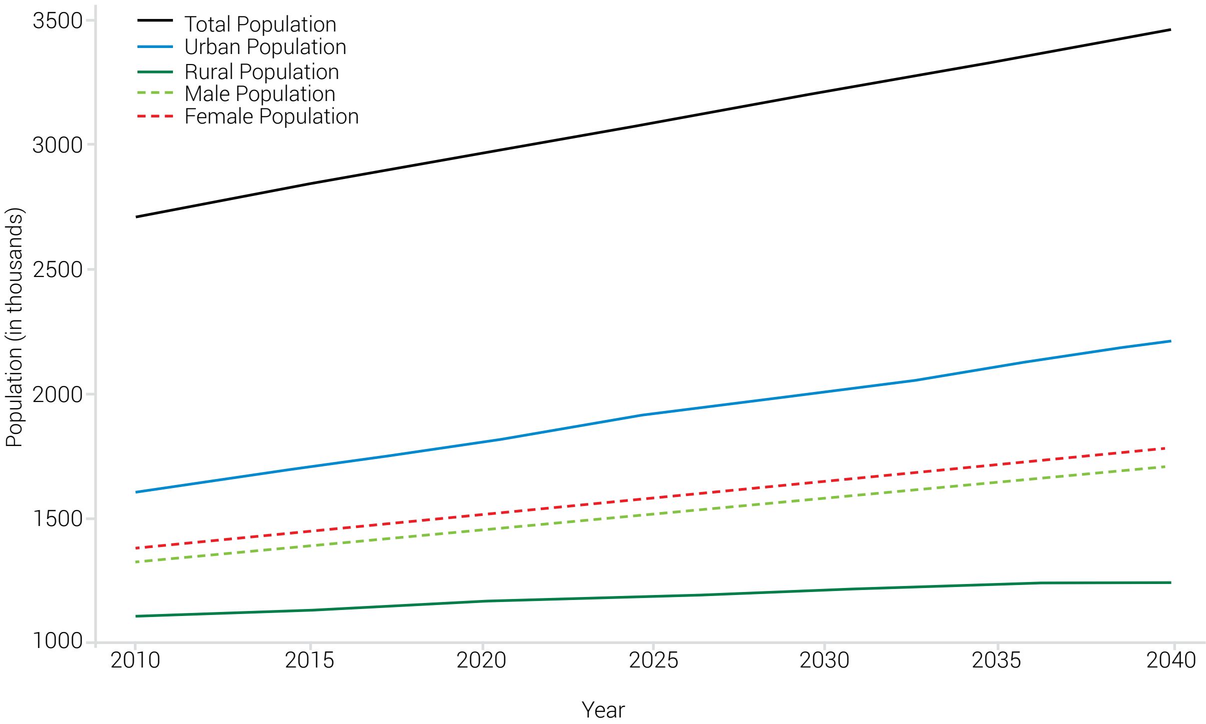

Figure A. 4. Population trend in Mongolia (2010-2040)

The expansion of unplanned ger areas—a direct result of rural-to-urban migration driven by climate-induced displacement (e.g., dzuds, droughts, pasture degradation)—has outpaced infrastructure development[291]. These settlements are now the epicenter of Mongolia's energy insecurity, public health stress, and urban GHG emissions due to:

- Widespread use of raw coal and biomass for heating;
- Over-reliance on diesel-based transport;
- Inadequate sanitation, drainage, and stormwater systems.

This spatial concentration of both population and emissions creates a climate policy paradox: the same areas driving emissions growth are also the most vulnerable and underserved. Despite successive programs-such as the Ulaanbaatar Clean Air Project, Ger Area Redevelopment Strategy, and Green City Action Plan-transformative progress has been constrained by fragmented mandates, short-term financing, and weak coordination between national and city governments[292].

Critically, urbanization is not evenly distributed. While Ulaanbaatar attracts disproportionate migration and investment, secondary cities (e.g., Darkhan, Erdenet, Choibalsan) remain underutilized in spatial planning frameworks. This reinforces geographic inequality in adaptation access, investment flow, and climate service delivery- contrary to the decentralization principles set out in Mongolia's long-term policies.

Moreover, urban poverty and informality undermine the inclusiveness of Mongolia's NDC. Ger area residents are often excluded from centralized services (heating, electricity, waste collection), and adaptation programs frequently lack tailored approaches for informal households. Without deliberate targeting and integration of informal populations into green infrastructure investments, maladaptation risks will increase, as will socially discontent over inequitable climate outcomes.

291 National Emergency Management Agency (NEMA). "Climate Migration and Displacement Trends," 2021.

292 Asian Development Bank. "Green City Action Plan: Ulaanbaatar." 2020; UNDP. "Urban Climate Resilience in Mongolia," 2022.

These improvements are essential for ensuring that Mongolia's climate strategies remain inclusive, evidence-based, and geographically equitable, while avoiding maladaptation and promoting efficient resource allocation in climate-sensitive sectors such as energy, housing, health, and transport.

GEOGRAPHICAL PROFILE

Mongolia is a landlocked country in north-central Asia, covering an area of approximately 1,564,116 square kilometers, ranking as the 18th largest country globally in terms of land area. It lies between 41°35'N–52°09'N latitude and 87°44'E–119°56'E longitude, bounded by the Russian Federation to the north and the People's Republic of China to the south[293]. The country's central position in the Eurasian landmass, coupled with its high elevation and inland location, creates a markedly continental climate characterized by extreme seasonal variability in temperature and precipitation.

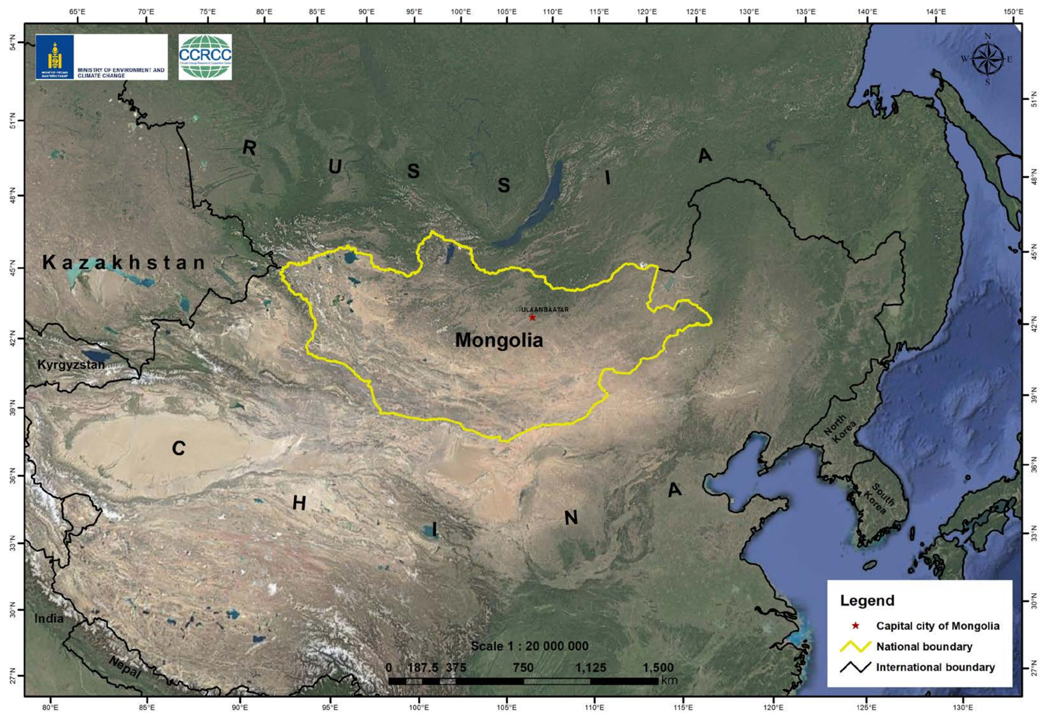

Figure A. 5. Geographic location of Mongolia

Mongolia has an average elevation of approximately 1,580 meters above sea level, characterized by pronounced regional topographic heterogeneity. The western and northern regions are dominated by high mountain systems, including the Altai, Khangai, and Khentii ranges, while the central and eastern zones comprise expansive steppe and plateau landscapes. The southern region is defined by the Gobi Desert—an extensive arid ecosystem typified by fragile, erodible soils, low vegetation productivity, and extreme climatic variability[294].

Land cover classification data confirm that grasslands comprise over 75% of the national territory, underpinning Mongolia's extensive

[293] General Authority for State Registration (GASR). (2022). *Geodetic and Cartographic Reference Atlas of Mongolia*.
[294] National Agency for Meteorology and Environmental Monitoring (NAMEM). (2023). *Climate Change Vulnerability Assessment for Mongolia*. Ulaanbaatar.

pastoral livestock systems[295]. Forests, predominantly boreal taiga dominated by Larix sibirica (Siberian larch), cover approximately 7.9% of the land area, mostly concentrated in the northern and northeastern high-altitude zones[296]. Arable land remains limited-accounting for roughly 1% of total land area-mainly located in river valleys and intermontane basins where agroecological conditions permit cultivation[297].

Mongolia's land use structure is fundamentally shaped by its physiographic constraints and nomadic pastoral economy. These factors present both opportunities and challenges for meeting targets under the NDC, particularly within AFOLU sub-sectors. Key considerations include emission reductions from degraded grasslands, sustainable forest management, afforestation, and improved soil carbon sequestration through enhanced pasture and livestock practices[298].

Hydrologically, Mongolia belongs to three major river basins: the Arctic Ocean Basin, the Pacific Ocean Basin, and the Central Asian Internal Drainage Basin, with more than 76% of the country's rivers draining into closed basins with no ocean outlet[299]. The headwaters of major river systems—including the Selenge, Orkhon, and Onon-originate from mountain ranges and are fed by seasonal snowmelt and glacial runoff, which are increasingly sensitive to climate variability and long-term warming trends. The country hosts more than 3,500 rivers, 7,000 springs, and 4,000 lakes, but over 70% of river runoff is generated in only 30% of the territory, indicating high spatial disparity in water availability[300].

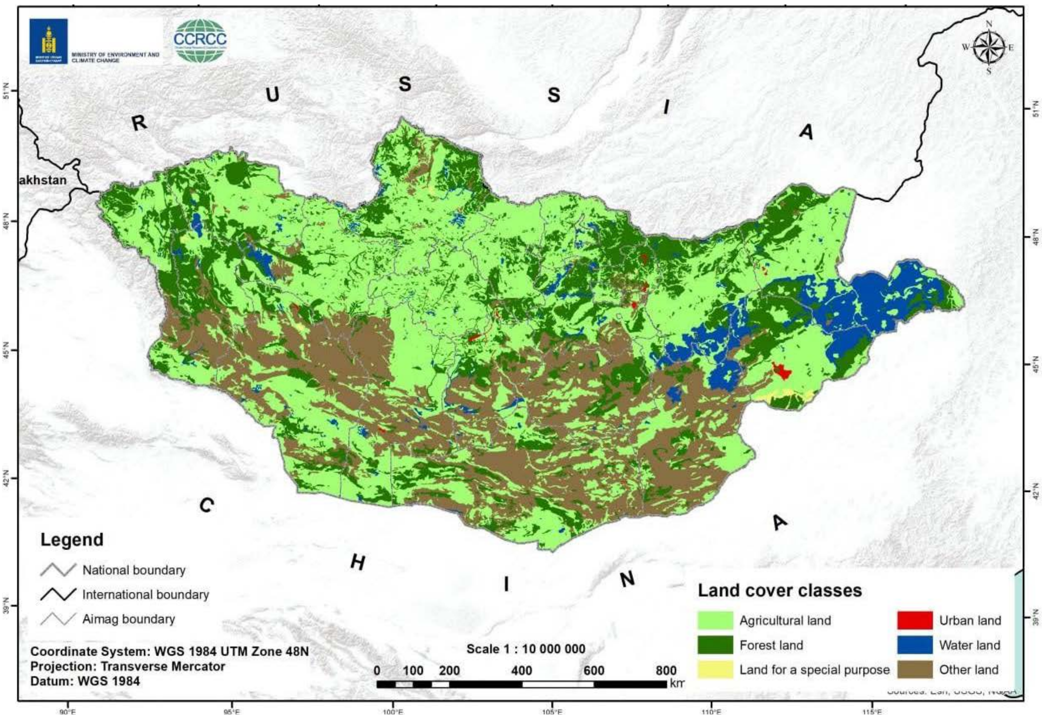

Figure A. 6. Land use categories

[295] Information and Research Institute of Meteorology, Hydrology and Environment (IRIMHE). (2022). *National Land Cover Assessment Report (2019–2021).*

[296] Ministry of Environment and Tourism. (2021). *Forest Inventory and Monitoring Data.* Ulaanbaatar.

[297] Ministry of Food, Agriculture and Light Industry (MOFALI). (2022). *Crop Production Statistical Yearbook 2021.* Ulaanbaatar.

[298] Ministry of Environment and Tourism & FAO. (2022). *NDC Implementation Roadmap for the AFOLU Sector (2021–2030).* Ulaanbaatar.

[299] Ministry of Environment and Tourism & National Agency for Meteorology and Environmental Monitoring (NAMEM). (2023). *Hydrology and Water Resources Annual Bulletin 2022.* Ulaanbaatar: MET/NAMEM.

[300] National Statistics Office of Mongolia (NSO). (2023). *Mongolia Statistical Yearbook 2022.* Ulaanbaatar: NSO.

As of financial year 2022, Mongolia's land use profile highlights its predominantly natural landscapes, with significant portions designated as grasslands and forest steppe. These ecosystems play crucial roles in supporting the country's pastoral economy, ecological stability, and terrestrial carbon balance. Mongolia's arid and semi-arid climate, combined with its unique geographic and biophysical conditions, has shaped distinct land use patterns that are central to traditional nomadic livestock farming, biodiversity conservation, and climate change adaptation strategies. The predominance of grasslands and ecological heterogeneity is vital for sustaining rural livelihoods and maintaining long-term environmental resilience[301]. Thus, Mongolia's land use structure reflects its unique biophysical characteristics, climatic conditions, and socio-economic reliance on natural ecosystems. In 2025 Ministry of Environment and Tourism issued Mongolia Environmental State Report 2021–2023 (ESR-2023)[302]. According to this ESR-2023 the classification is based on the unified land fund assessment (2021–2023), which provides the official source of baseline for monitoring land-based greenhouse gas emissions, removals, and ecosystem services. (Table A. 1)[303].

Table A. 1. Land use categories

Category	Share	Comment
Grasslands	69.8%	Grasslands dominate Mongolia's land cover and constitute the foundation of the traditional herding economy and cultural heritage. These areas are essential for livestock grazing and play a critical role in maintaining ecosystem equilibrium and carbon flux dynamics.[304]
Forest Land	9.1%	Primarily located in northern regions, forest ecosystems contribute significantly to carbon sequestration, water retention, and biodiversity preservation.[305]
Cropland	0.7%	Agricultural land is constrained by Mongolia's extreme continental climate. Crops are mainly limited to hardy varieties such as grains, potatoes, and select vegetables.[306]
Wetlands	0.4%	Though small in extent, wetlands are vital for biodiversity conservation, particularly as habitats for migratory bird species and endemic flora.[307]
Settlements	0.6%	Urban and peri-urban settlements, notably Ulaanbaatar, Darkhan, and Erdenet, occupy a minimal share of land but serve as economic and administrative centers.[308]
Road Networks	0.5%	This category includes linear infrastructure such as roads, railways, airports, and water transport facilities.[309]
Protected Areas	16.7%	Includes designated special protection zones, border security areas, and territories reserved for national defense.[310]
Other Land	2.1%	Encompasses hayfields, fallow land, cultivated plots not used for crops, and land under agricultural infrastructure.[311]

301 Ministry of Environment and Tourism (2025). Environmental State Report of Mongolia 2021–2023 (ESR-2023). Based on the Unified Land Fund Assessment (2021–2023), which serves as the official national dataset for land classification in support of LULUCF sector reporting under the 2006 IPCC Guidelines and the Enhanced Transparency Framework (ETF) of the Paris Agreement.
302 Ministry of Environment and Tourism. 2025. Mongolia Environmental State Report 2021–2023
303 Ministry of Environment and Tourism. 2025. Mongolia Environmental State Report 2021–2023
304 Ibid., p. 58.
305 Ibid., p. 59.
306 Ibid., p. 60.
307 Ibid., p. 61.
308 Ibid., p. 62.
309 Ibid., p. 63.
310 Ibid., p. 64.
311 Ibid., p. 65.

This distribution illustrates the ecological and economic significance of grasslands and forests in supporting national climate adaptation and mitigation efforts. Grasslands, covering nearly 110.9 million hectares, are instrumental for carbon sequestration, while forest land contributes to regulating water cycles and sustaining biodiversity.[312]

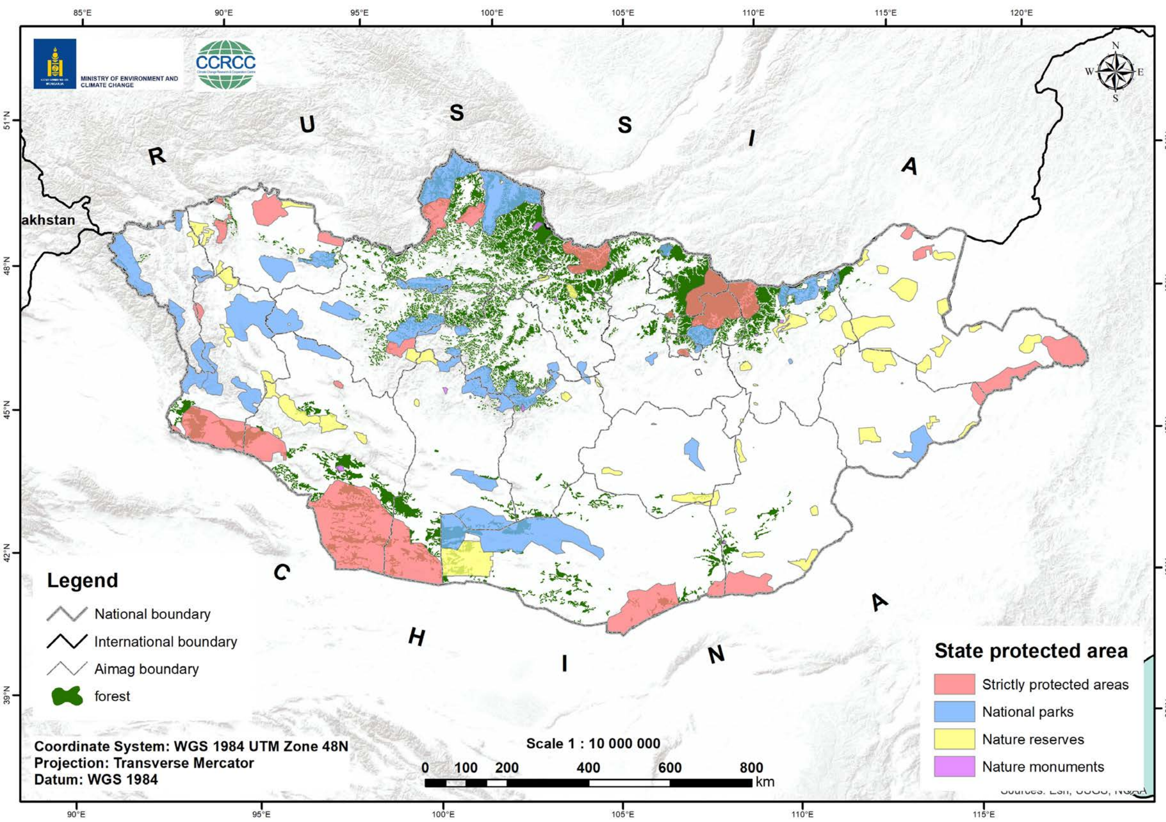

Figure A. 7. Map of Protected Areas of Mongolia

Despite the extensive natural landscapes, Mongolia faces intensifying environmental degradation pressures, including desertification, pastureland overuse, and uncontrolled urban expansion. These drivers have resulted in the degradation of an estimated 4.8 million hectares as of 2023, predominantly affecting rangelands.[313] This trend jeopardizes rural livelihoods, reduces ecosystem service capacity, and exacerbates climate vulnerability.

To address these challenges, Mongolia has prioritized the expansion of its protected area network. Currently, the country has established 120 nationally designated Specially Protected Areas (SPAs), covering approximately 31 million hectares. In addition, local authorities have designated 24.5 million hectares as locally protected areas. Collectively, these zones account for roughly 15.7% of Mongolia's total landmass.[314]

Climate Profile

Mongolia has a cold, arid continental climate, characterized by pronounced temperature extremes, low precipitation, and high interannual variability. Located deep within the Eurasian interior, the country experiences four distinct seasons long, harsh winters and short, warm summers. (See detailed information in Chapter 3)

312 Ministry of Environment and Tourism (2025). *Environmental Status Report of Mongolia, 2021–2023,* Figure II.54
313 Ibid., Figure II.55 and associated dataset.
314 Ibid., Figure II.55 and associated dataset.

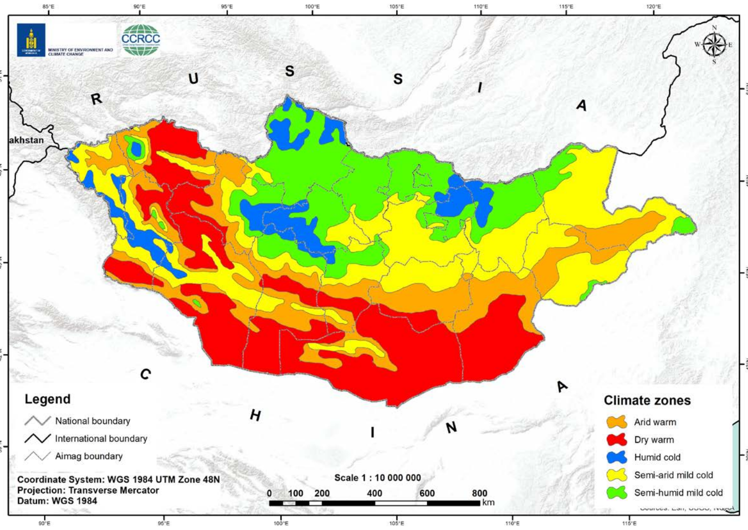

Figure A. 8. Climate zones of Mongolia

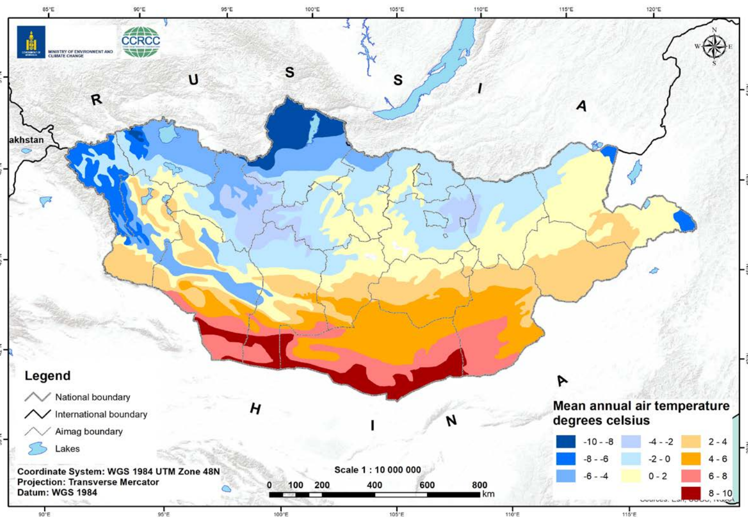

Figure A. 9. Mean annual temperature

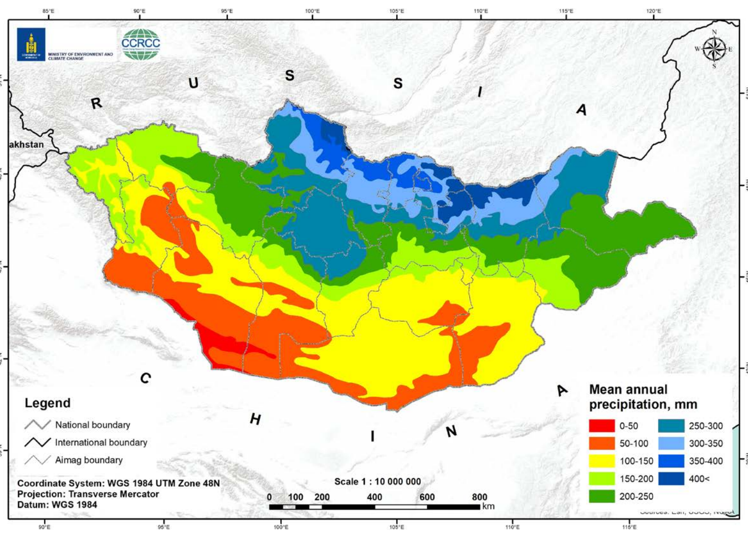

Figure A. 10. Mean annual precipitation

ECONOMIC PROFILE AND DEVELOPMENT TRAJECTORY

Mongolia's planned to a market-based economy, underpinned by its comparative advantage in natural resource endowments and extensive livestock systems. This dual dependence on mineral extraction and pastoralism has resulted in a growth model that is structurally narrow and acutely sensitive to external shocks, posing both opportunities and systemic vulnerabilities for achieving sustainable development and meeting climate targets under the Nationally Determined Contribution (NDC)[315].

The 1990s marked a period of profound socioeconomic transformation following the dissolution of the Soviet Union. Mongolia experienced a collapse of institutional and trade linkages with its former socialist partners, triggering a sharp contraction in real GDP, hyperinflation, widespread poverty, and a significant decline in industrial output[316]. Structural adjustment reforms—including the privatization of state-owned enterprises, liberalization of prices, and fiscal restructuring—were initiated to stabilize the economy. Despite the initial turbulence, this period laid the foundational architecture for a market-based system and Mongolia's integration into the global economy.

In the 2000s, Mongolia entered a resource-driven growth phase propelled by the development of large-scale mining projects. Notably, the Oyu Tolgoi copper-gold deposit emerged as a flagship investment, catalyzing foreign direct investment and enhancing fiscal revenues. Between 2005 and 2013, the national economy grew at an average annual rate of 8.5%, placing Mongolia among the top-performing developing economies globally[317]. However, this period of growth was highly sectoral concentrated, with over one-third of GDP and 90% of exports attributed to the extractive sector, rendering the economy vulnerable to volatility in global commodity markets.

By 2011, Mongolia recorded an unprecedented GDP growth rate of 17.3%, driven by high copper and coal prices, expansionary fiscal policy, and investor optimism. However, beginning in 2014, the economy entered a downturn due to falling global commodity prices, external debt accumulation, and rising macroeconomic imbalances. The country's credit rating was downgraded, and fiscal and external account deficits widened significantly.

In response to growing vulnerabilities, the Government of Mongolia entered into a three-year Extended Fund Facility (EFF) arrangement with the International Monetary Fund (IMF) in 2017. The program supported a series of stabilization reforms, including fiscal consolidation, enhanced debt management frameworks, and banking sector resilience measures[318]. These interventions contributed to macroeconomic recovery by 2019, although the COVID-19 pandemic and subsequent global disruptions introduced renewed challenges.

Figure II.13 illustrates the evolution of Mongolia's real GDP and GDP per capita between 1990 and 2023, capturing the structural shifts, external shocks, and recovery dynamics that characterize Mongolia's economic narrative over the past three decades.

By the 2010s, Mongolia's economy reached a peak in 2011, with GDP expanding by 17.3%, fueled by high global commodity prices and foreign investment. However, a downturn followed from 2014 onwards due to declining

[315] Government of Mongolia. (2020). Updated Nationally Determined Contribution (NDC). Ministry of Environment and Tourism.

[316] World Bank. (2003). Mongolia: Sources of Growth. Washington, DC.

[317] Asian Development Bank. (2015). Mongolia: Promoting Inclusive Growth. Manila.

[318] International Monetary Fund. (2021). Sixth Review Under the Extended Fund Facility Arrangement for Mongolia. IMF Country Report No. 21/9. Washington, DC.

coal and copper prices, mounting debt, and macroeconomic instability. Stabilization efforts, supported by an International Monetary Fund (IMF) program, introduced fiscal consolidation and debt management strategies that restored confidence and gradually improved fiscal performance[319].

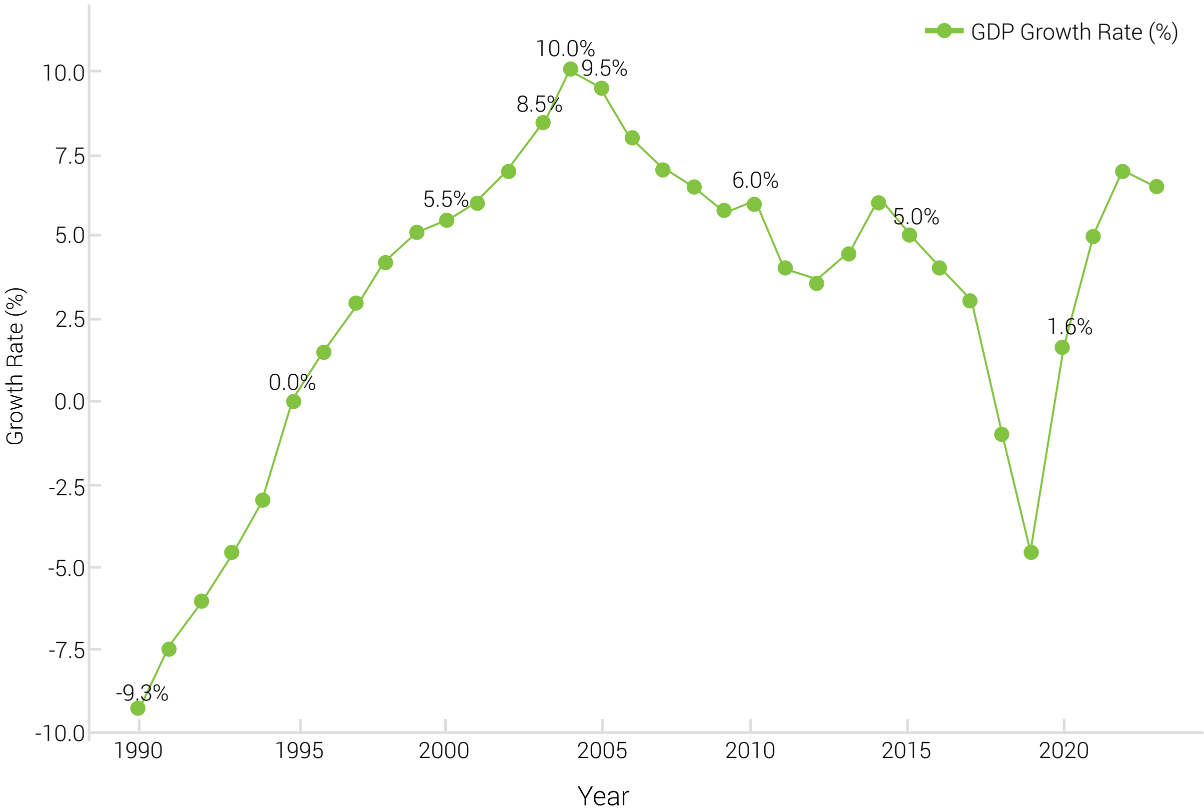

Figure A. 11. Economic growth (1990-2023)

In the 2020s, the COVID-19 pandemic triggered Mongolia's most significant economic contraction in decades. In 2020, GDP declined by 5.3% due to border closures, disrupted trade, and decreased household consumption. Recovery began in 2021, bolstered by global demand for minerals and domestic stimulus. In 2023, the economy grew by 7.42%, driven by record-high mining output and increasing private consumption .[320, 321]

Table A. 2. .Key Economic Indicators (2023

Indicator	*Value*
Nominal GDP	USD 20.33 billion
GDP per capita (nominal)	USD 5,839
GDP per capita (PPP-adjusted)	USD 16,223
Real GDP growth rate	7.42%
Population	3.5 million (NSO, 2023)

319 International Monetary Fund. 2022. Mongolia – IMF Country Report No. 22/94
320 National Statistics Office (NSO). Statistical Yearbook of Mongolia. 2024
321 Bank of Mongolia. 2024. Monthly Statistical Bulletin. March, 2024

Structural Composition of the Economy

Mongolia's economy is a hybrid of resource dependence, rural agricultural livelihoods, and expanding service industries. The mining sector is the largest contributor, accounting for 23% of GDP and over 80% of total exports in 2023. It remains the dominant source of fiscal revenue and foreign direct investment.

Agriculture represents about 10% of GDP and employs approximately 27% of the labor force. Livestock herding is central to rural livelihoods and food security, yet it is also the largest source of agricultural greenhouse gas emissions, particularly methane from enteric fermentation and manure management.

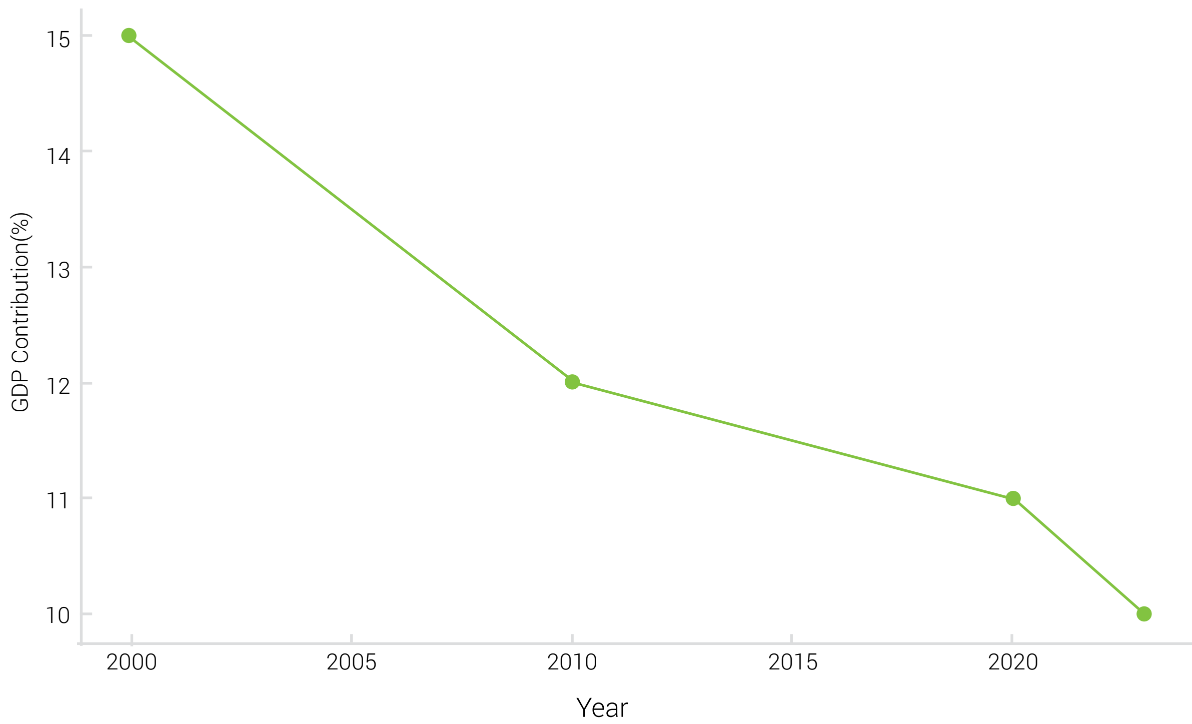

Figure A. 12. Agriculture GDP contribution (2000-2023)

The services sector has grown steadily, contributing 57% of GDP in 2023. Key subsectors include retail, transport and logistics, telecommunications, and financial services—driven largely by urbanization, digitalization, and infrastructure development (World Bank, 2024).[322]

Trade Structure and External Dependencies

Mongolia's economy is deeply dependent on trade, particularly in mineral exports. Over 80% of exports consist of coal, copper concentrates, gold, and iron ore. China accounts for more than 85% of Mongolia's total exports, making the economy highly sensitive to Chinese demand and border policies. Other significant export destinations include Switzerland (mainly gold), South Korea, and Russia.

322 World Bank (WB). 2024. National Accounts Data

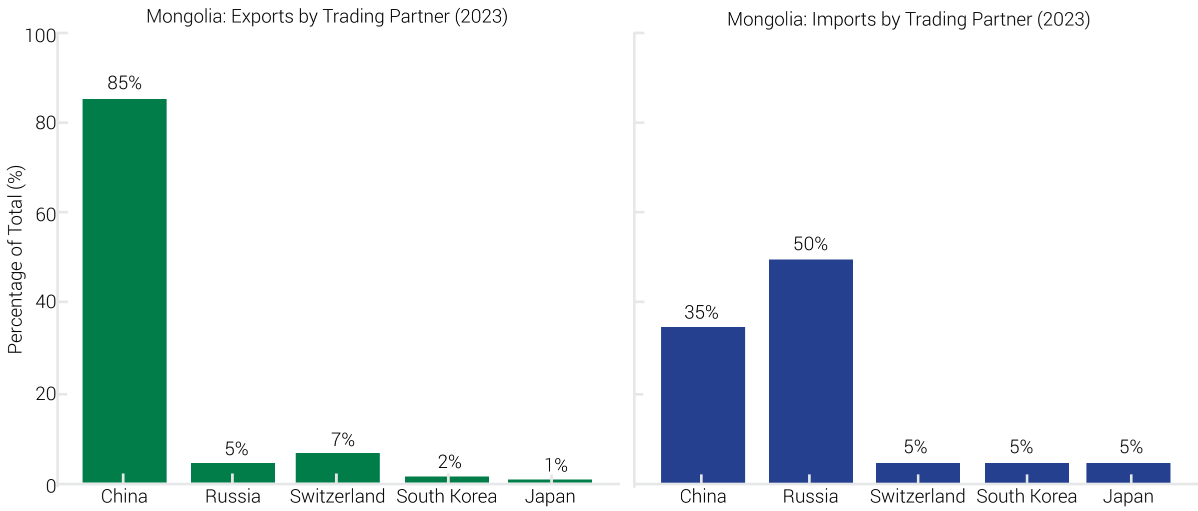

Figure A. 13. Mongolia's trading partners (2023)

Imports consist primarily of petroleum products, heavy machinery, construction materials, and consumer goods. These are sourced predominantly from China and Russia, with additional imports from Japan, South Korea, and Germany. Mongolia often maintains a trade surplus due to the value of mineral exports, but this balance is highly susceptible to commodity price swings and logistical constraints.

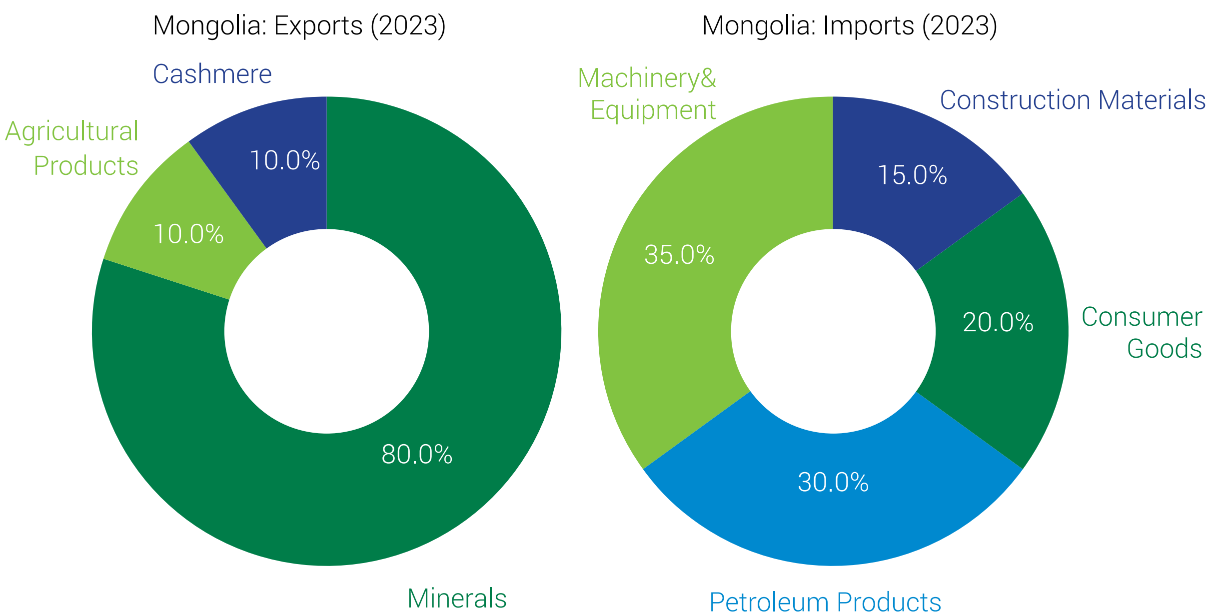

Figure A. 14. Import and export by commodities (2023)

Focusing on the concentration of trade in a few sectors and partners, diversification remains a national priority. Opportunities include expanding value-added exports such as processed cashmere, meat, and agricultural products, as well as leveraging strategic infrastructure corridors like the China-Mongolia-Russia Economic Corridor. Investments in renewable energy and climate-resilient agriculture also offer pathways toward a more diversified and green economy.[323, 324]

Sectoral Information Relevant to NDC Implementation

Agriculture:

Agriculture continues to be the backbone of rural livelihoods in Mongolia, particularly for pastoral herding communities. However, it is also one of the largest contributors to national greenhouse gas (GHG) emissions, primarily due to methane (CH_4) released from enteric fermentation in livestock. As outlined in Chapter 1 of this report, the agriculture sector contributes over 40% of Mongolia's total greenhouse gas (GHG) emissions, with methane accounting for more than 80% of the sector's emissions.

Mongolia's updated NDC (2020) identifies a set of mitigation and adaptation interventions for the agriculture sector. These include rotational grazing systems, pastureland restoration, climate-resilient fodder cultivation, and improved manure management practices. These measures are designed to both reduce GHG emissions and strengthen the adaptive capacity of vulnerable herder households[325].

Energy:

Mongolia's energy sector remains heavily dependent on coal. In 2022, 79.1% of electricity was generated from domestic coal-fired power plants, while 20.9% was imported from regional electricity grids[326]. High energy losses occur across the generation, transmission, and distribution systems due to outdated infrastructure and limited energy efficiency measures.

Despite the country's significant potential for solar and wind energy—estimated at over 2,600 GW of technical potential—renewable energy deployment remains limited. Key barriers include a lack of enabling policies, regulatory uncertainty, and investment risk[327]. The Updated NDC (2020) and Vision-2050 both emphasize the transition toward clean energy sources, increased energy efficiency, and energy security enhancement through the expansion of renewable capacity and the integration of energy storage technologies[328].

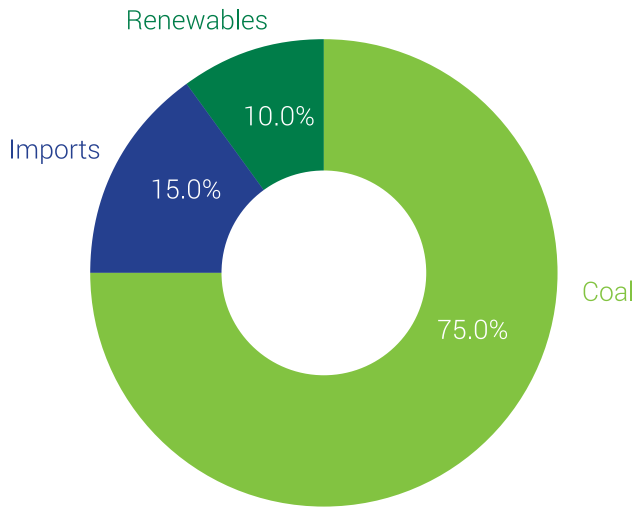

Figure A. 15. Electricity Generation Sources, 2023

323 Government of Mongolia. 2023. Vision 2050 Long-term Development Policy.
324 Asian Development Bank. 2023. "Unlocking Mongolia's Rich Renewable Energy Potential." Montsame
325 Ministry of Environment and Tourism (2020). Updated Nationally Determined Contribution of Mongolia under the Paris Agreement. Ulaanbaatar.
326 Ministry of Energy (2023). Annual Energy Report 2022. Ulaanbaatar.
327 National Renewable Energy Center (NREC) (2022). Mongolia Renewable Energy Potential and Investment Risk Assessment.
328 Government of Mongolia (2020). *Vision-2050: Long-Term Development Policy of Mongolia.* Vol. II – Green Development and Infrastructure

Industry:

Mongolia's industrial sector remains heavily reliant on mineral extraction. In 2023, coal production reached 81.2 million tonnes, underscoring the sector's central role in the national economy.[329] However, the manufacturing base is still relatively underdeveloped, concentrated in a few subsectors such as food processing, cement, and metallurgy. These subsectors present significant opportunities for emission reductions through adoption of energy efficiency measures, cleaner production technologies, and low-carbon industrial innovations.

Waste:

Rapid urbanization and rising consumption have led to increased solid waste generation, particularly organic waste, which contributes to methane emissions from unmanaged landfills. Mongolia's updated Nationally Determined Contribution (NDC) prioritizes methane recovery, waste segregation, recycling, and public awareness initiatives.[330] Nonetheless, effective implementation requires strengthened institutional frameworks, enhanced inter-municipal coordination, and significant investment in waste management infrastructure.[331]

Mongolia's economic structure—anchored in extractive industries, traditional herding systems, and a growing urban service sector—defines both the opportunities and constraints for achieving its NDC commitments. Economic diversification, infrastructure development, and low-carbon investments in agriculture, energy, and waste sectors are critical for long-term, climate-compatible development. Continued mainstreaming of climate priorities into strategic frameworks such as *Vision 2050* and the *New Recovery Policy* will be essential for enhancing national resilience and ensuring sustainable, inclusive growth.[332]

INSTITUTIONAL ARRANGEMENT

Legal and Policy Framework

Mongolia's climate action is guided by a comprehensive, multi-level framework integrating international commitments with national policies to address climate risks, foster sustainable development, and build long-term resilience.

Mongolia joined the UNFCCC in 1993, ratified the Kyoto Protocol in 1999, and became a Party to the Paris Agreement in 2016.[333] It is also a signatory of the Global Methane Pledge and a member of the Global Methane Initiative, reaffirming its commitment to reduce short-lived climate pollutants.[334]

At the national level, climate governance is anchored in the Law on Environmental Protection (1995, amended), which provides the legal foundation for sustainable resource use and environmental management. The *National Climate Change Policy (NCCP)* outlines strategic priorities for mitigation and adaptation. A *Draft Climate Change Law* (2022) is under development to institutionalize carbon market regulation, strengthen GHG monitoring, and promote climate finance.[335]

329 Ministry of Mining and Heavy Industry (2023). *Statistical Bulletin on Mineral Resources and Production*, Government of Mongolia.
330 Government of Mongolia (2020). *Updated Nationally Determined Contribution (NDC)* under the Paris Agreement.
331 Ministry of Environment and Tourism (2023). Environmental Status Report of Mongolia, 2021–2023.
332 Government of Mongolia (2021). *Vision 2050* Long-Term Development Policy; *New Recovery Policy*, 2022 Implementation Strategy.
333 UNFCCC (1993); Kyoto Protocol (1999); Paris Agreement (2016) – Mongolia's official ratification records.
334 Global Methane Pledge (2021); Global Methane Initiative country profile – Mongolia.
335 Government of Mongolia (1995, amended). *Law on Environmental Protection*; MET (2024). *Draft Climate Change Law Concept Note*.

Vision 2050

Mongolia's long-term development policy, *Vision 2050*, adopted in 2020, includes strong climate components—aiming to transition to a low-carbon, inclusive green economy and enhance climate resilience.[336]

New Recovery Policy (2021)

As part of post-COVID economic recovery, the *New Recovery Policy* emphasizes renewable energy, energy security, and afforestation through the "Billion Trees" initiative, aimed at carbon sequestration and land restoration.[337]

Nationally Determined Contributions (NDCs)

Mongolia's first INDC (2015) set a 14% GHG reduction target by 2030. The updated NDC (2020) raised this to 22.7%, with a conditional potential of 44.9% through additional measures, including CCS, waste-to-energy, and forest sinks. Adaptation priorities cover agriculture, water, forestry, biodiversity, disaster risk, public health, and social safeguards.[338]

National Adaptation Plan (NAP)

In 2021, the *National Adaptation Plan* initiated sectoral adaptation strategies through 2030, with a budget of USD 8.3 billion. Priority sectors include water resources, agriculture, health, forests, and disaster risk reduction.[339]

Climate Finance and Green Investment

Mongolia has adopted the *National Sustainable Finance Roadmap (2030)* and introduced the *Green Taxonomy (2018)* and *SDG Finance Taxonomy (2023)* to guide climate-aligned investments. It also utilizes international mechanisms such as the *Green Climate Fund (GCF)* and the *Joint Crediting Mechanism (JCM)* for mobilizing finance and technology.[340]

Table A. 3. List of key legal and policy documents as 2022

Policy/Framework	Description	Key Goals/Targets	MPG Alignment
UNFCCC (1993)[341]	Mongolia became a party to the UNFCCC in 1993.	Commitment to international climate cooperation and reporting.	§64(a), §118
Kyoto Protocol (1999)[342]	Ratified to support GHG reduction mechanisms.	GHG reductions, participation in CDM/JI.	Legacy
Paris Agreement (2016)[343]	Joined in 2016 for long-term climate action.	Net Zero GHG by 2050.	§64(b–c), §66, §67
iNDC (2015)[344]	Initial NDC with 14% reduction from 2010 BAU by 2030.	14% GHG reduction target.	§64(a)
Updated NDC (2020)[345]	Increased ambition: 22.7% (unconditional); 44.9% (with conditions & sinks).	Enhanced ambition by 2030.	§64(a), §66
Global Methane Pledge (2022)[346]	Joined at COP27, pledging CH_4 reductions.	Reduce CH_4 by 30% by 2030.	§66(e), SLCP focus

336 Government of Mongolia (2020). *Vision 2050: Long-Term Development Policy.*
337 Government of Mongolia (2021). *New Recovery Policy.*
338 Government of Mongolia (2020). *Updated Nationally Determined Contributions (NDCs).*
339 MET (2024). *National Adaptation Plan of Mongolia (2024–2030).*
340 Bank of Mongolia & Financial Regulatory Commission (2023). SDG *Finance Taxonomy*; Ministry of Finance (2018). Green *Taxonomy*; MET (2023). *National Sustainable Finance Roadmap (2030).*
341 Government of Mongolia, Resolution No. 276 (1993).
342 Parliament of Mongolia, Resolution No. 68 (1999); Kyoto Protocol Ratification.
343 Government Resolution No. 295 (2016). Paris Agreement Accession Document.
344 Ministry of Environment and Green Development (2015). iNDC Submission to UNFCCC.
345 Ministry of Environment and Tourism (2020). Updated NDC Document.
346 Ministry of Environment and Tourism (2022). COP27 Global Methane Pledge Statement.

Vision-2050 (2020)[347]	Long-term vision for low-carbon, resilient economy.	Carbon neutrality, sustainable growth.	§64(c), LT-LEDS
New Revival Policy (2021)[348]	Post-COVID green recovery strategy.	Climate-friendly infrastructure and resilience.	§67(b), §67(f)
NDC Implementation Action Plan (2021)[349]	Revised institutional and MRV architecture under ETF.	Establishment of tracking systems for NDC progress, GHG inventory coordination, and alignment with Paris Agreement requirements.	§66, §118
National Adaptation Planning Guidelines (2022)[350]	Guidelines for subnational/ sectoral NAP processes.	Coherence with Article 7, vulnerability & risk.	§67(a), §67(f)

Institutional, Administrative, and Procedural Arrangements

The institutional arrangements for tracking progress made in implementing and achieving Mongolia's Nationally Determined Contributions (NDCs) are consistent with the structures established for preparing and compiling the national greenhouse gas (GHG) inventory, as outlined in Chapter 1[351]. These arrangements reflect Mongolia's whole-of-government approach and commitment to operationalizing the Enhanced Transparency Framework (ETF) under the Paris Agreement[352].

Mongolia's climate governance architecture comprises the following core functions:

- Strategic oversight by the National Committee on Climate Change, which ensures high-level policy coherence and cross-ministerial coordination[353];
- Policy execution led by the Ministry of Environment and Tourism (MET) as the national focal point for the UNFCCC[354];
- Technical analysis and data consolidation by the Climate Change Research and Cooperation Center (CCRCC)[355];
- Sectoral implementation by line ministries, agencies, and subnational governments in accordance with the NDC Implementation Action Plan (2021)[356].

These institutional roles are designed to align with Mongolia's long-term carbon neutrality vision for 2050 and to ensure the country is on a sustained trajectory toward enhanced transparency and accountability[357].

Despite recent institutional strengthening, notable gaps remain - particularly in the areas of interagency data coordination, retention of skilled personnel, and subnational capacity to track adaptation and mitigation outcomes. MET has formally identified these as priority capacity-building areas, and corresponding efforts are being implemented in line with Article 13, paragraph 15 of the Paris Agreement[358], which encourages support for developing countries in strengthening institutional arrangements for transparency.

347 Government of Mongolia (2020). Vision-2050, Vol. I–III.
348 Ministry of Economy and Development (2021). *New Revival Policy Implementation Plan.*
349 MET and CCRCC (2021). *NDC Implementation Action Plan.*
350 MET & GIZ (2022). *National Adaptation Planning Guidelines for Subnational Implementation.*
351 See Chapter 1.3 of this report.
352 Paris Agreement, Article 13; MPGs §118.
353 Government Resolution No. 295 (2019) on Climate Governance Coordination.
354 Ministry of Environment and Tourism (MET) designated as UNFCCC focal point, 1994.
355 MET Order A/07 (2020) establishing CCRCC as technical lead for GHG inventory and MRV.
356 MET (2021). *NDC Implementation Action Plan of Mongolia (2021–2030).*
357 Vision-2050, Chapter 3.5; Long-Term Low Emissions Development Strategy under development.
358 Paris Agreement, Article 13(15); capacity-building needs for ETF implementation.