KINGDOM OF BHUTAN

FIRST BIENNIAL UPDATE REPORT TO THE UNFCC, 2022

National Environment Commission

Royal Government of Bhutan

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First Biennial Update Report 2020 from Bhutan to the UNFCCC

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Contents

Glossary of Acronym

ABI	***Association of Bhutanese Industries***
AFOLU	*Agriculture, forestry, and other land use*
BAU	*Business as usual*
BC	*Biological corridors*
BCCI	*Bhutan Chamber for Commerce and Industries*
BTFEC	*Bhutan Trust Fund for Environmental Conservation*
BUR	*Biennial Update Report*
C4	*Climate Change Coordination Committee*
CCD	*Climate Change Division*
CDM	*Clean development mechanism*
CH_4	*Methane*
CNR	*College of Natural Resources*
CO	*Carbon monoxide*
COP	*Conference of the Parties*
CO_2	*Carbon dioxide*
CO_2e	*Carbon dioxide equivalent*
CSO	*Civil society organization*
CST	*College of Science and Technology*
CWP	*Country work program*
DDM	*Department of Disaster Management*
DHPS	*Department of Hydropower and Power Systems*
DNA	*Designated National Authority*
DoA	*Department of Agriculture*
DoFPS	*Department of Forests and Park Services*
DoI	*Department of Industries*
DoL	*Department of Livestock*
DRC	*Department of Revenue and Customs*
DoE	*Department of Energy*
ETF	*Enhanced Transparency Framework*
EF	*Emission factor*
FAR	*Forth Assessment Report*
FMU	*Forest management unit*
FRMD	*Forest Resources Management Division*
FYP	*Five-year plan*
GCF	*Green Climate Fund*
GDP	*Gross domestic product*
GEF	*Global Environment Facility*
Gg	*Giga gram*
GHG	*Greenhouse gas*
GNH	*Gross national happiness*
GNHC	*Gross National Happiness Commission*

GPG	*Good practice guidance*
IPPC	*Inter-governmental panel on climate change*
IPPU	*Industrial processes and product use*
KCA	*Key category assessment*
KM^2	*Square kilometer*
LCMP	*Land use classification mapping project*
LDC	*Least developed countries*
LPG	*Liquified petroleum gas*
LULC	*Land use and land use change*
LULUCF	*Land use land-use change and forestry*
M^3	*Meter cube*
MASL	*Meter above sea level*
MoAF	*Ministry of Agriculture and Forests*
MoHCA	*Ministry of Home and Cultural Affairs*
MoIC	*Ministry of Information and Communication*
MoWHS	*Ministry of Works and Human Settlement*
MSTCCC	*Multi-sectoral technical committee on climate change*
MT	*Million tones*
MW	*Megawatt*
N_2O	*Nitrous oxide*
NAMA	*Nationally appropriate mitigation action*
NAP	*National adaptation plan*
NAPA	*National adaptation plan of action*
NBC	*National Biodiversity Center*
NCCC	*National climate change committee*
NCD	*Nature Conservation Division*
NCHM	*National Center for Hydrology and Meteorology*
NEC	*National Environment Commission*
NECS	*National Environment Commission Secretariat*
NGO	*Non-governmental organization*
NOx	*Nitrogen oxides*
NSB	*National Statistical Bureau*
NSSC	*National Soil Service Center*
NPPC	*National Plant Protection Center*
NTWG	*National thematic working group*
OPC	*Ordinary Portland cement*
ORC	*Outreach clinic*
PAs	*Protected areas*
PGR	*Population growth rate*
PHCB	*Population housing census*
P&M	*Policies and Measures*
PPC	*Portland pozzolana cement*
PSC	*Portland slag cement*
QA / QC	*Quality assurance quality control*

RDF	*Refuse derived fuel*
RGoB	*Royal Government of Bhutan*
RNR	*Renewable natural resources*
RUB	*Royal University of Bhutan*
SAR	*Second assessment report*
SLM	*Sustainable land management*
SLMP	*Sustainable land management project*
SNC	*Second National Communication*
SOC	*Soil organic carbon*
tCO_2e	*Tones of CO_2 equivalent*
TERI	*The Energy Resource Institute*
TJ	*Terajoule*
TM	*Traditional medicine*
TNC	*Third National Communication*
TOE	*Tones of energy*
UNDP	*United Nations Development Program*
UNEP	*United Nations Environment Program*
UNFCCC	*United Nations Framework Convention on Climate Change*
UNGA	*United Nations General Assembly*
USD	*United States dollar*
Glossary of Dzongkha Terms	
Druk Gyalpo	His Majesty the King
Dzongdag	*District Administrator*
Dzongkhag	*District*
Gewogs	*Local level smaller administrative blocks*
Tshogde	*Upper House*
Tshogdu	*Lower House*

Foreword

I am pleased to present the First Biennial Update Report (BUR) of Bhutan under the United Nations Framework Convention on Climate Change (UNFCCC).

As one of the most vulnerable countries to the impact of climate change, Bhutan demonstrates a strong solidarity to contribute to the ultimate objective of UNFCCC by pledging carbon neutrality for all times to come at the COP 15, submitting its Nationally Determined Contribution (NDC) in 2015 and ratifying the Paris Agreement in 2016. Bhutan has been actively communicating to regional and international dialogues to resolve the financial, technical and capacity challenges, along with strengthening the institutional capacity to build the robust mechanism to combating climate change.

The First BUR has updated the information contained in Bhutan's Third National Communication (TNC 2020) focusing on the updated information for the period 2016-2020. The preparation of the First BUR has been carried out by national experts representing agencies from government and non-government organizations as well as private sector supported by a national consultant team.

While the information contained in this report relied mostly on national statistics and results of surveys conducted, there are areas of improvement identified to enhance the national system for reporting under both the Convention and the Paris Agreement. I believe that the information provided in this report will be useful for both national and international policy makers, development partners and the private sectors to mobilize potential resources of global climate initiatives.

Bhutan's First BUR would not have been possible without hard work and dedication of the BUR project team and national experts in articulating the report. Contribution of sectoral agencies, civil society organizations and private sector stakeholders were essential for successful completion of the report,

Finally, I would also like to take this opportunity to thank the Global Environment Facility, Secretariat of UNFCCC and United Nations Environment Programme for providing the funds and methodological support for producing this report.

Sonam P Wangdi
Secretary
National Focal Point to UNFCCC

EXECUTIVE SUMMARY

Executive Summary

National Circumstances

Bhutan is a small, landlocked country with an area of 38,394 square kilometers situated on the southern slope of the Eastern Himalayas. The country is almost entirely mountainous with altitudes ranging from about 100 meters above sea level (masl) in the foothills to over 7,500 masl in the north. Due to its fragile mountainous ecosystem, Bhutan is highly vulnerable to impacts of climate change and extreme weather events. The situation is further worsened by the country's low adaptative capacity and poor economic status constrained by limited financial, technical, and human capacity. Additionally, the country's economy is still predominantly dependent on climate sensitive sectors like agriculture and hydropower. The mountainous landscape makes communication and transport very fragile and expensive.

The dominant topographic features consist of the high Himalayas in the north with snow-capped peaks and alpine pastures, north–south valleys and ranges forming watersheds, deep valleys created by fast-flowing rivers, rugged foothills, and alluvial plains with broad river valleys.

Bhutan is one of the least populated countries in Asia with a total projected population of 748,931 in 2020. The annual population growth rate (PGR) recorded was 1.3% as per the Housing and Population Census of Bhutan 2017 (NSB, 2017).

Bhutan is one of the world's smallest economies, with Gross Domestic Product (GDP) in 2017 recorded at Nu. 171.57 billion or approximately USD 2.5 billion. However, growth has been remarkable, with the economy growing at an average rate of seven percent over the past decade, mainly due to investments in the hydropower sector. GDP per capita increased from Nu. 174,400.70 million in 2015 to Nu. 229,090.40 million in 2020.

The climate of Bhutan is exceptionally diverse with three distinct climatic zones: subtropical, alpine and temperate, which encompass numerous micro-climates due to dramatic variations in elevation and topography (NCHM, 2018). Two main factors causing climatic variation of mean temperature and precipitation are the vast differences in altitude in the country and the influence of the North Indian monsoons. Bhutan's location at the northern periphery of the tropical circulation is an important feature that determines its climate.

Bhutan receives about 70% of the precipitation during monsoons, while pre-monsoon rainfall accounts for 20%. The annual precipitation ranges widely across the country. The northern region gets about 40 mm of annual precipitation, mostly in the form of snow. Whereas, the temperate central valley and the southern region receives annual rain of about 1,000 mm and 1500 mm, respectively (NCHM, 2018). The monsoons in Bhutan last from late June through late September.

Bhutan has a total forest cover of 70.77 % (2,717,161.64 ha), out of the total geographical area of the country (FRMD, 2017). The forest cover of Bhutan marginally

increased from 70.46% in 2010 (NSSC, 2011) to 70.77% in 2016 (FRMD, 2017). The broadleaved forests constitute around 65% of the forested area, while conifer forests make up about 35%. The estimated total forest carbon stock of Bhutan is 645 million tonnes of carbon in the form of biomass carbon and soil organic carbon (SOC) (FRMD, 2020). Amongst, the biomass carbon pool constitutes 457 million tonnes of total carbon stock, and 188 million tonnes of carbon is stored in mineral soils/soil carbon pool (FRMD, 2020).

Bhutan being located in the eastern Himalayas with large forest cover, pristine environment, strong conservation efforts and good network of Protected Areas, houses some of the rarest flora and fauna on earth. As per the Biodiversity Statistics of Bhutan 2017 a total of 11,248 species of all biodiversity groups - 5,114 animal species, 5,369 plant species and 690 species of fungi were recorded in Bhutan (NBC, 2019). Amongst, several plants and animal species listed as vulnerable, endangered, or critically endangered in the International Union for Conservation of Nature Red List of threatened species are also found in Bhutan. The country recorded 15 vulnerable, 20 endangered and 13 critically endangered seed plants; 13 vulnerable, 11 endangered and two critically endangered mammal species; 22 vulnerable, four endangered and four critically endangered bird species; eight vulnerable and three endangered fish species, 11 vulnerable, five endangered and two critically endangered amphibians; and one vulnerable butterfly (MoAF, 2018).

Bhutan has abundant water resources in the form of rivers originating from glaciers and are recharged by watershed areas. The river system is generally distinguished by main rivers that flow from north to south, with tributaries flowing in an east-west direction.

Most of the river discharge results from rainfall, supplemented by an estimated 2-12% glacial melt and another 2% from snow melt. The combined outflow of the rivers is about 70,576 million m^3, or 2,238 m^3/s, which corresponds to annual per capita flow of 109,000 m^3, the highest in the region.

Bhutan is one of the world's smallest economies, with gross domestic product (GDP) recorded at Nu 171.57 billion or approximately USD 2.1 billion in 2017. However, growth has been remarkable, with the economy growing at an average rate of seven percent over the past decade, mainly due to investments in the hydropower sector. The per capita GDP of the country had increased from Nu. 174,400.7 in 2015 to Nu. 229,090.40 in 2020. However, the COVID 19 pandemic has led to a shrinkage in economic activities with the economy recording a drastic drop in growth of -10.08 percent in 2020, which is 15.83 percentage points drop as compared to a growth of 5.76 percent in 2019. The key sectors that contributed to the contraction of the economy were Mining & Quarrying at -81.84 percent; Hotel & Restaurants at -73.46 percent; Manufacturing, Construction, and Transport & Communication at -20.76 percent, -20.64 percent, and -14.65 percent, respectively. Further, Finance & Insurance; Wholesale & Retail Trade; and Other Business services have also contracted contributing to the overall contraction of the economy in 2020 (NSB 2021).

Bhutan was categorized as a Least Developed Country (LDC) by the United Nations General Assembly (UNGA) in 1971. However, over the decades, Bhutan has made remarkable socio-economic advancements, qualifying the country for graduation from this category for the first time at the 2015 triennial review of the list of LDCs and is poised to graduate in 2023. As a least-developed country with a young growing population, Bhutan has pressing needs for economic development and poverty eradication in a challenging environment while conserving of a globally significant natural environment.

National Greenhouse Gas Inventory

The main sources and sinks of greenhouse gas (GHG) emissions and removals have been divided into the four categories of Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), and Waste following the Inter-governmental Panel on Climate Change (IPCC) 2006 Guidelines. Total GHG emissions in Bhutan in 2020 was 2,723.28 Gg CO_2 equivalent (CO2e) excluding removals by forest.

The GHG sink capacity of Bhutan in 2020 was 9513.49 Gg CO2e, comprising of the more than 70% forest cover and other landuse. This sink estimate excludes sequestration by agro-forestry and orchard plantations.

Net GHG emissions in 2020 was -6,790.21 Gg CO2e. In general, emissions and removal from all sectors decreased in 2020 as shown in *Figure 1 and Figure 2* due to reduced economic activities brought about by the COVID-19 Pandemic.

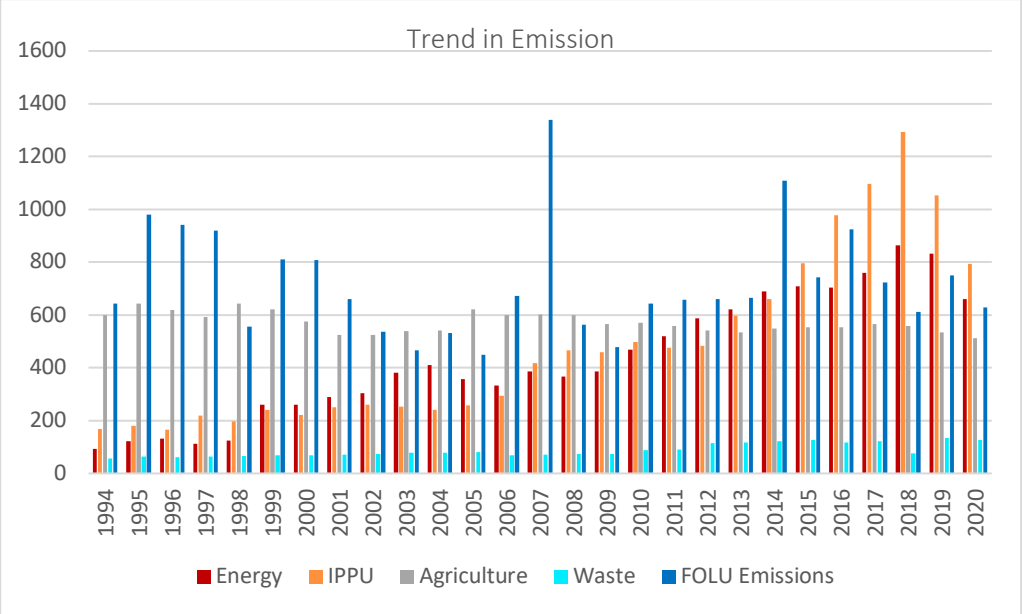

Figure 1. Sectoral Emissions

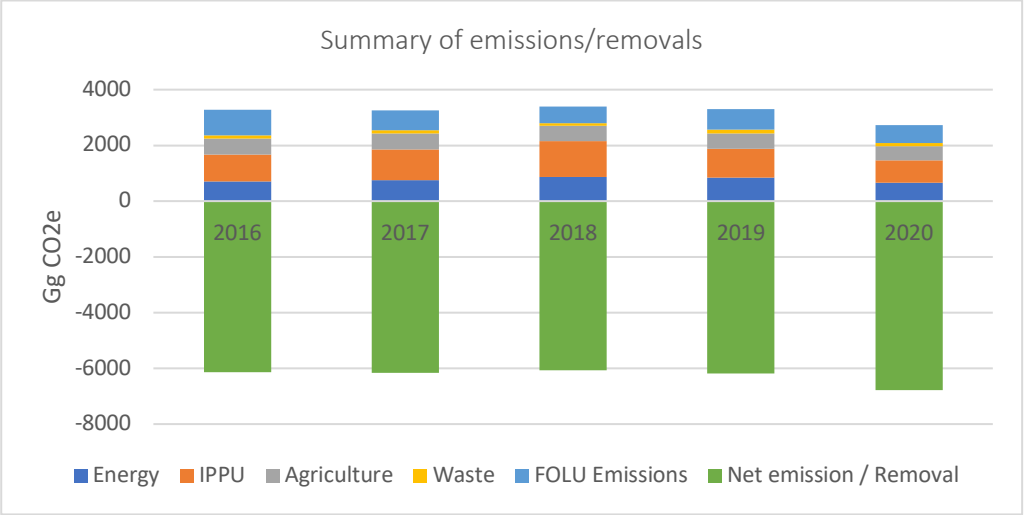

Figure 2. Summary of emissions and removals

As shown in *Figure 1*, the agriculture and waste sectors' contribution to net national emission has remained more or less constant which indicates very little change in population and that agriculture emissions are survival emissions.

Mitigation Actions and their Effects

The Royal Government of Bhutan promotes the four pillars and nine domains of the philosophy of Gross National Happiness and these are closely aligned with the United Nation's Sustainable Development Goals. As a least developing country with competing priorities of sustenance and climate action, policies and measures (P&Ms) are not directly targeted for GHG reduction, many of the P&Ms have mitigation benefits. *Figure 3* and *Table 1* summarizes mitigation actions and their effects which were estimated based on the latest available information. However, other policies and measures were also introduced where mitigation effects could not be estimated for want of data and capacity.

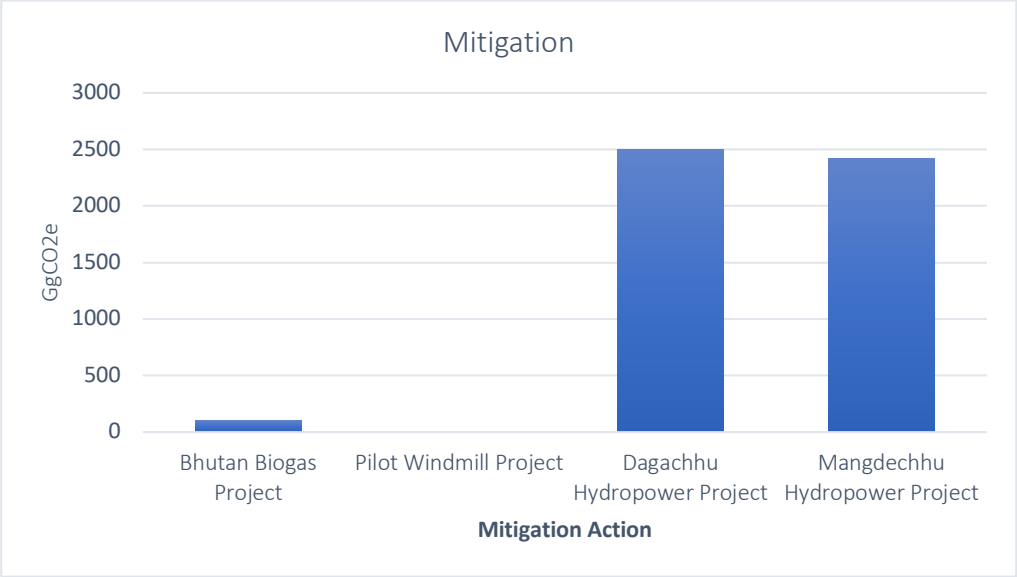

Figure 3. Mitigation Actions and their effects

Table 1. Mitigation Actions, estimates and co-benefits

Mitigation Effects		
Name of Mitigation Action	Estimated Mitigation 2016-2020 (Gg CO_2e)	Co-benefits
Bhutan Biogas Project	108.57	Improved health, reduced drudgery and gender empowerment.
Pilot Windmill Project	7.57	Energy security, local employment and capacity building for renewable energy.
Dagachhu Hydropower Project	2500	Energy Security, Energy Export and socio-economic development
Mangdechhu Hydropower Project	2,421.27	Energy Security, Energy Export and socio-economic development
Total Mitigation	5,037.41	

The annual afforestation and reforestation programmes carried out by the Department of Forest and Park Services as well as the promotion of agro-forestry and orchard plantation by the Department of Agriculture can further increase Bhutan's GHG mitigation.

Measurement, Reporting and Verification (MRV)

For Bhutan, the MRV focuses on emissions, sequestrations and support. While the MRV on emissions and sequestration are fairly advanced based on experiences and capacities built during the development of previous national communications, the institutional mechanism for reporting on MRV doesn't formally exist and rely heavily on the official mandates of the respective institutions.

The MRV of emissions and sequestration are carried out by the NEC in collaboration with the sectoral agencies who collect data and prepare estimates for compiling the greenhouse gas inventory. Additionally, for projects already registered as CDM projects, the NEC as the national focal point is entrusted with the MRV functions.

The erstwhile GNHC as the central planning and aid mobilization agency serves the purpose of maintaining information on support in the form of grants and technical assistance while he Ministry of Finance maintains information on loans to finance climate action.

To advance to the Enhanced Transparency Framework and comply with the reporting requirements, it is recommended that the government institute clear MRV frameworks and assign mandates to respective agencies.

Finance, technology and capacity building needs and support received

As a landlocked least developing country, Bhutan needs support to both mitigate climate change through emission reduction and sink enhancement measures as well as to adapt to the impacts of climate change. As asserted in all the formal communications, due to competing priorities of socio-economic development and climate action, Bhutan looks forward to both the multilateral financing windows and bilateral development partners for the support required. The support required has been worked out through various studies in developing low emission development strategies and policy documents.

Against the required support of USD 3,392.76 million, (*Table 2*) Bhutan has received a total of USD 82.5 million as shown in *Table 3*.

Table 2. Support needs identified

Sector	Actions	Amount (in Million USD)

Forest conservation & management	Actions across four measures, namely (i) Strengthening Forest Management Practices; (ii) Climate-Smart Primary Production; (iii) Integrated Land Use Planning and (iv) Improved Rural Livelihoods, were planned whereby actions include: improving forest management and conservation, maintaining at least 50% of the land area through climate smart restoration, initiating and promoting agro-forestry and conserving wetland.	54.4
Food Security	Mitigation actions to reduce emissions and increase carbon sequestration include switching from synthetic to organic fertilisers, improving agricultural practices, increasing perennial crop production, reducing continuous rice flooding, promoting domestic biogas production, and improving dairy cattle production through better breeds and feeding management. The implementation of these measures has a mitigation potential of up to 710 Gg CO_2e.	61.65
Human Settlement	Measures for the human settlement sector were considered across energy in buildings, transport infrastructure, waste management, land use in urban areas, and information communication and technology. Implementing these short-term prioritised measures will lead to a mitigation potential of 4,122 Gg CO_2e.	101.84
Industries	Mitigation measures were proposed in this sector through technical measures and diversification away from heavy industries to promote higher value-addition and manufacturing products to benefit other sectors. The cumulative mitigation potential for this sector is estimated at 9,990-11,370 Gg CO_2e.	3.52
Surface Transport	Interventions recommended for transport and mobility include mass transit, EV promotion, low emission freight transport, non-motorised transport system, improving fuel efficiency through stringent vehicle emission standards, and private vehicle demand management. The mitigation potential for this sector is estimated at 5,283 Gg CO_2e.	3,233

Total		3,392.76

Table 3. Support received

Support Source	Amount (USD Million)
GEF OP VI	3.15
GEF OP VII	8.45
GEF LDCF	13.97
GCF RPSP	4.39
GCF Competitive	52.45
Other	0.09
Total	**82.5**

New and additional sources of climate finance are needed to ensure Bhutan stays on the path of carbon neutrality through conscious low emission development pathways. The approval process for climate financing is cumbersome and often requires complex documentation that takes a long time to process. Therefore, it mandates the formulation and implementation of a national climate financing strategy by establishing a climate fund in partnership with local or multilateral banks.

The Royal Government of Bhutan received financial assistance of US$. 350,000 from the Global Environment Facility through UNEP to prepare the BUR and carry out related capacity building activities.

The consultative process of developing Bhutan's climate change reports like development of long-term low greenhouse gas emission and resilient development strategies, four sectoral low emission development strategies namely on Surface Transport, Industries, Human Settlement and Food security and Bhutan's Second Nationally Determined Contribution all feed into the preparation of the BUR.

Bhutan also received support through training on NDC tracking progress under the Adaptation Communication, National Adaptation Plan, and NDC tracking of progress under the ETF. The UNFCCC and the UNDP Country Office - Bhutan in collaboration with the NECS provided and facilitated training for GHG Mitigation potential analysis

and baseline setting and IPCC 2006 Guidelines for the national climate change working group members, sectoral thematic working group members, and other stakeholders from various government agencies, private sector and CSOs. More than 160 participants were trained in this session.

NATIONAL CIRCUMSTANCES

National Circumstances

A brief overview of the national circumstances of Bhutan is presented below to set context for Bhutan's Biennial Update Report (BUR). A full description of the national circumstances is available in Bhutan's Third National Communication submitted in 2020.

1.1 Geography

Bhutan is a small, landlocked country with an area of 38,394 Km2 situated on the southern slope of the Eastern Himalayas. The country is almost entirely mountainous with altitudes ranging from about 100 meters in the foothills to over 7,500 meters in the north, the country's north-south border spans over 170 km while the east-west dimension measures around 300 km. The dominant topographic features consist of the high Himalayas in the north with snow-capped peaks and alpine pastures, north–south valleys and ranges forming watersheds, deep valleys created by fast-flowing rivers, rugged foothills, and alluvial plains with broad river valleys.Due to its fragile mountainous ecosystem, Bhutan is highly vulnerable to impacts of climate change and extreme weather events. The situation is further worsened by the country's low adaptative capacity and poor economic status constrained by limited financial, technical, and human capacity. Additionally, the country's economy is still predominantly dependent on climate sensitive sectors like agriculture and hydropower. The mountainous landscape makes communication and transport very fragile and expensive.

1.2 Climate

The climate of Bhutan is exceptionally diverse with three distinct climatic zones: subtropical, temperate and alpine, which encompass numerous micro-climates due to dramatic variations in elevation and topography (NCHM, 2018). Two main factors causing climatic variation of mean temperature and precipitation are the vast differences in altitude in the country and the influence of the North Indian monsoons. Bhutan's location at the northern periphery of the tropical circulation is an important feature that determines its climate.

Bhutan receives about 70% of the precipitation during monsoons, while pre-monsoon rainfall accounts for 30%. The annual precipitation ranges widely across the country. The northern region gets about 40 mm of annual precipitation, mostly in the form of snow. Whereas, the temperate central valley and the southern region receives annual rain of about 1,000 mm and 1500 mm, respectively (NCHM, 2018). The monsoons in Bhutan last from late June through late September.

1.3 Agriculture

Agriculture is highly dependent on monsoon rain and is highly vulnerable to climate change and extreme weather resulting to production uncertainties.

The agriculture sector comprises of agriculture, livestock and forestry which continues to be a major player in the country's economy. With only 2.75% of the total land area used for agriculture (FRMD, 2017), the sector accounted for 19.23% of the Gross Domestic Product (GDP) in 2020 (NSB, 2021) and employed about 51% of the total population.

Figure 4: Bhutan Physical Map (source: https://gisgeography.com)

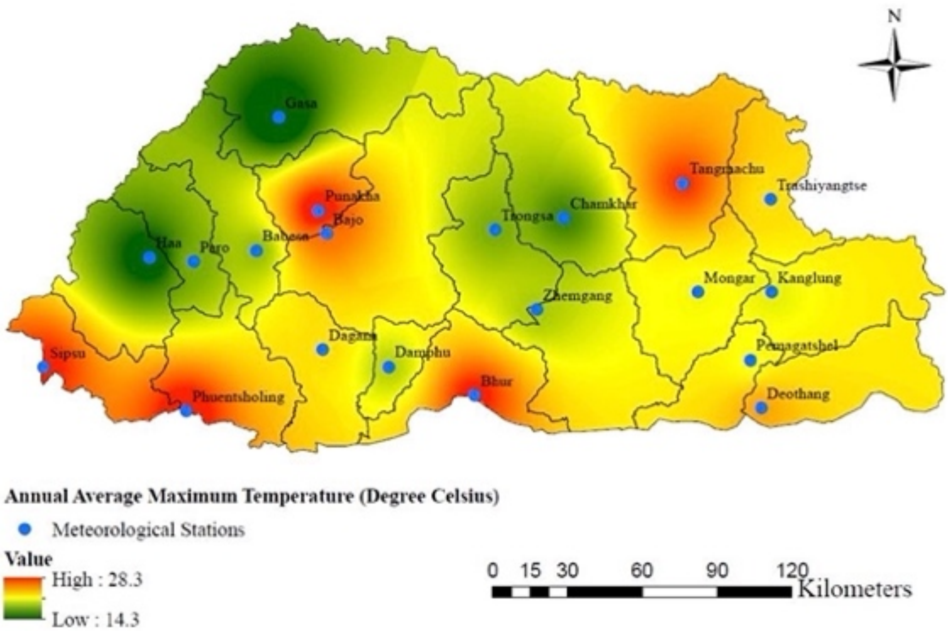

Figure 5: Bhutan climate, average annual maximum temperature in 2020. Source NCHM, Bhutan.

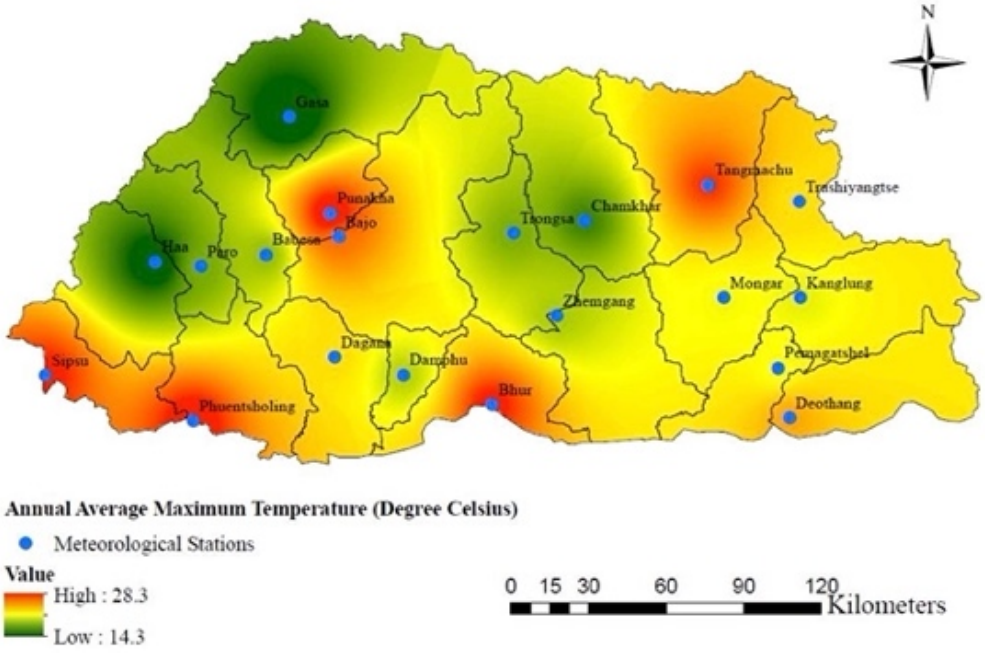

Figure 6: Bhutan climate, average annual minimum temperature in 2020. Source NCHM, Bhutan.

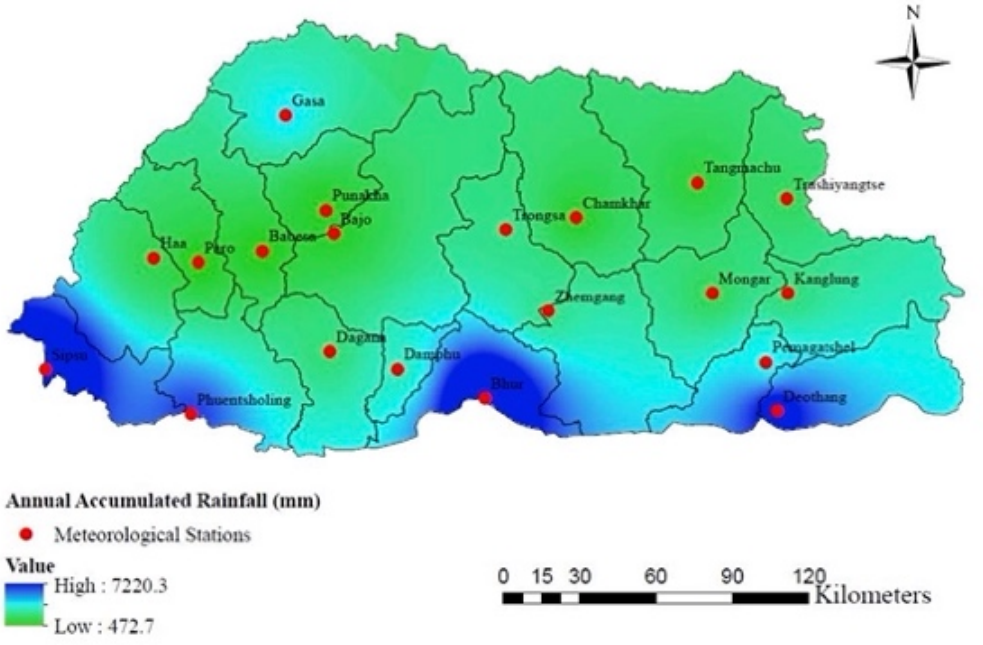

Figure 7: Bhutan climate, annual accumulated rainfall in 2020. Source NCHM, Bhutan.

1.4 Natural Resources

A. Forest resources

Bhutan has a total forest cover of 70.77 % (2,717,161.64 ha), out of the total geographical area of the country (FRMD, 2017). The forest cover of Bhutan marginally increased from 70.46% in 2010 (NSSC, 2011) to 70.77% in 2016 (FRMD, 2017). The broadleaved forests constitute around 65% of the forested area, while conifer forests make up about 35%. The estimated total forest carbon stock of Bhutan is 645 million tonnes of carbon in the form of biomass carbon and soil organic carbon (SOC) (FRMD, 2020). Amongst, the biomass carbon pool constitutes 457 million tonnes of total carbon stock, and 188 million tonnes of carbon is stored in mineral soils/soil carbon pool (FRMD, 2020).

B. Protected Area Network

The protected area (PA) network of Bhutan consists of five National Parks, four Wildlife Sanctuaries, one Strict Nature Reserve, eight Biological Corridors (BC) and a Royal Botanical Park (RBP). The total PA, including BC and RBP, covers 51.44% of the country's area. The PA system in Bhutan is unique in that there are human settlements within the PAs that play an essential role in conservation, unlike in other parts of the world, where communities in the PAs are relocated (MoAF, 2019).

C. Biodiversity

Bhutan being located in the eastern Himalayas with large forest cover, pristine environment, strong conservation efforts and good network of Protected Areas, houses some of the rarest flora and fauna on earth. As per the Biodiversity Statistics of Bhutan 2017 a total of 11,248 species of all biodiversity groups - 5,114 animal species, 5,369 plant species and 690 species of fungi were recorded in Bhutan (NBC, 2019). Amongst, several plants and animal species listed as vulnerable, endangered, or critically endangered in the International Union for Conservation of Nature Red List of threatened species are also found in Bhutan. The country recorded 15 vulnerable, 20 endangered and 13 critically endangered seed plants; 13 vulnerable, 11 endangered and two critically endangered mammal species; 22 vulnerable, four endangered and four critically endangered bird species; eight vulnerable and three endangered fish species, 11 vulnerable, five endangered and two critically endangered amphibians; and one vulnerable butterfly (MoAF, 2018).

D. Water resources

Most of the major rivers in Bhutan originate from glaciers and are recharged by watershed. The river system is generally distinguished by main rivers that flow from north to south, with tributaries flowing in an east-west direction. The main rivers are Amochhu, Wangchhu, Punatsangchhu and Manas. Two large rivers, Mangdechhu and

Drangmechhu, converge into one river and make up the Manas just before crossing the Indian border. The Manas river covers about half the country.

Most of the river discharge results from rainfall, supplemented by an estimated 2-12% glacial melt and another 2% from snow melt. The combined outflow of the rivers is about 70,576 million m^3, or 2,238 m^3/s, which corresponds to annual per capita flow of 109,000 m^3, the highest in the region.

1.5 Population

Bhutan is one of the least populated countries in Asia with a total projected population of 748,931 in 2020. The annual population growth rate (PGR) recorded was 1.3% as per the Housing and Population Census of Bhutan 2017 (NSB, 2017). The population density of Bhutan increased from 17 persons per km^2 in 2005 to 19 persons per km^2 in 2017 as a result of the gradual increase in the population size. The distribution of the population over the land area is not uniform with recorded highest population density at 67 persons per km^2 in the capital city, Thimphu, and the lowest with just 1.3 persons per km^2 in Gasa Dzongkhag.

Since the commencement of the planned socio-economic development in the 1960s, Bhutan has developed from a nascent health system to a closely-knit network of health facilities catering to its people's health needs. As of 2020, there are 58 hospitals that includes three referral hospitals, 182 primary health centers, 552 outreach clinics, and 54 sub posts spread across the country (NSB, 2021). Furthermore, the provision of traditional medicine (TM) services from 76 indigenous units and one national TM hospital has enhanced the health service delivery in the country. Health services are delivered free of cost, mainly financed by the government (MoH, 2018).

The Population and Housing Census of Bhutan (PHCB) 2017 reported the overall literacy rate of 71.4% for Bhutan, and the adult (aged 15 years and above) literacy rate of 66.6%. There is a marked difference in the literacy levels between the male and female populations, with 78.1% of the male population literate compared to 63.9% of the female population. Overall, the literacy rate is significantly higher in urban areas (84.1%) than in rural areas (63.6%).

1.6 Macroeconomy

Bhutan is one of the world's smallest economies, with gross domestic product (GDP) recorded at Nu 171.57 billion or approximately USD 2.1 billion in 2020. However, growth has been remarkable, with the economy growing at an average rate of seven percent over the past decade, mainly due to investments in the hydropower sector. The per capita GDP of the country had increased from Nu. 174,400.7 million in 2015 to Nu. 229,090.40 million in 2020.

However, the COVID 19 pandemic has led to a shrinkage in economic activities with the economy recording a drastic drop in growth of -10.08 percent in 2020, which is 15.83 percentage points drop as compared to a growth of 5.76 percent in 2019. The

key sectors that contributed to the contraction of the economy were Mining & Quarrying at -81.84 percent; Hotel & Restaurants at -73.46 percent; Manufacturing, Construction, and Transport & Communication at -20.76 percent, -20.64 percent, and -14.65 percent respectively. Further, Finance & Insurance; Wholesale & Retail Trade; and Other Business services have also contracted contributing to the overall contraction of the economy in 2020 (NSB 2021).

The public sector has long been the primary source of economic growth, but the government now recognised the significance of private sector growth. Economic diversification is accorded a higher priority, and Bhutan has made progress in modernizing its economic structure and reducing poverty. Constraints on private-sector development include an inefficient regulatory framework, significant nontariff barriers to trade, and a rudimentary investment code (The Heritage Foundation, 2019).

Bhutan's economic development policy continues to be guided by the overarching philosophy of Gross National Happiness (GNH) based on the four pillars of

(i) sustainable economic development;
(ii) preservation and promotion of culture and tradition;
(iii) conservation of the environment; and
(iv) good governance.

However, sustainable economic growth remains a major challenge as it is financed mainly by external aid (RGoB, 2016).

Bhutan was categorized as a Least Developed Country (LDC) by the United Nations General Assembly (UNGA) in 1971. However, over the decades, Bhutan has made remarkable socio-economic advancements, qualifying the country for graduation from this category for the first time at the 2015 triennial review of the list of LDCs and is poised to graduate in 2023.

As a least-developed country with a young growing population, Bhutan has pressing needs for economic development and poverty eradication in a challenging environment while conserving of a globally significant natural environment.

1.7 Governance structure

The government of Bhutan is a democratic constitutional monarchy with the executive power vested in the Cabinet (Lhengye Zhungtshog) headed by the Prime Minister. Bhutan's democratically elected Parliament is the highest legislative institution in the country. It consists of His Majesty the Druk Gyalpo, the National Council and the National Assembly. The Parliament is bicameral and follows Westminster Parliamentary systems. His Majesty the King is the Head of State. The National Assembly has the legislative, oversight and representational mandates. The National Council has both legislative and review functions and is also referred to as the House of Review on matters affecting the security and sovereignty of the country and the interests of the nation and the people. Under the current parliamentary structure,

there are a total of 72 members – 25 members in the National Council and 47 members in the National Assembly elected for a term of five years. (RGOB, 2022).

1.8 Administrative System

The administrative system in the country consists of Central Government and Local Government. The Central Government comprises of Ministries, Departments and Autonomous bodies. At the central level, the 10 different Ministry is headed by the Cabinet Ministers and at the local level, Bhutan is administratively divided into 20 *Dzongkhags* (districts), each governed by a district administrator or *Dzongda.* The Dzongkhags are sub-divided into small blocks or *gewogs.* There are 205 *gewogs* in the country, grouped under 47 constituencies. The Local Government comprises of Dzongkhag Tshogdu, Gewog Tshogde and the Thromde Tshogde (NSB 2021).

Figure 8: Bhutan: Administrative Map (source: https://gisgeography.com)

1.9 Biennial Update Report preparation and procedures

Bhutan's first Biennial Update Report was prepared through financial support of GEF under enabling activity with technical support of UNEP, Nairobi as the Multilateral Implementing Entity. The National Environment Commission led the process of BUR preparation with support from relevant sectors. Preparation of BUR has been a long and consultative process coordinated by the National Environment Commission as a project implementing partners and led by sectors. The process was launched in 2015 during a high-level seminar on "*Dialogue on Climate Resilient and Carbon Neutral Development"* launched by the Honourable Prime Minister of Bhutan. The actual preparation of BUR commenced in 2017 only and had to be deferred to prioritize completion of TNC and later due to the COVID-19 pandemic.

A national taskforce on climate change was constituted for national climate change reporting. Under the taskforce, a working group based on IPCC sector on greenhouse gases was instituted on Agriculture, Forest and Other Land Use (AFOLU), Industrial Processes and Product Use (IPPU), Energy and Waste led by relevant sectors with a member representation from private sectors, non-governmental organizations, civil society and government agencies.

Several round of consultation workshops, technical working group meetings, sectoral level consultations and validations was conducted in preparation and validation of the reports. As part of capacity building, numerous trainings, seminar, and capacity building workshops was conducted both in person and virtual and hybrid mode. COVID -19 pandemic restriction on travel and mass gatherings has largely affected the delivery of the project output especially on learning and capacity building program of the working group members and sectors.

The consultative process of developing Bhutan's climate change reports like development of long-term low greenhouse gas emission and resilient development strategies, four sectoral low emission development strategies namely on Surface Transport, Industries, Human Settlement and Food security and Bhutan's Second Nationally Determined Contribution all feed into preparation of BUR.

NATIONAL GHG INVENTORY

National GHG Inventory

2.1 Introduction

This chapter describes Bhutan's Greenhouse Gas Inventory for the inventory years 2016-2020. The inventory for the three main gases emitted, namely carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) is estimated while carbon monoxide (CO) and nitrogen oxide (NOx) were not estimated for energy, IPPU and waste sectors as they are precursors to N_2O and CO_2 and it is assumed that eventually they get oxidized, however, NOx emission was estimated for manure management and others under category 4.G. The chapter also contains information on data sources, uncertainties, QA/QC activities carried out, along with trend analysis. In order to ensure the transparency, consistency, comparability, completeness and accuracy of the inventory, the chapter also contains information from the previous inventory submission.

The inventory is prepared in accordance with paragraphs 8-24 of the Annex to Decision 17/CP.8 (UNFCCC, 2002), meant for reporting of National Communications (NC) from Non-Annex I Parties to the UNFCCC and the BUR Guidelines for NAI countries. The update is consistent with capacities, time constraints, data availability and the level of support received for reporting.

This inventory is organized according to the 2006 IPCC Guidelines, and covers the following sectors: Energy; IPPU; AFOLU; and Waste. GHG removals by sinks occur in the AFOLU sector as a result of management activities in protected areas and reforestation. The inventory was prepared following the 2006 IPCC Guidelines using the IPCC 2006 Software.

2.2 Comparison of Reference and Sectoral Approaches

The comparison between the Reference and the Sectoral Approach resulted in a difference of 13.87% in CO_2 emissions and 9.45% in energy consumption as depicted in *The difference is attributed to the inclusion of* combustion of lubricants under the Reference Approach whereas in the sectoral approach, this is included in the IPPU category. Another reason for the difference is in the accounting of fossil fuel reductants under the IPPU sector in the sectoral approach while in the reference approach, these are not segregated and instead included in total imports.

Table *4. Comparison of Reference and Sectoral Approach*. The difference is attributed to the inclusion of combustion of lubricants under the Reference Approach whereas in the sectoral approach, this is included in the IPPU category. Another reason for the difference is in the accounting of fossil fuel reductants under the IPPU sector in the sectoral approach while in the reference approach, these are not segregated and instead included in total imports.

Table *4. Comparison of Reference and Sectoral Approach*

	Reference Approach				Sectoral Approach		Difference	
Fuel Types	Apparent Consumption (TJ)	Excluded consumption (TJ)	Apparent Consumption (excluding non-energy use and feedstocks) (TJ)	CO2 Emissions (Gg)	Energy Consumption (TJ)	CO2 Emissions (Gg)	Energy Consumption (%)	CO2 Emissions (%)
Liquid Fuels: 22 item(s)	5,717.5	0	5,717.5	409.29	5,636.09	407.18	1.44	0.52
Solid Fuels: 11 item(s)	3,278.46	0	3,278.46	332.63	2,583.41	244.39	26.9	36.11
Gaseous Fuels: 1 item(s)	0	0	0	0	0	0	0	0
Other Fossil Fuels: 3 item(s)	0	0	0	0	0	0	0	0
Peat: 1 item(s)	0	0	0	0	0	0	0	0
Total								
	8,995.96	0	8,995.96	741.92	8,219.5	651.57	9.45	13.87

2.3 Methodology

The IPCC Guidelines (IPCC, 2006) provide detailed methodologies to estimate emissions and sequestrations for all the sectors and sub-sectors. A system of methodological tiers has been developed by IPCC to represent different levels of methodological complexity. Tier 1 uses an IPCC default value, Tier 2 uses country specific emission factors that are based on either measurements or IPCC Tier 2 emission factors, and Tier 3 is the most demanding in terms of complexity and data requirements. Considering national circumstances related to data availability and efforts required to estimate emissions, the emission and sequestration estimates in the inventory for Bhutan mainly uses data sourced from national statistics and default emission factors under Tier 1.

To estimate emissions in CO_2 equivalents, a global warming potential (GWP) is used. GWP is a quantified measure of the globally averaged relative radiative forcing of a particular GHG (*Table 5*). It is defined as the accumulated radiative forcing within a specific time horizon caused by emitting 1 kilogram (kg) of the gas, relative to that of the reference gas CO_2. Direct radiative effects occur when the gas itself absorbs radiation. Indirect radiative forcing occurs when chemical transformations involving the original gas produce a gas or gases that are GHGs, or when a gas influences other radiative important processes such as the atmospheric lifetimes of other gases. All calculations in the present report use the Global Warming Potential (GWP) of GHGs for 100 years presented in the IPCC Fourth Assessment Report (IPCC AR4).

Table 5. GWP of GHGs from IPCC AR4

Gas	Chemical Formula	GWP
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298
HFC32	CH_2F_2	675
Nitrogen Oxides	NOx	-25.3

In general, each method was applied based on the availability of data and analysis of key categories. The collection of data and information is still a challenge when compiling the GHG inventory for Bhutan. The data and information often come from national aggregated levels, but some are collected from point or direct sources. Considering the absence of national or regional emission factors, most of the calculations relied on IPCC default values and therefore uncertainty values for emission factors are relatively high.

For the energy, IPPU and waste emission, estimates of precursor to GHGs (CO, NOx and NMVOCs) have not been made with the assumption that these will eventually be converted into CO_2, CH_4 or N_2O as provided in the IPCC 2006 Guidelines as "default CO_2

emission factors assume that 100% of the fuel carbon is oxidized to CO2. This is irrespective of whether the carbon is emitted initially as CO_2, CO, NMVOC or as particulate matter".

Bhutan aspires to gradually improve its reporting by adopting higher tier methods as local capacity develops, and more disaggregated data becomes available. Bhutan's GHG inventory has been prepared using data from national statistics, surveys and activity data provided by different sectors.

For the national GHG inventory, in accordance with paragraph 12 of Decision 17/CP.8, to the extent possible, the key categories are analyzed, pursuant to IPCC Good Practice Guidance, to identify the subsectors that should be prioritized in terms of methodological refinement, taking into consideration the national circumstances, as well as the contribution of the identified subsectors to the total emissions.

A summary of methods and emission factors used for the National GHG Inventory is provided in *Table 6.*

Table 6. Summary of methodologies and emission factors used

Gas	CO_2		CH_4		N_2O		HFCs	
Categories	Method Used	EF	Method Used	EF	Method Used	EF	Method Used	EF
1 - Energy								
1.A - Fuel Combustion Activities	T1	D	T1	D	T1	D	NE	NE
1.B - Fugitive emissions from fuels	T1	D	NE	NE	NE	NE	NE	NE
2 - Industrial Processes and Product Use								
2.A - Mineral Industry	T1	D	NE	NE	NE	NE	NE	NE
2.B - Chemical Industry	T1	D	NE	NE	NE	NE	NE	NE
2.C - Metal Industry	T1	D	NE	NE	NE	NE	NE	NE
2.D - Non-Energy Products from Fuels and Solvent Use	T1	D	NE	NE	NE	NE	NE	NE

2.F - Product Uses as Substitutes for Ozone Depleting Substances	NE	NE	NE	NE	NE	NE	T1	D
2.G - Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO
3 - Agriculture, Forestry, and Other Land Use								
3.A - Livestock	NE	NE	T1	D	NE	NE	NE	NE
3.B - Land	T1, T2	D, CS	T1	D	T1	D	NE	NE
3.C - Aggregate sources and non-CO2 emissions sources on land	T1	D	T1	D	T1	D	NE	NE
3.D - Other	NE	NE	NE	NE	NE	NE	NE	NE
4 - Waste								
4.A - Solid Waste Disposal	NE	NE	NE	NE	NE	NE	NE	NE
4.B - Biological Treatment of Solid Waste	NE	NE	T1	D	NE	NE	NE	NE
4.C - Incineration and Open Burning of Waste	NE	NE	NE	NE	NE	NE	NE	NE
4.D - Wastewater Treatment and Discharge	NE	NE	T1	D	NE	NE	NE	NE
5 - Other								
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE	NE	NE	NE	NE	NE	NE	NE
5.B - Other (please specify)	NE	NE	NE	NE	NE	NE	NE	NE
Memo Items (5)								

International Bunkers								
1.A.3.a.i - International Aviation (International Bunkers)	T1	D	NE	NE	NE	NE	NA	NA
1.A.5.c - Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass burning	T1	D	NA	NA	NA	NA	NA	NA
CS – Country Specific, D - IPCC 2006 Default EF, NA – Not Applicable, NE - Not Estimated, NO - Not Occurring, T1 – Tier 1, T2 – Tier 2								

2.4 Quality Control and Quality Assurance

Following the 2006 IPCC Guidelines, national inventories have to be transparent, well documented, consistent, complete, comparable, assessed for uncertainties, and should be subjected to verification and QA/QC exercise. The quality system includes several procedures such as training of personnel, inventory planning and preparation, QA/QC procedures, peer-reviewed publications, data storage, and follow-up and improvements. The QA/QC plan also includes a scheduled timeframe describing the different stages of the inventory from its initial development to final reporting. The quality system ensures that the inventory is systematically planned, prepared and followed up in accordance with specified quality requirements, so that the inventory is continuously developed and improved.

2.4.1 Quality Control (QC)

Quality control is the check that is made during the inventory preparation on different types of data, emission factors and calculations that have been made. The quality control takes place according to general requirements (Tier 1) which applies to all types of data used as support material for the reporting, and the specific requirements for quality control (Tier 2) which are applied to certain types of data and/or emission sources.

In this inventory preparation exercise, the inventory team carried out general Tier 1 QC measures in accordance with the 2006 IPCC Guidelines comprising of the following:

- ✓ Check whether assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters were documented, compare with international agency estimates.
- ✓ Check for transcription errors in data input and references.
- ✓ Check that emissions and removals are calculated correctly.

- ✓ Check that parameters and units are correctly recorded and that appropriate conversion factors are used.
- ✓ Check the integrity of database files.
- ✓ Check for consistency in data between source categories.
- ✓ Check that the movement of inventory data among processing steps is correct. Check that uncertainties in emissions and removals are estimated and calculated correctly.
- ✓ Check time series consistency.
- ✓ Check completeness.
- ✓ Compare the reference and sectoral approach.
- ✓ Check whether assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters were documented, compare with international agency estimates.
- ✓ Check for transcription errors in data input and references.
- ✓ Check that emissions and removals are calculated correctly.
- ✓ Check that parameters and units are correctly recorded and that appropriate conversion factors are used.
- ✓ Check the integrity of database files.
- ✓ Check for consistency in data between source categories, particularly cross-checking data derived from national statistics with sectoral data.

2.4.2 Quality Assurance (QA)

According to IPCC Good Practice Guidance, good practice for QA procedures requires an objective review to assess the quality of the inventory and to identify areas where improvements should be made. In this inventory preparation exercise, the QA review is done by the members of the Thematic Working group on Climate Change which has members from agencies representing all IPCC source categories.

2.5 Emissions and Sequestration Estimates

2.5.1 Summary of Emissions and sequestration for 2020

Bhutan recorded a total GHG emissions of 2,723.28 Gg CO_2e in 2020 that includes 661.14 Gg CO_2e from energy, 792.7 Gg CO_2e from IPPU, -8667.72 CO_2e from AFOLU (512.69 Gg CO_2e from agriculture, and -8,884.11 Gg CO_2e from Land Use, Land Use Change and Forestry) and 127.37 Gg CO_2e from waste. The total sequestration of forest is estimated at 9,513.50 Gg CO_2e in the same year. However, removals from non-forest lands including agro-forestry and fruit plantations are not estimated in the inventory due to lack of data.

As shown in *Table 7, Figure 9 & 10* emissions peaked during 2018 and 2019 and dropped in 2020 owing to the COVID 19 pandemic and its impacts. At the same time, there was a slight increase in the sequestration due to exclusion of CO_2 emission from forest fire, additional plantations and natural expansion of forest land.

Table 7. Summary of emissions and removals

GHG Emissions (Gg CO2e)					
Category	2016	2017	2018	2019	2020
1. Energy	703.173	760.575	863.556	833.055	661.141
2. IPPU	977.788	1,096.29	1,292.23	1,054.18	793.356
3. (a) Agriculture	554.69	564.98	558.89	533.74	512.69
3. (b) FOLU	924.42	723.65	612.68	750.38	629.38
4. Waste	117.862	121.109	76.829	134.695	127.371
Total emission	***3277.93***	***3266.60***	***3404.19***	***3306.05***	***2723.94***
5. Memo Items	5.44	9.446	8.024	8.157	8.088
Sink capacity	-9411.98	-9437.36	-9462.74	-9488.12	-9513.5
Net emission (Gg CO_2e)	***-6,134.05***	***-6,170.76***	***-6,058.55***	***-6,182.07***	***-6,789.56***

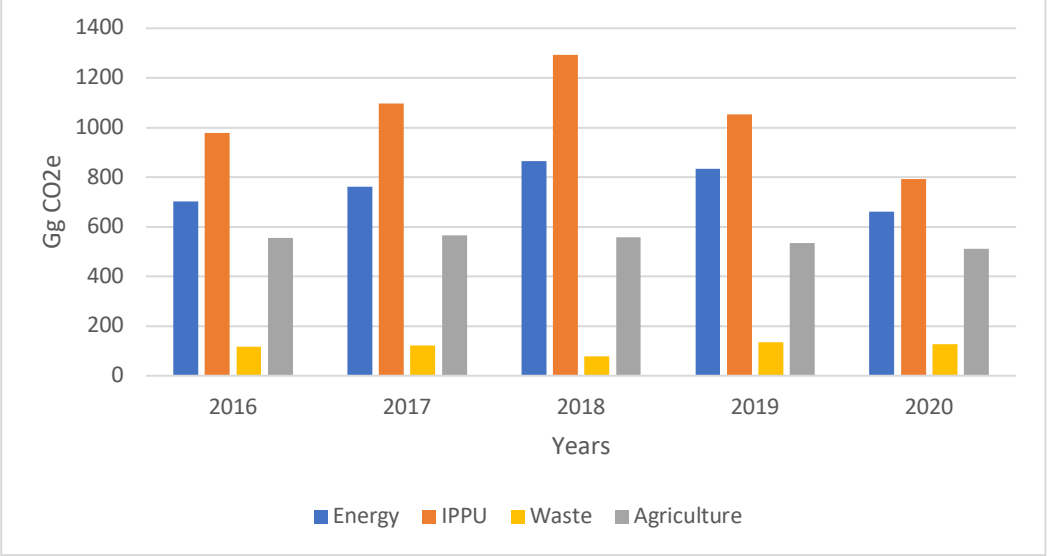

Figure 9. Emissions excluding FOLU

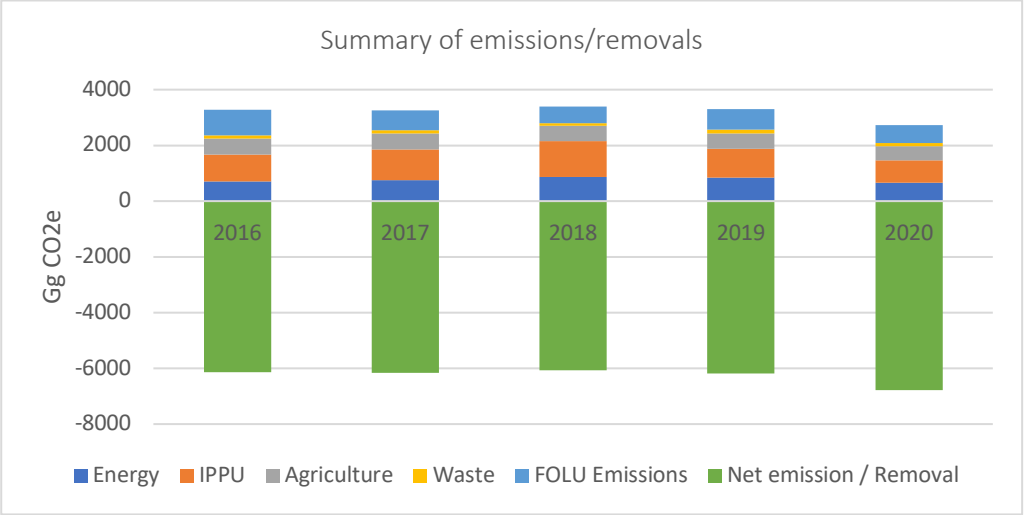

Figure 10. Summary of emissions and removals

2.5.2 Trends in Emissions and Sequestration

Emissions arising from economic activities, particularly in the energy and IPPU categories have been increasing steadily from 1994 (base year) to 2020 by as much as 606.35% as depicted in *Table 8.* The emissions took a downward turn in 2020 as the entire spectrum of economic activities have been impacted by the COVID-19 pandemic. As evident from the table, agriculture emissions have been stable throughout the time series indicating that these emissions are survival emissions required for the sustenance of the people. While the change in the sink capacity is not significant, Bhutan still continues to be a net carbon negative country with a carbon budget of 6,790.22 Gg CO_2e in 2020.

The highest contributor to the national emission is from the IPPU category with a share of 29.11% followed by energy at 24.28%, forest and other land use at 23.11%, agriculture at 18.83% and waste at 4.68%. As the economy develops and Bhutan transitions from the LDC group in 2023, the emissions in the energy and IPPU sectors are further expected to increase, particularly emissions from heavy industries as the industrial estates at Motanga, Jigmeling and Dhamdum come online.

Table 8. Trends in Emissions and Removals

Years	Energy	IPPU	Agriculture	Waste	FOLU Emissions	Total Emission	Sink Capacity	Net emission / Removal
1994	93.6	166.93	600.84	55.78	643.29	1560.44	-8975.93	-7415.49
1995	121.04	181.01	642.35	63.9	980.07	1988.37	-9006.66	-7018.29
1996	131.53	166.51	618.4	60.35	942.16	1918.95	-9037.38	-7118.43
1997	112.18	218.58	593.32	63.21	920.11	1907.40	-9068.11	-7160.71
1998	124.84	197.45	642.89	66.1	556.00	1587.28	-9098.83	-7511.55
1999	259.12	240.83	621.26	69.02	810.67	2000.90	-9129.56	-7128.66
2000	259.12	220.45	575.31	67.94	808.70	1931.52	-9160.28	-7228.76
2001	290.18	250.32	525.64	70.81	660.99	1797.94	-9170.22	-7372.29
2002	303.14	261.4	525.05	73.72	536.84	1700.15	-9180.17	-7480.01
2003	381.28	252.39	538.11	78.92	467.46	1718.16	-9190.11	-7471.94
2004	411.43	242.07	542.21	79.16	531.29	1806.16	-9200.05	-7393.88
2005	357.26	258.98	622.12	80.91	448.54	1767.81	-9209.99	-7442.18
2006	332.83	293.28	600.2	69.19	672.46	1967.96	-9219.93	-7251.97
2007	386.31	419.05	601.48	71.01	1338.29	2816.14	-9229.87	-6413.74
2008	368.12	465.96	600.64	72.89	562.21	2069.82	-9239.81	-7170.00
2009	386.92	459.31	565.09	74.75	477.84	1963.91	-9249.76	-7285.85
2010	468.63	497.13	570.01	87.75	643.83	2267.35	-9259.70	-6992.34

2011	519.4	475.92	557.91	89.46	658.96	2301.65	-9285.08	-6983.43
2012	588.63	482.84	542.29	113.76	659.67	2387.19	-9310.46	-6923.26
2013	620.39	596.33	533.19	117.82	665.73	2533.46	-9335.84	-6802.38
2014	689.2	660.42	549.93	122.06	1108.88	3130.49	-9361.22	-6230.73
2015	707.92	796.42	552.87	126.51	743.66	2927.38	-9386.60	-6459.22
2016	703.17	977.79	554.69	117.86	924.42	3277.93	-9411.98	-6134.05
2017	760.58	1096.29	564.98	121.11	723.65	3266.61	-9437.36	-6170.74
2018	863.56	1292.23	558.89	76.83	612.68	3404.19	-9462.74	-6058.55
2019	833.05	1054.18	533.74	134.7	750.38	3306.05	-9488.12	-6182.07
2020	661.14	792.7	512.69	127.37	629.38	2723.28	-9513.50	-6790.22
% Change 1994-2020	606.35	374.87	-14.67	128.34	-2.16	74.52	5.99	-8.43
% Change from 2015 - 2020	-7.08	-0.47	-7.84	0.68	-18.16	-7.49	1.33	4.87
% Contribution in 2020	24.28	29.11	18.83	4.68	23.11	100		

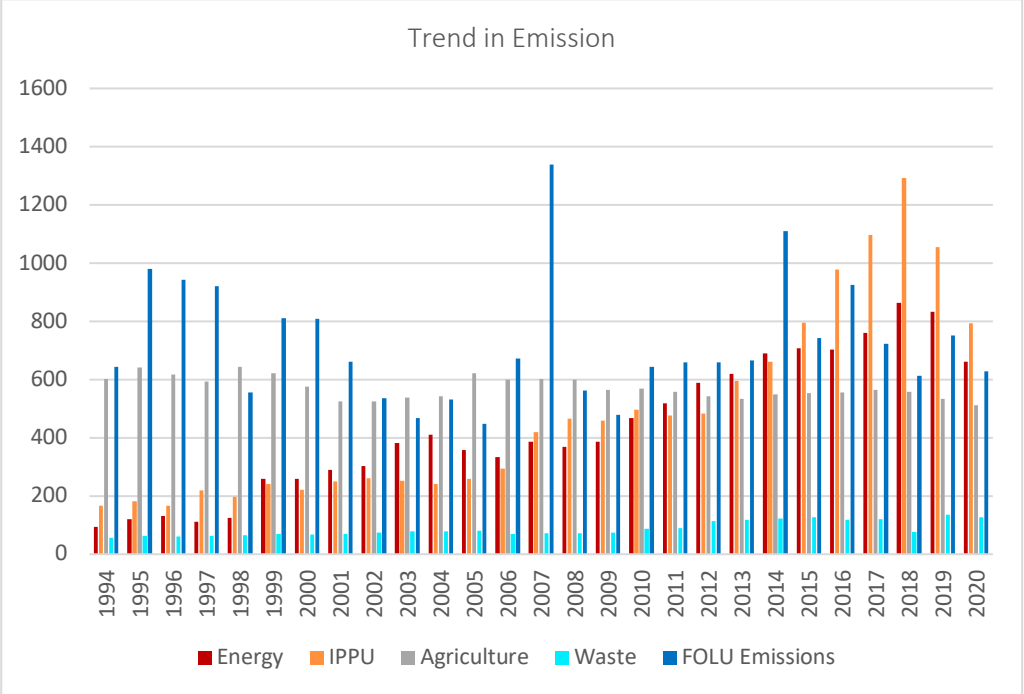

Figure 11. Emission Trends

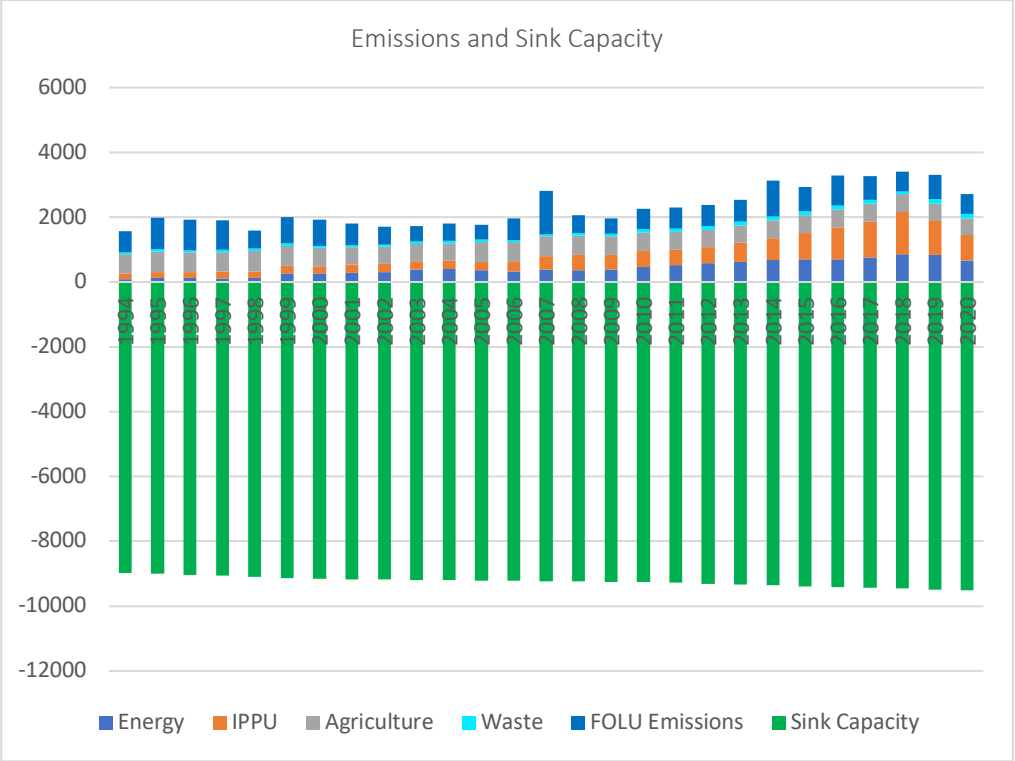

Figure 12. Trends in Sink and Net Emissions

2.6 Sectoral Emissions

2.6.1 Energy

The Energy sector, which includes the consumption of fossil fuels and their associated fugitive emissions, is the second largest GHG emitting sector in Bhutan, contributing to 24.28% of the total GHG emissions in 2020 (excluding FOLU). The total emissions from the energy sector were 661.14 Gg CO2e in 2020, comprising of 651.91 Gg CO_2, 0.10 Gg CH_4 and 0.022 Gg N_2O. The emissions in the sector had decreased by 6.6% since 2015, mainly due to the reallocation of fossil consumption in ferro alloy and carbide production to the IPPU category.

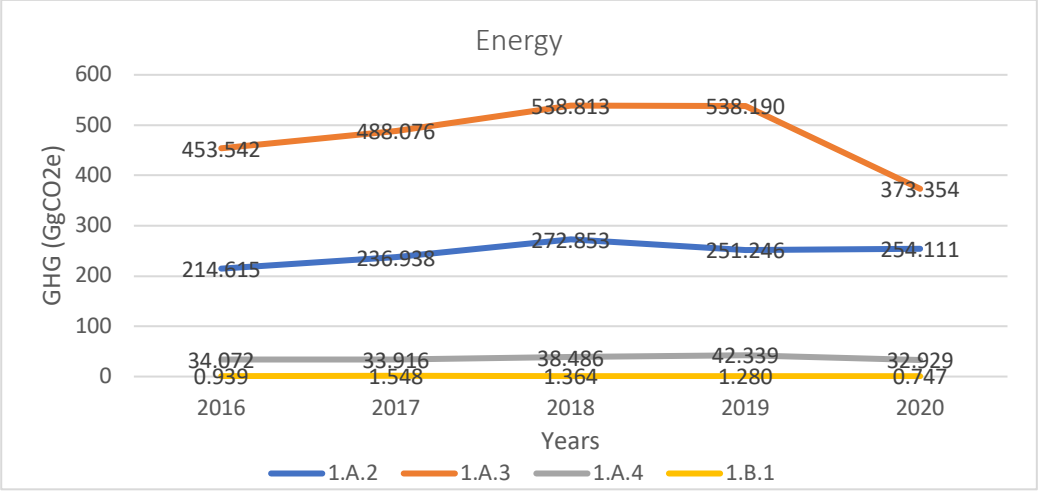

Figure 13. Energy Emissions

As evident from *Figure 13* emissions in the energy category were stable during the reporting period 2016 - 2019 and dipped in 2020. This is mainly attributable to the reduced demands in the transport sector (1.A.3) due to COVID-19 travel restrictions and lockdowns.

2.6.1.1 Energy industries [1A1]

While there are no heat plants in the country or petroleum refinery, it is assumed that there are no emissions from electricity generation, as the primary source of electricity in the country is run-of-the-river hydropower plants whose emissions are considered to be zero. The only distribution company in the Country, Bhutan Power Corporation Limited, maintains diesel generators as back-up for power outage exigencies, however, due to lack of data on diesel used and to prevent under-estimation, all diesel imported are assumed to be used in the transport sub-category. Therefore, emissions from 1.A.1 energy industries is zero.

2.6.1.2 Manufacturing industries and construction [1A2]

The manufacturing industries in Bhutan meet a significant portion of their energy requirement from the national electricity grid. The energy related emissions are mainly from diesel consumption in boilers, coal used in cement plants and furnace oil/ residual fuel oil used in the rolling mills to re-heat billets. As disaggregated data on fuel use in the construction industry is not available, emissions arising from the combustion of fuels in the construction sector are attributed under transport sector (1A.3). In 2020, emissions from this category using default emission factor were 252.28 Gg CO_2, 0.03 Gg CH_4 and 0.003 Gg N_2O.

2.6.1.3 Transport [1A3]

As a landlocked country heavily reliant on road transport, emissions in 1.A.3 are also considered lifeline emissions. Energy use in the transport sector relied partially on published sources and partly on calculations based on a control total for gasoline/diesel imports, namely the Bhutan Trade Statistics (2016-2020). To avoid overestimation from double-counting fuels in the energy industries, manufacturing industries, and transport, the activity data used in transport includes all imports of diesel and gasoline.

Emissions from the Transport category in 2020 was from road and air transportation. A tier one methodology was adopted using fuel import data, and default IPCC emission factors resulting in emission of 366.45 Gg CO_2, 0.05 Gg CH_4 and 0.02 Gg N_2O.

Emission from the domestic aviation was 1.20 Gg of CO_2 and this is attributable to limited domestic commercial flights in operation in three domestic airports. In addition, the fly time between these domestic airports is less than an hour's journey. Due to the lack of disaggregated fuel data between domestic and international aviation, expert judgement was used to split the fuel consumed in aviation into a 70% and 30% split between international and domestic aviation.

2.6.1.4 Other sectors [1A4]

Energy use in this subcategory includes the consumption of biomass and fossil fuels (LPG and kerosene) in the residential and commercial/institutional sectors. Hydropower generated electricity provides for most of the energy needs. Electricity generated from hydropower meets most of the energy demand in Bhutan, and biomass is used as source of energy for cooking and space heating, especially in rural areas. In contrast, LPG is used mainly for cooking and kerosene for space heating in urban areas. The emission is estimated based on the fuel import data from the Bhutan Trade Statistics 2020 and results in an emission of 32.83 Gg of CO_2 and 0.2 Gg CH_4.

2.6.1.5 Fugitive emissions from fuels [1B]

Solid fuels [1B1]

Bhutan has five surface coal mines, and production data from the mine and a default emission factor is used to estimate the emissions of 0.34 Gg of CO_2 in 2020.

2.6.1.6 Memo Items

International Bunkers

The activities occurring in this category are from the international flights operated by two airline companies. The emission from the international bunker is estimated to be 2.80 Gg of CO_2, 0.004 Gg of CH_4 and 0.02 Gg of N_2O.

2.6.2 Industrial Processes and Product Use

In Bhutan, several important industrial processes account for the emissions of greenhouse gases. Major industries include those in the "mineral products" category (e.g., cement production), chemical products (calcium carbide) and metal industry (ferroalloys). Each of these categories is discussed in the sections below.

Table 9 and *Figure 14* and *Figure 15* presents the IPPU emissions from 2016-2020. Industrial Processes and Product Use is the largest emitter of anthropogenic GHG emissions in Bhutan accounting for 792.70 Gg CO_2 and 0.65 Gg CO_2e of HFC, or about 29.11% of total GHG emissions in 2020. The industrial sector's activity data was obtained from surveys of individual industries, annual trade statistics and the national industrial license database.

Metal industry (ferro alloys) accounted for the largest share of emissions with 448.66 Gg CO_2, followed by mineral industry with 322.53 Gg CO_2 and the chemical industry accounted with 20.56 Gg CO_2. Emissions from lubricant use were 0.95 Gg CO_2 and other sub-category emissions were not estimated due to lack of reliable data.

For the first time, emissions, though negligible, from the use of refrigerants were estimated using the national database established for the import of substances controlled under the Montreal Protocol.

The use of other HFCs, PFCs and SF6 are not documented and data on their use is not available. Particularly for SF6, imported as part of transformers, tracking the leakages and life of the transformers with subsequent release of emissions is seen as an activity not feasible to be taken given the time, capacity and resource constraints as well as the expected negligible proportion of these emissions.

Table 9. IPPU Emissions

IPPU Emissions (Gg CO_2e)					
Category	2016	2017	2018	2019	2020
2.A	467.315	442.527	491.927	462.820	322.533
2.B	59.673	69.314	39.284	37.078	20.562
2.C	449.573	583.340	759.839	553.232	448.660

2.F	0.000	0.000	0.000	0.000	0.654
2.G	1.227	1.105	1.180	1.051	0.947

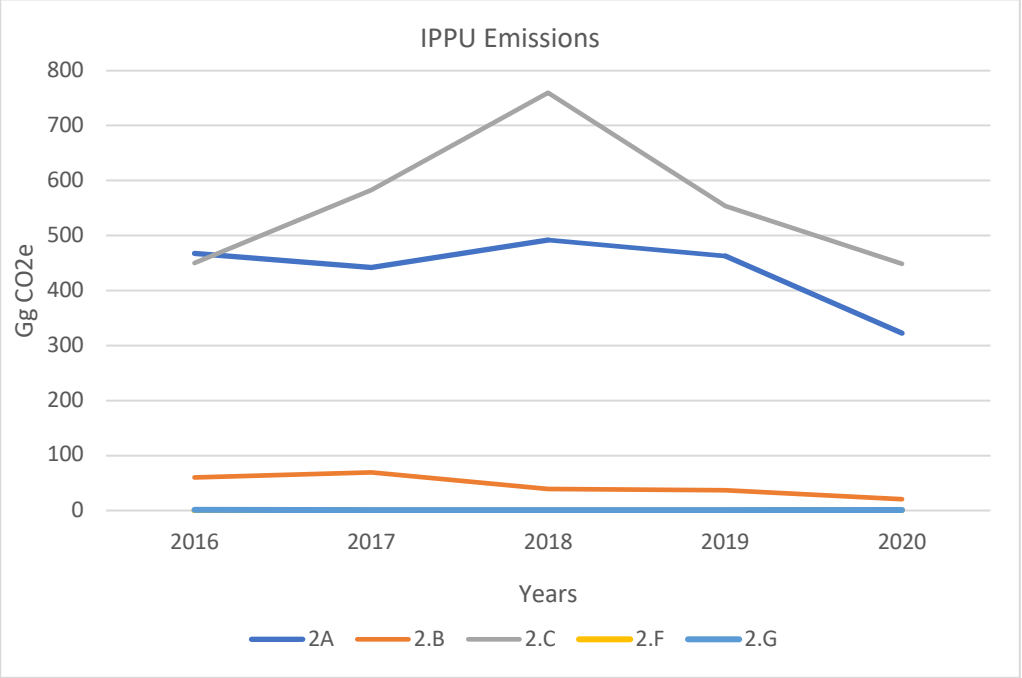

Figure 14. IPPU Emissions 2016-2020

2.6.2.1 Mineral industry [2A]

As of 2020, there were two cement plants in operation in the country. Carbon dioxide is produced during the production of clinker, an intermediate product used to make cement. A tier one methodology using plant specific activity data and default emission factors was used to estimate the emission of 322.53 Gg CO_2.

2.6.2.2 Chemical industry [2B]

There is only one plant in this category. The activity data on the quantity of silicon carbide produced is used with default emission factors to estimate the emissions of 20.56 Gg CO_2 in 2020.

2.6.2.3 Metal industry [2C]

The production of ferroalloys was the only source of emission in this category. A single tier methodology of using plant-specific activity data and the default emission factor was used to estimate the emissions of 446.93 Gg CO_2 in 2020.

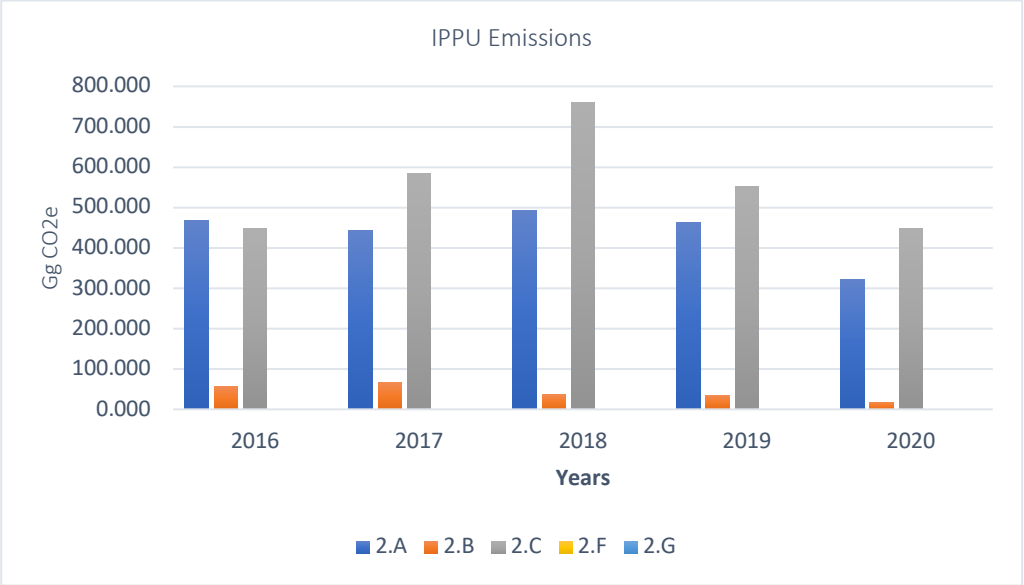

Figure 15. IPPU Emissions

2.6.3 AFOLU

The Agriculture, Forestry and Other Land Use sector when excluding removals contributed 18.83% and 23.11 % respectively to the national emissions with 512.69 Gg CO_2e and 629.38 Gg CO_2e in 2020.

The estimation of GHG emissions and removals from the AFOLU Sector includes CO_2 emissions and removals resulting from Carbon stock changes in biomass, dead organic matter and mineral soils; N_2O emissions from managed soils; CO_2 emission associated with urea application on managed soils; CH_4 emissions from rice cultivation; livestock (enteric fermentation and manure management); and N_2O emissions manure management systems.

2.6.3.1 Agriculture

Agriculture and livestock activities contributed 512.69 Gg CO_2e, corresponding to 18.83% of total national emissions in 2015. The majority of the sector's emissions were from livestock that emitted 390.86 Gg of CO_2e, of which enteric fermentation accounted 341.42 Gg of CO_2e while manure management contributed only 49.44 Gg of CO_2e and similarly, rice cultivation emitted 33.21 Gg of CO_2e. Direct N_2O emission from managed soils, indirect N_2O emissions from managed soils and indirect N_2O emissions from manure management contributed 0.3, 0.001 and 0.007 Gg N_2O respectively. The emission from urea application on land was only 1.06 Gg of CO_2.

Agriculture emissions have been almost constant throughout the reporting period as shown in *Figure 16* and *Table 10* because agriculture is still largely practiced at a subsistent level with very little chemical inputs. Agricultural emissions are therefore survival emissions.

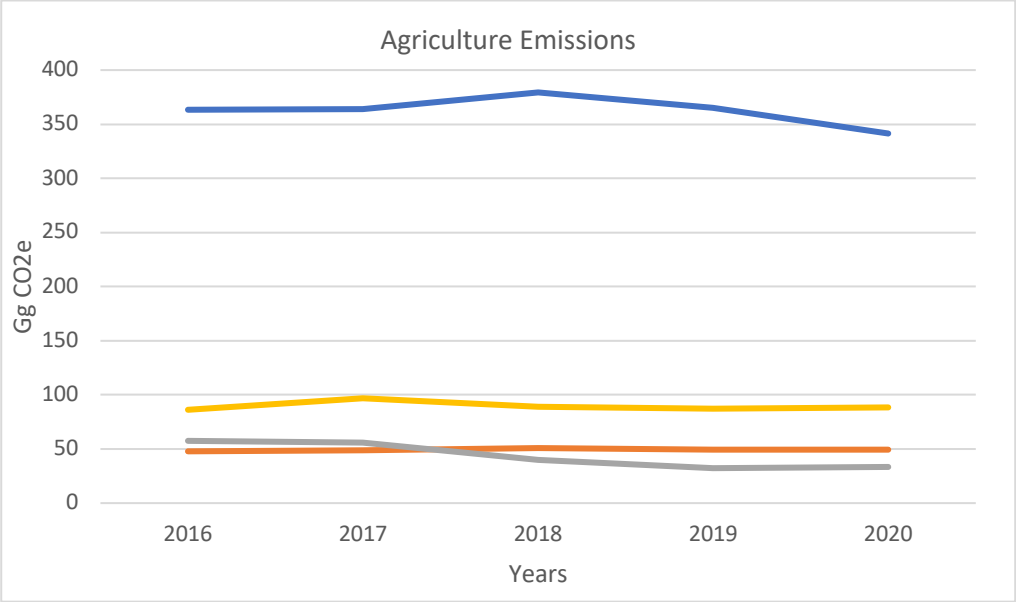

Figure 16. Agriculture Emissions

Table 10. Agriculture Emissions 2016-2020

Category	Emissions (Gg CO2e)				
	2016	2017	2018	2019	2020
4A - Enteric Fermentation	363.135	363.872	379.365	364.847	341.416
4B - Manure Management	47.831	48.577	50.856	49.655	49.441
4C - Rice Cultivation	57.517	55.687	39.754	32.291	33.219
4D - Agricultural Soils	86.206	96.845	88.912	86.945	88.614

2.6.3.2 Land Use, Land Use Change and Forestry

This section provides an assessment of the greenhouse gas fluxes resulting from forestry and other land uses in Bhutan. 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) recommends reporting fluxes according to changes within and conversions between all land-use types, including Forest Land, Cropland, Grassland, Wetlands, and Settlements (as well as Other Land). The greenhouse gas flux from Forest Land Remaining Forest Land is reported for all carbon stock in aboveground biomass, belowground biomass, deadwood, litter, and carbon stock changes from mineral and non-CO_2 emissions from forest fires. Calculations for the FOLU category was made manually as country specific data and factors were available

from the forest inventory exercise carried out which was not compatible with the IPCC software.

All carbon pools are accounted for estimation of emissions when forest land is converted to non-forest land. The removals are estimated only for forest land, and it is assumed that removals and emissions balance out land categories remaining same land category for 20 years. The statistics of timber removals, forest fire disturbance, and area brought under plantation are obtained from forestry facts and figures/ statistics and other unpublished records maintained by Department of Forests and Park Services.

In 2020, Forestry and Other Land Use (FOLU) acted as a CO_2 sink sequestering 8,969.01 Gg CO_2 and 8,884.115 Gg CO_2 respectively excluding and including non-CO_2 emission from biomass burning in forest land. Forest land sequestered 9,513.49 Gg CO_2 in 2020 excluding emissions from deforestation, wood removals and non-CO_2 emission from fire disturbance in forest. The total emission from FOLU in 2020 is 629.382 Gg CO_2e, timber harvesting (wood removal and fuelwood) contributing 50% (316.937 Gg CO_2e), deforestation 36% (227.548 Gg CO_2e) and non-CO_2 emission from forest fire disturbance contributing 14 % (84.489 Gg CO_2e) to the total emission in land sector.

The net removal in FOLU saw an increase of 4.5% from 1994 (base year) and 2 % increase from 2015 (last inventory reported third national communication to UNFCCC. This increase is mainly due to exclusion of CO_2 emissions from fire disturbance and segregation of fuelwood into whole tree and tree parts, which was reported at whole tree in last inventory. *Figure 18* shows that interannual changes in FOLU emissions occur due to variations in forest fires and harvesting of fuel wood while emissions from non-forest land are stable throughout the reporting period. Sequestration by forest has gradually increased during the reporting period from 9,411.98 Gg CO_2 in 2016 to 9,513.50 Gg CO_2 in 2020 owing to natural expansion of forest land and concerted efforts at afforestation and reforestation as shown in *Figure 17.*

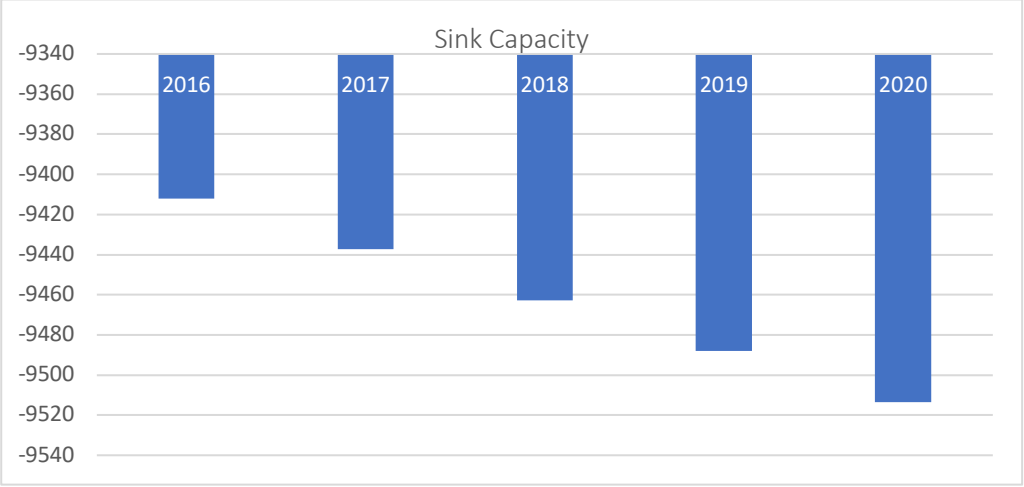

Figure 17. GHG sequestration by forest

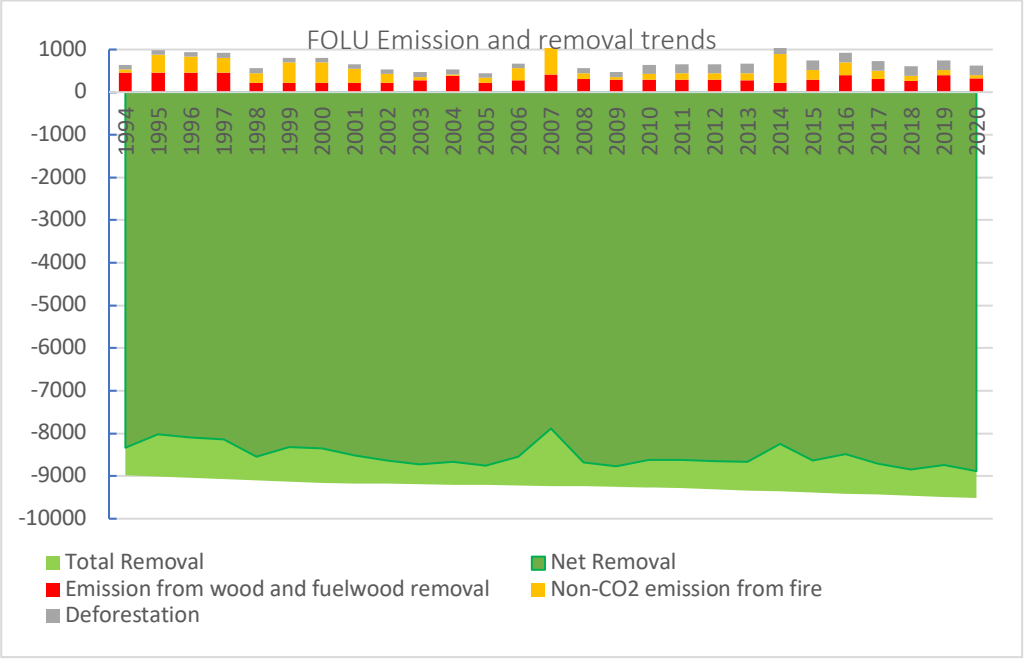

Figure 18. FOLU Emissions

2.6.4 Waste

GHG emissions from the waste sector was 127.37Gg CO_2e in 2020 and represented 4.68 % of total national GHG emissions. Sources for waste management data included survey findings, published literature and population statistics. Emissions were estimated using a bulk waste approach with activity data of population/ GDP (Tier 1).

Emissions in the waste sector were stable during the reporting period as depicted in *Figure 19* indicating little changes in both technology of waste management and population.

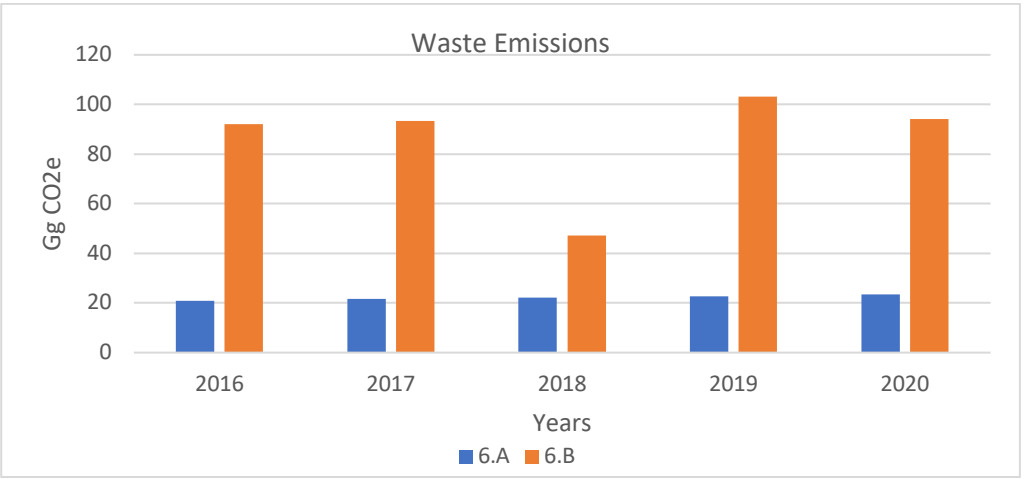

Figure 19. Waste Emissions

2.7 Key Category Analysis

Key categories are defined as sources of emissions or removals that have a significant influence on the inventory, in terms of emission levels, the trend, or both. When summed together in descending order of magnitude, key categories add up to over 95% of total emissions (level assessment) or the inventory trend in absolute terms. The analysis of key categories was performed based on sectoral distribution and the Tier 1 approach for level estimates. The key categories from the analysis are presented in *Table 12 and Table 13.*

The analysis of key sources followed the 2006 IPCC Guidelines. IPCC Software Version 2.691 was used to populate the activity data and estimate the emissions. Two approaches can be used to determine the key categories: the level approach if only one year of data is available, and the trend approach if there are two comparable years.

The inventory provides emissions for more than one year; therefore, both the level and trend assessments for key category analysis were performed. For the trend assessment, the emission estimates for 2016 and 2020 were used. The most significant sources of GHG emissions in Bhutan are forest land remaining forest (CO_2), ferro alloys production (CO_2), road transportation (CO_2), enteric fermentation (CH_4), cement production (CO_2) and manufacturing industries and construction- solid fuels (CO_2) based on the Level Assessment. The approach 1 trend assessment resulted in forest land remaining forest (CO_2), ferro alloys production (CO_2), road transportation (CO_2), enteric fermentation (CH_4), cement production (CO_2, manufacturing industries and construction- solid fuels (CO_2), wastewater treatment and discharge (CH_4), direct N_2O emissions from managed soils, (N_2O) and emission from biomass burning (CH_4 & N_2O) as key categories.

Table12. Level Assessment

A	B	C	D	E	F	G
IPCC Category code	IPCC Category	Greenhouse gas	2020 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-8669.99	8669.99	0.80	0.80
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	448.66	448.66	0.04	0.84
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	365.25	365.25	0.03	0.88
3.A.1	Enteric Fermentation	METHANE (CH4)	341.42	341.42	0.03	0.91
2.A.1	Cement production	CARBON DIOXIDE (CO2)	322.53	322.53	0.03	0.94
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	244.39	244.39	0.02	0.96

Table13. Trend Assessment

A	B	C	D	E	F	G	H
IPCC Category code	IPCC Category	Greenhouse gas	2016 Year Estimate Ex0 (Gg CO2 Eq)	2020 Year Estimate Ext (Gg CO2 Eq)	Trend Assessment (Txt)	% Contribution to Trend	Cumulative Total of Column G
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-7228.84	-8669.99	0.14	0.64	0.64
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	446.78	448.66	0.02	0.08	0.72
3.A.1	Enteric Fermentation	METHANE (CH4)	363.14	341.42	0.01	0.06	0.78
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO2	207.07	244.39	0.01	0.05	0.83
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	442.97	365.25	0.01	0.04	0.88
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	88.42	94.03	0.00	0.02	0.90
2.A.1	Cement production	CARBON DIOXIDE (CO2)	467.32	322.53	0.00	0.02	0.92
3.C.1	Emissions from biomass burning	METHANE (CH4)	120.21	33.70	0.00	0.02	0.93
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	85.83	88.20	0.00	0.02	0.95
3.C.1	Emissions from biomass burning	NITROUS OXIDE (N2O)	79.27	22.22	0.00	0.01	0.96

2.8 Uncertainty Analysis

An uncertainty assessment is an essential element of the GHG emission inventory to prioritize efforts to improve future inventories' accuracy. In Bhutan, uncertainties are associated with data access/constraints, potential unsuitability of generic emission factors, and an incomplete understanding of emission processes.

Uncertainty and time series assessments were conducted using the Tier 1 methodology in accordance with the 2006 IPCC Guidelines and good practices, taking 2020 as the inventory year for the uncertainty level. Based on expert judgment, activity data collection uncertainty for almost all the sector ranges between ± 3% and ±20%. The default emission factor's uncertainty values were taken to analysis the uncertainty for all sectors. The uncertainty analysis resulted in a total inventory uncertainty of 12.71% and a trend uncertainty of 3.57%.

Attention to two areas could help reduce uncertainty in Bhutan's GHG inventory. First, improving the accuracy of some emission factors to calculate emissions from various sources is vital. Most of the emission factors correspond to IPCC default factors. For example, the accuracy of current emission factors for enteric fermentation by animals at high altitude remains uncertain in the absence of local sampling and testing activities. Secondly, the availability of detailed activity data will support the refinement of inventory estimates. Although methodologies have been used to estimate emissions for some sources, problems arose in obtaining activity data at a level of detail in which aggregate emission factors can be applied. Addressing these areas through additional capacity strengthening and development of dedicated observation networks will enhance future emission inventories' quality and accuracy.

2.9 Data and Information Gaps

2.9.1 Improvement Plans

Availability of both financial and human resources in particular, limited technical knowledge on GHG inventory systems and also lack of quality data, and country specific emission factor remain a major challenge to estimate and come up with reliable GHG emission for the country. Therefore, the main focus of improvement will be on national systems and improved data accuracy, particularly institutional arrangements and developing country-specific data. There is a strong need to improve data collection in all the IPCC sectors and publication of National Energy Balance and other data and statistics on a regular basis to improve accuracy of reporting.

With the ongoing implementation of capacity building initiative for transparency (CBIT) project, it is envisioned that coherent and effective institution and system will be put in place to address such problems and issues and enhance the national capacity on transparency and reporting.

MITIGATION ACTIONS AND THEIR EFFECTS

Mitigation Actions and Their Effects

3.1 Key Policies and Measures

The Royal Government of Bhutan promotes the four pillars and nine domains of the philosophy of Gross National Happiness and these are closely aligned with the United Nation's Sustainable Development Goals. While policies and measures are not directly targeted for GHG reduction, many of the P&Ms have mitigation benefits. The following sections give a brief overview of the policies and measures:

3.1.1 Energy

Under the Energy category, the primary focus of P&Ms is to promote sustainable energy in the form of hydropower and alternative renewable energy sources such as solar, wind and biogas. The Bhutan Sustainable Hydropower Development Policy (SHDP) 2021 identifies hydropower as a strategic national resource and intends to develop hydropower resource as a means to achieve universal access to clean energy, as a driver for economic growth in Bhutan and cross-border trade in electricity. The universal access to sustainable clean energy will lead to replacing biomass and LPGs from the domestic and commercial space heating and cooking fuels and mitigate GHG emissions. Further, the use of clean electricity sourced from hydropower plants will ensure that energy use in manufacturing industries do not lead to GHG emissions while cross border trade in electricity, primarily export of clean electricity to India will lead to offsetting emissions from thermal power plants in India. The Royal Government of Bhutan also intends to adopt emerging technologies and innovative solutions such as green hydrogen fuel, green ammonia and energy storage schemes (SHDP).

Transport sector in Bhutan is highly dependent on road transport and the network of national highways, dzongkhag roads, feeder roads and farm roads serve as the vital arteries to Bhutan's socio-economic development. As a result of the country's strong dependence on surface transport, the import of fossil fuels for the transport sector has the highest impact on Bhutan's balance of trade and balance of payment with India besides its carbon footprint. Therefore, policies and measures aimed at improving public transport and introducing low and zero emission vehicles including hydrogen fuel cell and hydrogen vehicles serve the dual purpose of reducing Bhutan's GHG emissions while also supporting the country's drive for national self-reliance.

3.2 Required Policies

The Climate Change Policy of the Kingdom of Bhutan 2020 provides the overall policy directive for the country and one of the key policy objectives is for Bhutan to remain carbon neutral for all times to come. The policy further provides guidance on climate resilience as well as indicative means of implementation. While this policy provides the national level policy goals and objectives, there is an acute disconnect between sectoral policies and the national goals and objectives pertaining to climate change. While sectoral policies on climate change are not felt needed, there is an urgent need

to mainstream these climate goals into the sectoral policies and ensure that climate action is addressed in a whole of government approach and establish inter-agency linkages.

3.3 Mitigation Measures Undertaken

3.3.1 Bhutan Biogas Project

Fuel wood is still predominately used for cooking by rural households while liquefied petroleum gas (LPG), kerosene and electricity are widely used for cooking by urban households (90%). Fuel wood consumption contributes to forest deforestation and smokes with adverse health effects on households. Besides environment, climate and human health issues, the import of fossil fuel has a significant impact on Bhutan's balance of trade and balance of payment situation.

The objectives of the project were to:

(i) improve access to modern household cooking and heating using clean, renewable biogas,
(ii) reduce greenhouse gas emissions, and
(iii) reduce forest deforestation.

Additional benefits of the proposed project include

(i) a reduction in adverse health effects from indoor air pollution resulting from firewood smokes,
(ii) a positive social impact as the time spent on collecting firewood will be reduced, and
(iii) an improvement of farmer's crop yields by using the organic by-product form biogas plants.

The Bhutan Biogas Project mitigation is estimated as follows:

- BAU Scenario without biogas digestor: 898.45 tCH_4
- CO_2 emission during combustion: 673.84 t
- Mitigation: 21,714 tCO_2e per annum
- Total for 2016-2020: 108,570 tCO_2e.

To further promote biogas as an alternative fuel source, the National Biogas Implementation Strategy was launched in 2020.

3.3.2 Pilot Windmill Project

While Bhutan's electricity is sourced from run-of-the river hydroelectric plants, any surplus electricity produced in Bhutan is exported to India under a bilateral agreement and the assumption here is that any clean electricity exported from Bhutan reduces demand from thermal power plants in India. While the mitigation is not occurring within the territorial boundary of Bhutan, there is regional and global benefits accrued from promoting alternative renewable energy in Bhutan. The mitigation estimated using the combined grid emission factor of North and Northeast India is as follows:

- 600 KW x 360 days x 24 hrs/day x 0.3 = 1576.8 MWh
- Assuming Indian GEF of 0.96 t CO_2e/MWh, mitigation: 1513.73 tCO_2e/annum
- For 2016-2020:7568.64 tCO_2.

3.3.3 Hydropower Development

Dagachhu Hydropower plant is a 126 MW run-of-the river hydroelectric plant which is also registered as a CDM project and has been generating carbon credits (CERs) since 2015. Since the entire power generated by this plant is exported to India through a power purchase agreement with Tata Power in India, mitigation from this power plant happens within the territorial power boundary of India.

The mitigation benefits are estimated as follows:

- Annual Mitigation: 500,000 tCO_2e/ annum
- Mitigation 2016-2020: 2,500,000 tCO_2e

Mangdechhu Hydropower Project is a 720 MW hydroelectric project built as a bilateral project between the Government of India and Royal Government of Bhutan and registered as a CDM project has been submitted to the UNFCCC. The project was commissioned in 2019 with an annual mitigation potential of 2,421,268 tCO_2e.

3.3.4 Other Interventions

In addition to the above interventions, several policies and measures have been taken by the Royal Government of Bhutan during the reporting period where it is not possible to quantify mitigation benefits directly but still have climate benefits as well as other socio-economic and SDG co-benefits. Some of these policies and measures are listed below:

i. National Energy Efficiency and Conservation Policy 2019
ii. Transport Policy 2017 and Policy Protocol
iii. Transport 2040 Integrated Strategic Vision
iv. Low Emission Development Strategies (Food Security, Industries, Human Settlement and Surface Transport).
v. Agriculture Land Development Guidelines 2017.
vi. Forest and Nature Conservation Rules and Regulations of Bhutan 2017.
vii. RNR Strategy 2030 and 2040
viii. Bhutan's National Pathways-Food Systems for Gross National Happiness Transformative Pathways for Bhutan 2021

MEASUREMENT, REPORTING AND VERIFICATION

Measurement, Reporting and Verification (MRV)

The Bali Action Plan introduced language on "measurable, reportable and verifiable" greenhouse gas (GHG) mitigation actions and commitments, as well as support for GHG mitigation actions in developing countries. For Non-Annex I countries, the MRV framework is based on the non-intrusive non-prescriptive and country driven principles.

For Bhutan, the MRV focuses on emissions & sequestrations and support. While the MRV on emissions and sequestration are fairly advanced based on experiences and capacities built during the development of previous national communications, the institutional mechanism for reporting on MRV doesn't formally exist and rely heavily on the official mandates of the respective institutions.

The following paragraphs summarize the MRV framework in Bhutan.

4.1 MRV- Emissions and Sequestrations

The measurement of emissions and sequestration is carried out by sectoral agencies who are represented in the thematic working group on climate change- the non-formal body instituted to develop GHG inventories, National Communications and other ad-hoc activities. While collection of activity data for estimating GHG emissions and sequestration does not exist in the energy, IPPU and waste sectors which collects such data on a need basis, the system of carrying out regular national forest inventories provides a formal pathway for collecting, archiving and reporting required information to estimate emissions and sequestrations.

Reporting of emissions and sequestration is done by the national focal point for UNFCCC which is the National Environment Commission, the secretariat of which also houses the Climate Change Division.

Independent verification of emissions and sequestration is not a standard practise in Bhutan unless such emissions and sequestration are part of an international market mechanism such as the CDM mechanism. However, the members of the Thematic Working Group carry out validation exercises to ensure that the emissions and sequestration are in line with existing national circumstances and UNFCCC reporting requirements. Figure 20 shows the MRV framework for emissions and sequestrations.

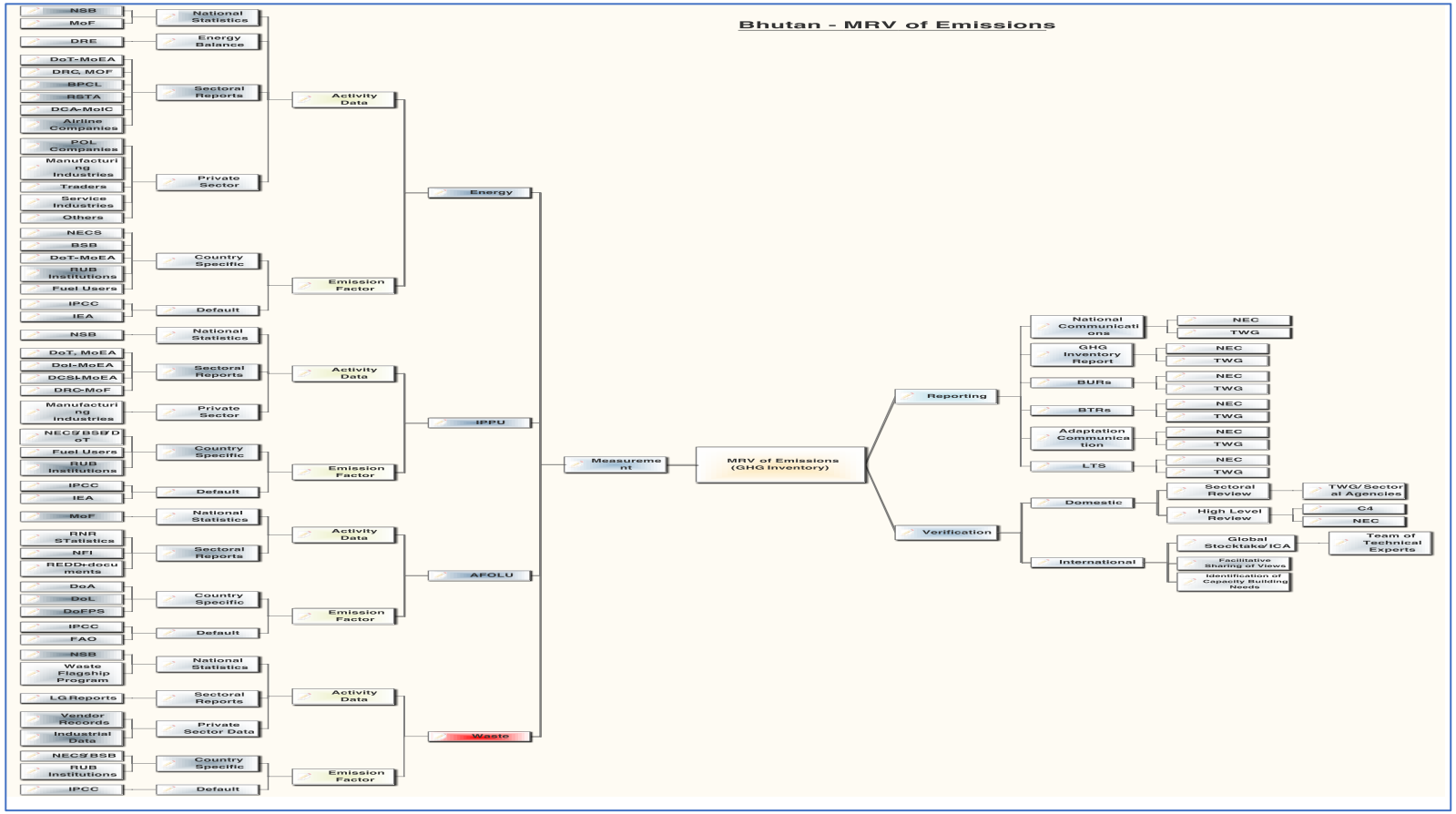

Figure 20. MRV Emissions and Sequestration

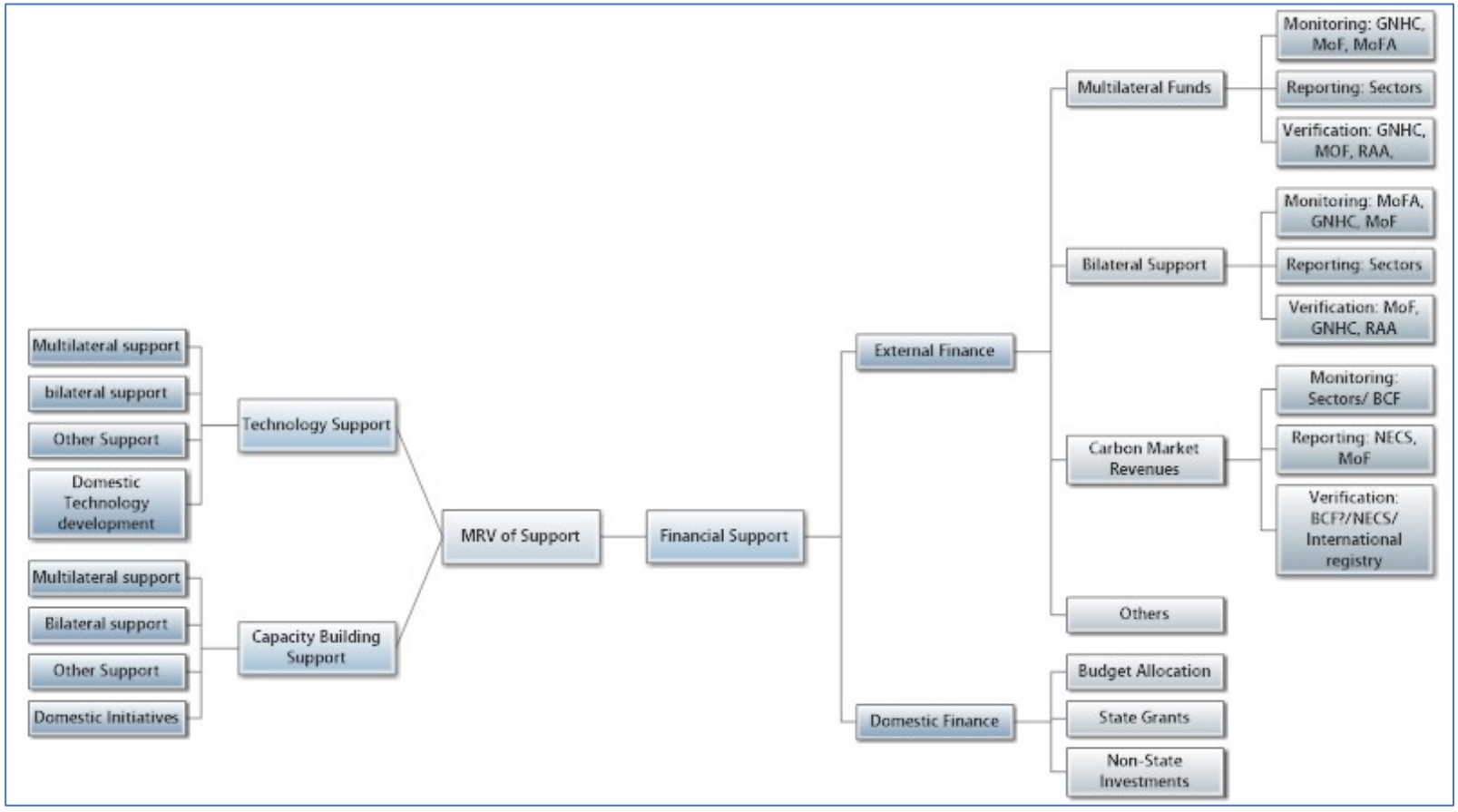

Figure 21. MRV Support

4.2 MRV- Support

Support in the context of Bhutan comes as bilateral and multilateral grant projects or international borrowing. While standalone technology and capacity building support did not take place during the reporting period, several grants were received, mostly from multilateral agencies for climate change activities.

In the case of grant assistance, the Gross National Happiness Commission is the focal agency and serves as the central repository of information. The sectoral agencies contribute to the negotiation of such grant assistance and implement the activities while the GNHC maintains oversight over the grant project.

The Department of Macro-Fiscal and Development Finance under the Ministry of Finance is responsible of resource mobilization and public debt management and therefore takes the lead in initiating and negotiating external borrowings, both from bilateral and multilateral sources.

A common issue as iterated in the Third National Communication is the absence of centralized and readily available data relating to climate finance and associated support and it is recommended that the focal agency for UNFCCC consolidates information on all climate support received both by government and non-government agencies in Bhutan. *Figure 21 (page 75)* shows the MRV framework for support in Bhutan.

FINANCE, TECHNOLOGY AND CAPACITY BUILDING NEEDS AND SUPPORT RECEIVED

Finance, technology and capacity-building needs and support received

5.1 Reporting

The approach adopted for reporting to the Convention was consolidated in-house reporting. The country is in the process of developing reporting capacity with unavailability of consistent and reliable data as a major challenge. Constraints and barriers still exist at the institutional and technical level to meet the standard requirements of the Enhanced Transparency Framework of the Paris Agreement. Findings have shown that the country still faces seven constraints and barriers that have been outlined in Bhutan's TNC, which include:

(i) lack of the availability of financial resources to address climate change challenges,
(ii) lack of technical and technological support and knowledge,
(iii) limited capacity building support and availability for climate action,
(iv) coordination related issues among government agencies and international financing and project implementing entities,
(v) lack of legal and policy enforcement mechanisms and planning of climate actions,
(vi) mainstreaming and integrating climate change issues into national, subnational, and sectoral development programmes and plans, and uncertainties relating to the research of climate change projects, such as potential impacts and the consequences of the implementation of climate change response actions.

Developing capacity for the preparation of the BTR (2024), meeting the ETF requirements of the Paris Agreement remains to be of utmost importance. The request for funding for the NC4 and BTR from GEF is under development. UNFCCC and UNEP GSP provided several rounds of virtual capacity building on MRV and the Transparency Framework.

5.2 Implementation

While Bhutan has developed Low Emission Developmental Strategies (LEDS) for four sectors, namely food security, human settlement, industry and surface transport in 2021, it has been unable to implement the strategies due to limited financial resources. Similarly, the three NAMAs were developed in 2016 for road transport, housing (residential and institutional) and municipal solid waste management though the country has not been able to implement these NAMAs due to difficulties faced in securing support.

Bhutan has implemented climate action by integrating climate change into its developmental planning under the sixth National Key Result Area (NKRA) of the 12th Five Year Plan, "Climate Neutrality, Climate and Disaster Resilience." Mitigation and

adaptation measures from the NDC were developed into programs across different sectors at the local and the national levels.[1] The Fiscal Incentives Act of Bhutan 2021 offers a direct tax incentive in the form of a tax exemption for ten years for the energy sector (excluding the hydropower sector).[2]

The Climate Change Policy of the Kingdom of Bhutan 2020 envisions a resilient and carbon-neutral Bhutan under a changing climate whereby the policy provides strategic guidance for Bhutan to remain carbon neutral and protect the wellbeing of the citizens of Bhutan by:

(i) adapting to climate change,
(ii) delegating roles and responsibilities to ensure meaningful participation of all relevant stakeholders for climate action change, and
(iii) ensuring that challenges and opportunities related to climate change are addressed through adequate means of implementation including finance, technology, capacity building and awareness through the integration of these measures into relevant plans and policies.[3]

Stakeholder participation in climate dialogue across various government agencies has been ensured through the Climate Change Coordination Committee. Additionally, a climate change one-stop platform that is currently in the testing-phase is being set up to improve coordination between climate sensitive sectors and to increase knowledge sharing, synergies, reporting and monitoring between various agencies.

In response to the ratification of the Kigali Amendments to the Montreal Protocol on Ozone Depleting Substances in 2019, the NEC has formulated the "Regulation on Substances that Deplete the Ozone Layer and Hydrofluorocarbons" in 2021 that adheres to Article 4B of the Montreal Protocol "to establish and implement a licensing system for the import and export of new, used, recycled and reclaimed controlled substances under the Montreal Protocol."[4]

The country has also undertaken various measures in the energy sector such as the National Energy Efficiency and Conservation Policy, the Energy Efficiency Roadmap 2030, the Renewable Energy Master Plan (2017-2032), and the Sustainable Hydropower Development Policy 2021 to promote energy efficiency for sectors that include buildings, transport and industries; and to promote the usage of renewable energy technologies to aid in Bhutan's efforts to remain carbon neutral. Measures taken in the transportation sector include the implementation of the Bhutan Electric Vehicle (EV) Roadmap (2020–2025) to transition to zero-emission mobilities. Under

[1] Gross National Happiness Commission (2019): Twelfth Five Year Plan 2018 – 2023, Royal Government of Bhutan, Thimphu.
[2] Ministry of Finance (2021): Fiscal Incentives Act of Bhutan 2021, Royal Government of Bhutan, Thimphu.
[3] National Environment Commission (2020): Climate Change Policy of the Kingdom of Bhutan 2020. Royal Government of Bhutan, Thimphu.
[4] National Environment Commission (2021): The Regulation on Substances that Deplete the Ozone Layer and Hydrofluorocarbons, 2021 Bhutan. Royal Government of Bhutan, Thimphu.

this Roadmap, the Bhutan Sustainable Low-emission Urban Transport System is being implemented to promote the transition of taxis to EVs for eventual market transformation. For the waste sector, the country aims to achieve Zero Waste Bhutan by changing the current waste trend of 80% of waste disposed of in landfills to 20% based on the principles of a circular economy.

For the AFOLU sector, the Renewable Natural Resources Strategy 2040 integrates resilience to climate change and low emissions as key strategies to achieve transformational change in the sector. This strategy builds on the REDD+ Strategy, the National Strategy for Sustainable Socio-economic Development through the Commercialisation of Organic Farming 2019 and LEDS for Food Security 2021. Bhutan has implemented the REDD+ readiness programme and has established the National REDD+ Framework. While the country has received a grant for Strengthening REDD+ and Watershed Management from GCF, the country is awaiting support to implement the strategies outlined to contribute to forest conservation and sustainable management of forests.

5.3 Constraints, Gaps & Needs

Bhutan's geographical positioning in the Eastern Himalayan range has made the country highly vulnerable to climate change. Communities in the north are susceptible to losing their homes and livelihoods through GLOFs (glacial lake outburst floods). As the majority of the population is engaged in agrarian farming, they are vulnerable to losing their sources of livelihood due to climate change and extreme weather events. Bhutan has always committed to remaining carbon neutral, which can be noted from several initiatives and pledges made by the country such as the country's constitutional mandate of maintaining at least 60% of forest cover, the ratification of the Paris Agreement in 2017, the implementation of the Climate Change Policy of the Kingdom of Bhutan 2020 and Bhutan commitment to being carbon neutral by being the first carbon negative country in the world, and most recently in COP26, reaffirming its status as a carbon negative country joining the exclusive group, the Coalition of Carbon Negative Countries.

While the country has submitted its TNC, its most challenging difficulty was the unavailability of consistent and reliable data. The country used IPCC default emission factors for all sectors, with the exception of the forestry sector. The country still lacks country-specific emission factors calling for the need to develop country-specific emission factors for improved reporting. Key findings of constraints identified in the TNC to implement climate change activities include the lack of financial resources, technology, research, and human capacity development. Bhutan, an LDC and a landlocked nation, has faced the brunt of the climate crisis and is among the most vulnerable countries. The country requires the support of the international community in order to implement mitigation and adaptation measures to cope with the climate crisis.

5.4 Support Received

Table 14 illustrates the summary of support received for the period of 2015 – 2020. The country has received support for climate finance projects amounting to US$ 82.51 million from GCF, GEF and UNEP. Additionally, Table 40 of the TNC outlines approved projects and programs that are being implemented whereby accredited agencies include WWF, UNDP and the World Bank.

Table 14. Summary of Projects Approved

Sl. No.	Name of Project	Amount (USD in millions)	Name of the Donor	Year
GEF – Operational Phase VI				
1.	Small Grant Program	0.50	GEF – STAR	2014 – 2018
2.	Bhutan Sustainable Low Emission Urban Transport – GEF 6 – Cycle Project	2.65	GEF – STAR	2014 – 2018
GEF – Operational Phase VII				
3.	Bhutan Sustainable Low Emission Urban Transport	3.00	GEF – STAR	2018 – 2022
4.	Small Grant Program	0.60	GEF – STAR	2018 – 2022
	Mainstreaming Biodiversity Conservation into the Tourism Sector in Bhutan	4.85	GEF – STAR	2018 – 2022
GEF - LDCF				
6.	Enhancing Sustainability and Climate Resilience of Forest and Agriculture Landscape and Community Livelihood	13.97	GEF – LDCF	2017 – 2023
GCF – Readiness and Preparatory Support Programme				
7.	NDA Readiness Support project: “Strategic framework	0.40	GCF	2018

	to strengthen the Capacity of NDA to access resources from the Green Climate Fund and support for direct access accreditation process"			
8.	NAP Readiness Support project: "Preparation of the National Adaptation Plan (NAP) for Bhutan with a focus on the implementation of comprehensive risk management in the water sector"	3.00	GCF	2019
9.	GCF Readiness Support Project: "Strengthening NDA and related institutions, including financial institutions, in Bhutan for effective engagement with GCF"	0.40	GCF	2019
10.	REDD+ Readiness Support Project: Strengthening REDD+ and Watershed Management in Bhutan	0.59	GCF	2019
GCF Competitive Fund				
11.	Bhutan Green Transport Program	0.5	GCF	2020
12.	Supporting Climate Resilience and Transformational Change in the Agriculture Sector in Bhutan	25.35	GCF	2020 – 2025
13.	Bhutan for Life	26.60	GCF	2018 – 2032
Other				
14.	Building Climate Resilience of Urban Systems through	0.09	UNEP	2020

	Ecosystem based Adaptation in the Asia Pacific Region			

5.5 Financial, Technical and Capacity Needs

The Royal Government of Bhutan has presented priority action plans through the draft Country Work Program (CWP) for GCF Financing, whereby three strategic areas ecosystems include

(i) agriculture,
(ii) sustainable infrastructure and
(iii) resilient communities.

These strategic themes have been outlined in Table 39 of Bhutan's Third National Communication. The Second Nationally Determined Contribution gives an update on sectoral targets and actions for low emission development with cost estimates which have been developed for varying timelines that range from 2021–2050[5] which have been outlined in *Table 15.*

Table 15. Sectoral Targets and Actions for Low Emission Development with Cost Estimates

Sector	Actions	Amount (in USD)
Forest conservation & management	Actions across four measures, namely (i) Strengthening Forest Management Practices; (ii) Climate-Smart Primary Production; (iii) Integrated Land Use Planning and (iv) Improved Rural Livelihoods, were planned whereby actions include: improving forest management and conservation, maintaining at least 50% of the land area through climate smart restoration, initiating and promoting agro-forestry and conserving wetland.	$54.4 million
Food Security	Mitigation actions to reduce emissions and increase carbon sequestration include switching from synthetic to organic fertilisers, improving agricultural practices, increasing perennial crop production, reducing continuous rice flooding, promoting domestic biogas production,	$ 61.65 million

[5] Details of the timeframe for each sector and action can be found in the Second Nationally Determined Contribution of the Kingdom of Bhutan in Annex I, Section 1(c).

	and improving dairy cattle production through better breeds and feeding management. The implementation of these measures has a mitigation potential of up to 710 Gg CO_2e.	
Human Settlement	Measures for the human settlement sector were considered across energy in buildings, transport infrastructure, waste management, land use in urban areas, and information communication and technology. Implementing these short-term prioritised measures will lead to a mitigation potential of 4,122 Gg CO_2e.	$101.84 million
Industries	Mitigation measures were proposed in this sector through technical measures and diversification away from heavy industries to promote higher value-addition and manufacturing products to benefit other sectors. The cumulative mitigation potential for this sector is estimated at 9,990-11,370 Gg CO_2e.	$3.52 million
Surface Transport	Interventions recommended for transport and mobility include mass transit, EV promotion, low emission freight transport, non-motorised transport system, improving fuel efficiency through stringent vehicle emission standards, and private vehicle demand management. The mitigation potential for this sector is estimated at 5,283 Gg CO_2e.	$3,233 million

The Third National Communication outlines pipeline projects covering several sectors, including transportation, resilience to natural disasters, livestock, human settlement, and infrastructure, among other sectors.[6] These pipeline projects require financial assistance and support; the projects have been estimated at US$. 911.58 million in order to implement these programs.

[6] Third National Communication of the Kingdom of Bhutan. National Environment Commission. Royal Government of Bhutan. Table 41 Pipeline projects. Page 127.

5.6 Information on the level of support received to enable the preparation and submission of the biennial update reports.

5.6.1 Financial

The Royal Government of Bhutan received financial assistance of US$. 350,000 from the Global Environment Facility through UNEP to prepare the BUR and carry out related capacity building activities.

5.6.2 Technical

Bhutan received support through training on NDC tracking progress under the Adaptation Communication, National Adaptation Plan, and NDC tracking of progress under the ETF. The UNFCCC and the UNDP Country Office Bhutan provided and facilitated training for GHG Mitigation potential analysis and baseline setting and IPCC 2006 Guidelines for the Thematic Working Group Members, and other stakeholders from various government agencies, private sector and CSOs; more than 160 participants from various sectors including private, non-governmental, CSOs and governmental organizations were trained in this session.

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