



Eswatini's First Biennial Update Report (BUR) to the United Nations Framework Convention on Climate Change

23 February 2023

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List of Acronyms

AFOLU	Agriculture, Forestry and Other Land Use
Annex I	Parties included in Annex I to the United Nations Framework Convention on Climate Change
BUR	Biennial Update Report
CAEP	Climate Action Enhancement Package
CBIT	Capacity Building Initiative for Transparency
CO ₂	Carbon Dioxide
CH ₄	Methane
COMESA	Common Market for Eastern and Southern Africa
CPEIR	Climate Public Expenditure and Institutional Review
CSIR	Council for Scientific and Industrial Research
DBSA	Development Bank of Southern Africa
EEA	Eswatini Environment Authority
ERA	Eswatini Revenue Authority
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
HDI	Human Development Index
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
MSW	Municipal Solid Waste
MHUD	Ministry of Housing and Urban Development
MNRE	Ministry of Natural Resources and Energy
MoA	Ministry of Agriculture
MRV	Measurement, Reporting and Verification
MTEA	Ministry of Tourism and Environmental Affairs
NAMA	Nationally Appropriate Mitigation Action
NA	Not Available
NC	National Communication
NCCC	National Climate Change Committee
NDC	Nationally Determined Contribution
NDMA	National Disaster Management Agency
NE	Not Estimated
NIR	National Inventory Report
NO	Not Occurring
N ₂ O	Nitrous Oxide
QA/QC	Quality Assurance and Quality Control
SEA	Swaziland Environmental Authority
SF ₆	Sulphur Hexafluoride

Ministerial Foreword

It is my great pleasure to present the first biennial update report (BUR) of the Kingdom of Eswatini to the United Nations Framework Convention on Climate Change (UNFCCC). This report is a demonstration of our commitment and contribution to the global efforts to combat climate change and its adverse impacts.

Eswatini is a landlocked country in Southern Africa that is highly vulnerable to the effects of climate change, such as droughts, floods, storms, and diseases. These effects pose serious threats to our socio-economic development, food security, water resources, health, biodiversity, and cultural heritage. As a responsible member of the international community, Eswatini has ratified the UNFCCC in 1996 and its Kyoto Protocol in 2006. In 2016, Eswatini also signed and ratified the Paris Agreement, which aims to limit the global temperature rise to well below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C.

In accordance with our obligations under the UNFCCC and its Paris Agreement, Eswatini has submitted its first nationally determined contribution (NDC) in October 2021, which outlines our adaptation and mitigation strategies to reduce greenhouse gas (GHG) emissions and enhance resilience. The NDC covers 12 sectors: agriculture, health, water, ecosystems and biodiversity, infrastructure, energy, waste, industry, forestry, gender, youth and disaster risk reduction. The NDC requires an estimated USD 1.3 billion to be implemented between 2020 and 2030.

This BUR provides an update of the information contained in our third national communication (NC3), which was submitted in December 2016. The BUR includes a national GHG inventory for the year 2018, which shows that 48% of emissions in 2018 are attributed to the AFOLU sector, 40% to Energy, 11% to Waste, and IPPU provides the remaining 1%. The BUR also provides information on our mitigation actions, needs and support received.

The preparation of this BUR was a participatory and inclusive process that involved various stakeholders from different ministries, public institutions, private sector, civil society organizations, academia and development partners. I would like to express my sincere gratitude to all those who contributed to this report, especially the technical team from the Department of Meteorology, Climate Change Unit under my ministry. I would also like to acknowledge the financial and technical support provided by the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP).

I hope that this BUR will serve as a useful source of information for all stakeholders interested in our climate change actions and achievements. I also hope that this BUR will facilitate the exchange of experiences and best practices with other Parties to the UNFCCC and enhance our cooperation and partnership on climate change issues.

Hon. Jane Mkhonta - Simelane

Minister of Tourism and Environmental Affairs

Acknowledgements

The preparation and submission of the Fourth National Communication (NC4) of the Kingdom of Eswatini to the United Nations Framework Convention on Climate Change (UNFCCC) was a collaborative effort that involved the participation and contribution of various stakeholders from different sectors and institutions.

We would like to express our sincere gratitude and appreciation to all those who have supported and facilitated this process, including:

- The Global Environment Facility (GEF) for providing the financial resources for the NC4 project through the United Nations Environment Programme (UNEP), The UNEP for providing the technical assistance and guidance for the implementation of the NC4 project, as well as the quality assurance and review of the reports.
- The Ministry of Tourism and Environmental Affairs for coordinating and overseeing the NC4 project, as well as providing the policy direction and institutional support.
- The National Climate Change Committee (NCCC) for providing the strategic oversight and stakeholder engagement for the NC4 and BUR1 projects, as well as endorsing the reports.
- The Department of Meteorology for providing the operational management and technical support for the NC4 project, as well as compiling and editing the reports.
- The national consultants and experts who have conducted the studies, analyses, and assessments for the different components of the NC4, as well as contributed to the writing of the reports.
- The government ministries and departments, non-governmental organizations, private sector, academia, research institutions, media and civil society who have provided the data, information, feedback, and inputs for the NC4, as well as participated in the workshops, consultations, and validation meetings.

Executive Summary

As signatory to the United Nations Framework Convention on Climate Change (UNFCCC), and a Non-Annex I Party, Eswatini is required to submit to the Conference of the Parties information relevant to the achievement of the objective of the Convention, in accordance with Articles 4 and 12 of the Convention. Pursuant to Decision 1CP/16, Non-Annex I Parties should also submit Biennial Updates Reports (BUR), every two years. The Kingdom of Eswatini is submitting its first BUR to the UNFCCC. The BUR comprises six chapters, summarized below.

•ES1 National circumstances

The Kingdom of Eswatini is in the south-eastern part of the African continent. The country is not a significant contributor to global greenhouse gas (GHG) emissions but is disproportionately impacted by climate change.

Eswatini's National Development Strategy is the country's overarching development framework that seeks to ensure poverty eradication, employment creation, gender equity, social integration, and environmental protection. The country is developing a new National Development Plan (NDP) and revising its National Development Strategy (NDS) for the period 2023-2027. Recognizing that Climate change is an emerging threat the Kingdom of Eswatini has developed a Climate Change Strategy. This strategy provides a means to facilitate the implementation of the country's revised Nationally Determined Contribution.

•ES2 National GHG Emissions Inventory

The GHG emissions inventory presented in this report covers the period 1990 to 2018 and includes the Energy, Industrial Process and Product Use (IPPU), Waste and Agriculture, and Forestry and Other Land Use (AFOLU) sectors. The total GHG emissions have been steadily increasing since 1990, especially with the inclusion of the AFOLU sector. The increasing emissions in the AFOLU sector are due to the deforestation of indigenous forests, harvesting of timber in plantation forests, and dam infrastructure development.

Figure ES 2.1 shows that 48% of emissions in 2018 are attributed to the AFOLU sector, 40% to Energy, 11% to Waste, and IPPU provides the remaining 1%. Total GHG emissions peaked in 2015, dipped in 2016, before increasing again over the last years of the time series. The drop in emissions in 2016 is driven by an increase in the carbon sinks in 3.B.1 Forest Land. The trend seen in the AFOLU sector is predominantly from emissions and removals from 3.B Land, which are driven by land use change. The Harvested Wood Products category showed a downward trend from 1990, with the sink declining over the time series.

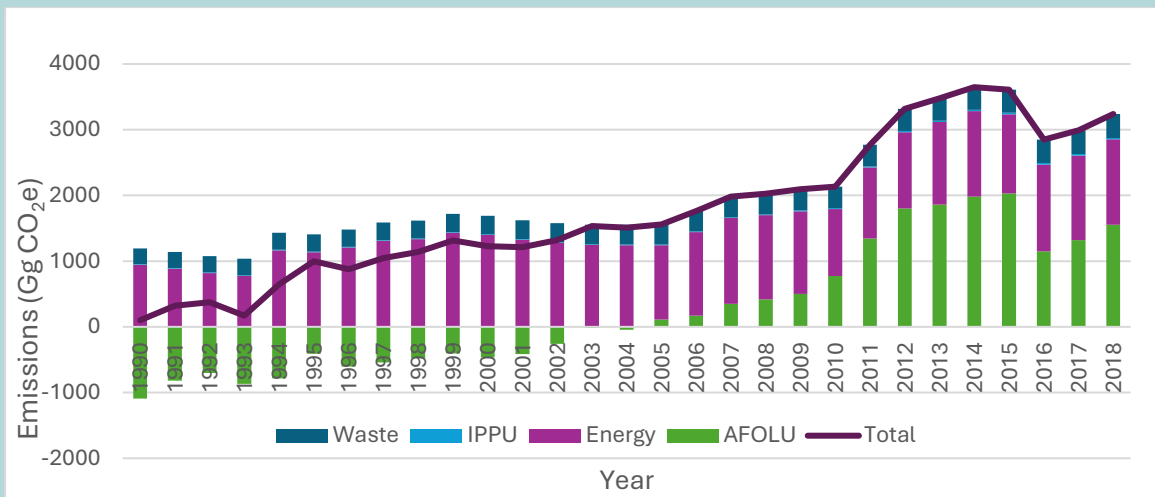


Figure 1-1: Time-series of total sectoral GHG emissions from 1990 to 2018 excluding FOLU

The inventory was compiled by a team of national experts and international consultants. Quality control and assurance activities occurred throughout the compilation of the inventory, based on the UNFCCC Annex I Review Handbook 6 and input from the national and international experts. All calculations were checked by multiple individuals using a transparent documentation and commenting system. Additionally, all data sources and calculations were archived on an online archiving site, set-up for Eswatini's GHG inventory. All processes of the calculations and estimations were archived for document integrity and the data was obtained and cross-checked. The development of the online archiving site represents a key improvement to facilitate the updating and continuous reporting of the country's GHG emissions.

The national GHG inventory does not consider uncertainty assessment of Eswatini's GHG inventory due to a lack of available estimate datasets. While improvements were made in the activity data used in this inventory, challenges remained in the availability of activity data. To address this issue, key interventions and data collection needs have been identified (and presented as recommendations) for improvement for the next GHG inventory. Further improvements to the country's Nationally Determined Contributions (NDC) inventory have been presented in this BUR.

Greenhouse Gas Source And Sink Categories	CO ₂	CH ₄	N ₂ O	NO _x	CO	NM VOC	SO ₂
	CO ₂ equivalent (Gg)			(Gg)			
1 ENERGY	1131.68	120.01	52.12	NE	NE	NE	NE
1A Fuel Combustion Activities	1131.68	89.60	52.12	NE	NE	NE	NE
1A1 Energy Industries	NO	NO	NO	NO	NO	NO	NE
1A1 b Petroleum Refining	NO	NO	NO	NO	NO	NO	NE
1A1 c Manufacture of Solid Fuels and Other Energy Industries	IE	IE	IE	IE	IE	IE	NE
1A2 Manufacturing Industries and Construction	222.36	8.07	15.98	NE	NE	NE	NE
1A3 Transport	775.95	2.93	20.54	NE	NE	NE	NE
1A3 a Civil Aviation	0.78	NO	0.01	NE	NE	NE	NE
1A3 b Road Transportation	696.81	2.84	11.16	NE	NE	NE	NE
1A3 c Railways	78.35	0.09	9.37	NE	NE	NE	NE
1A3 d Water-borne Navigation	NE	NE	NE	NE	NE	NE	NE
1A4 Other Sectors	133.37	78.60	15.59	NE	NE	NE	NE
1B Fugitive Emissions from Fuels	NE	30.41	NA	NE	NA	NE	NE
1B1 Solid Fuel	NE	30.41	NA	NE	NA	NE	NE
1B1 a Coal Mining and Handling	NE	30.41	NA	NE	NA	NE	NE
2. Industrial Processes and Product Use	4.95	NA, NE	0.1	NA, NE	NA, NE	16.30	NA, NE
2D. Non-Energy Products from Fuels and Solvent Use	4.95	NA	NA	NA	NA	0.58	NA
2D1. Lubricant Use	4.14	NA	NA	NA	NA	NA	NA
2D2. Paraffin Wax Use	0.81	NA	NA	NA	NA	NA	NA
2D3. Solvent Use	NA	NA	NA	NA	NA	0.58	NA
2F. Product Uses as Substitutes for Ozone Depleting Substance	NA	NA	NA	NA	NA	NA	NA
2F1. Refrigeration and Air Conditioning	NA	NA	NA	NA	NA	NA	NA
2G. Other Product Manufacture and Use	NA	NA	0.10	NA	NA	NA	NA
2G1. Electrical Equipment	NA	NA	NA	NA	NA	NA	NA
2G3. N₂O from Product Uses	NA	NA	0.10	NA	NA	NA	NA

Greenhouse Gas Source And Sink Categories	CO ₂	CH ₄	N ₂ O	NO _x	CO	NM VOC	SO ₂
	CO ₂ equivalent (Gg)			(Gg)			
2H2. Food and Beverages Industry	NE	NE	NA	NE	NE	15.71	NE
3. Agriculture, Forestry, and other Land Use (AFOLU)	482.88	421.29	646.97	0.66	14.21	NE	NE
3A. Livestock	NA	409.15	125.44	NA	NA	NE	NE
3A1 Enteric Fermentation	NA	383.41	NA	NA	NA	NE	NE
3A2. Manure Management	NA	25.74	125.44	NA	NA	NE	NE
3B1. Forest Land	-1520.00	NA	NA	NA	NA	NE	NE
3B2. Cropland	1121.49	NA	NA	NA	NA	NE	NE
3B3. Grassland	877.73	NA	NA	NA	NA	NE	NE
3B4. Wetlands	78.85	NA	NA	NA	NA	NE	NE
3B6. Other Land	0.30	NA	NA	NA	NA	NE	NE
3C. Aggregate Sources and Non-CO ₂ Emissions Sources on Land	7.83	12.15	521.53	0.66	14.21	NE	NE
3C1. Biomass Burning	NE	12.15	12.58	0.66	14.21	NE	NE
3C2. Liming	0.02	NA	NA	NA	NA	NE	NE
3C3. Urea Application	7.81	NA	NA	NA	NA	NE	NE
3C4. Direct N ₂ O Emissions from Managed Soils	NA	NA	306.41	NA	NA	NE	NE
3C5. Indirect N ₂ O Emissions from Managed Soils	NA	NA	105.97	NA	NA	NE	NE
3C6. Indirect N ₂ O Emissions from Manure Management	NA	NA	96.56	NA	NA	NE	NE
3D. Other	-98.24	NA	NA	NA	NA	NE	NE
3D1. Harvested Wood Products	-98.24	NA	NA	NA	NA	NE	NE
4. Waste	68	289.78	7	NA, NO	NA, NE, NO	NA, NE, NO	NE
4A. Solid Waste Disposal	NA	177.41	NA	NA	NA	NA	NE
4A1 Managed Waste Disposal	NA	177.41	NA	NA	NE	NE	NE
4A2 Unmanaged Waste Disposal Sites	NA	NE	NA	NA	NE	NE	NE
4A3 Uncategorized Waste Disposal Sites	NA	NE	NA	NA	NE	NE	NE
4B. Biological Treatment of Solid Waste	NA	1.13	1.00	NA	NA	NA	NE
4B1 Composting	NA	1.13	1.00	NA	NA	NA	NE
4C. Incineration and Open Burning of Waste	67.56	12.38	4.22	NA	NA	NA	NE
4C1 Waste Incineration	0.13	NA	NA	NA	NA	NA	NE

Greenhouse Gas Source And Sink Categories	CO ₂	CH ₄	N ₂ O	NO _x	CO	NM VOC	SO ₂
	CO ₂ equivalent (Gg)			(Gg)			
4C2 Open Burning of Waste	67.43	12.38	4.22	NA	NA	NA	NE
4D. Wastewater Treatment and Discharge	NA	98.85	1.75	NA	NA	NA	NE
1 Domestic Wastewater Treatment and Discharge	NA	98.85	1.75	NA	NA	NA	NE
2 Industrial Wastewater Treatment and Discharge	NA	IE	IE	NA	NA	NA	NE
4E. Other	NO	NO	NO	NO	NO	NO	NE

ES3 Mitigation actions and their effects

The purpose of the mitigation actions chapter is to communicate the progress of the country's implementation of GHG emission reduction activities both in policy and development. The Kingdom of Eswatini's National Climate Change Policy (2016) sets the basis for the country's response to climate change, and the need to advance mitigation measures. The intent and ambition of these mitigation goals are presented within the country's updated NDC which adopts an economy wide GHG emissions reduction target of 5% by 2030 compared to the NDC baseline scenario.

The enabling policy and regulations for climate change mitigation are summarized including National Development Plans, Environmental Management, National Climate Change Policy, and the Technology Needs Assessment. The mitigation potential analysis of the National Determined Contribution Update which sets the upper and lower boundaries for NDC commitments are highlighted. The evaluation of achieved GHG emissions reductions for the reporting period 2010 to 2020 is described in relation to the GHG emissions in the "without policy" scenario for the period 2010 to 2020. The business as usual (BAU) scenario is the timeseries of the GHG inventory, and is also known as the "with policy" scenario.

Fourteen mitigation actions were initially identified for ex-post assessment of mitigation based on the outcomes of the mitigation potential analysis update study. Ten of these actions were identified as implemented and with sufficient data available to use in the ex-post quantification of emission reductions, these actions were included in the assessment boundary. Key policy drivers across sectors include the Energy Policy (2018), Electricity Act (2007), Ozone Regulations (2003) and Kigali Amendment, Waste Regulations (2000), National Forest Policy (2002), Second National Biodiversity and Action Plan (2016), and the Comprehensive Agriculture Sector Policy (2005). These policies and regulations were not designed with the intention to support the monitoring and evaluation of GHG emission metrics. Therefore, there is a need to set up a Monitoring and Evaluation framework to align

and plan for all sectors. Several gaps and suggestions for improvement in the data collection and reporting for mitigation actions are presented in the chapter.

Mitigation actions which were prioritized in the INDC and NDC were included in the ex post assessment if implementation occurred prior to 2020 and there was sufficient activity data available from online publicly available reports. The mitigation actions considered in the ex-post mitigation assessment include doubling the renewable energy share in the energy mix; reducing the energy intensity of the residential, industrial, agricultural, commercial, and public services sectors; reducing GHG emissions in the Waste sector through improvements in waste treatment, and reducing land degradation. The mitigation actions not considered in the ex-post mitigation assessment included improving energy access in the residential sector, commercialisation of 10% ethanol fuel blend in petrol, exploring electric mobility options, and the phase out of Hydrofluorocarbons. The activity data collected to quantify GHG emission reductions ex-post were from government reports published on-line. For the next cycle of reporting, it is expected that the activity data to be used in mitigation assessments will be sourced from the operational MRV information system that is currently under development.

The “with policy” and “without policy” scenarios of the NDC are shown in Figure ES 3.1. The ex-post “with policy” scenario indicates the year-to-year GHG effect of mitigation actions on the NDC “without policy” scenario. GHG emissions in the ex-post “with policy” scenario are below NDC levels from 2010 to 2015 and then from 2019 to 2020 (when annual achieved GHG emission reductions) exceed the desired GHG emission reductions from the NDC. The GHG emissions in the ex- post “with policy” scenario are higher than GHG emission levels in the NDC “with policy” scenario from 2016 to 2018 due to a decline of carbon sinks from forestland.

As shown in Figure ES 3.2, actions in the AFOLU sector contribute to 73.41% of total GHG emission reductions, actions in the energy sector contribute to 25.89% of the total emission reductions, while the remaining contributions are from actions in the waste sector (0.70%). As reflected in the figure, the spike during the 2025-2026 period is due to the uncertainty to meet the

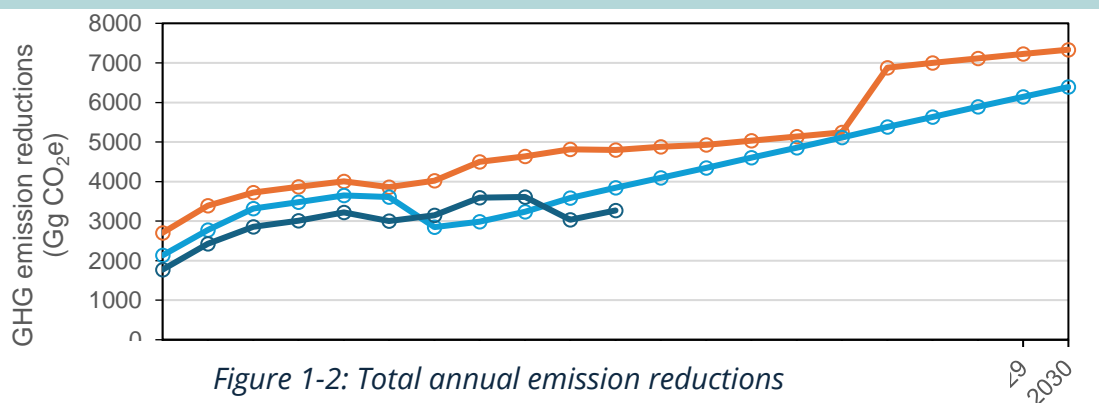


Figure 1-2: Total annual emission reductions compared to desired reductions under the NDC.

energy demand, with the current agreement with South Africa coming to an end. No emission reductions occur in the IPPU sector, as no implementation was planned in the current period.

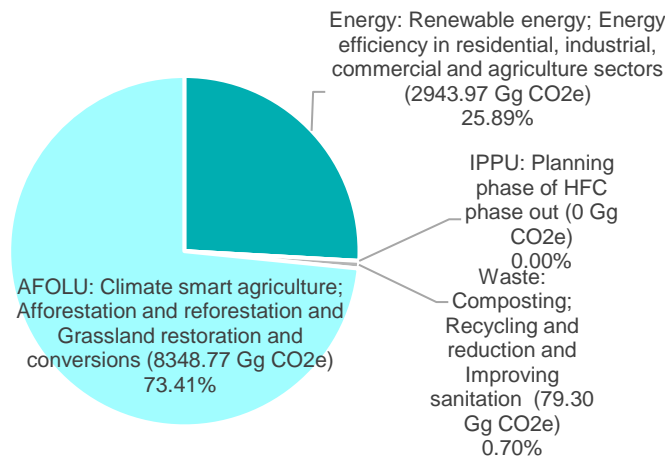


Figure 1-3: Summary of mitigation action progress.

ES4. Financial resources, technology transfer, capacity building, technical support received, and needs

The chapter assesses climate change-related finance, capacity and technical support received and needed by Eswatini. This includes an analysis of international and domestic climate-related climate finance flows committed through government grants and loans, as well as non-monetised support received, capacity building and technology support received and further required from donor funding sources within the reporting period (up to 31 December 2020).

The main sources of climate finance were the European Development Fund (EDF) through the Delegation of the European Union (EU) to Eswatini, the World Bank (WB), and the Global Environmental Facility (GEF). Domestic climate finance, reported in the Government of Eswatini's Climate Public Expenditure and Institutional Review (CPEIR), provided the domestic climate change budget allocations and actual expenditures data which included a yearly breakdown of projects and programmes approved through national budgets, implementing agency, total budget allocation, actual expenditures incurred and whether the projects contained mitigation and/or adaptation components. Adaptation measures were the predominant focus and priority of the government (95%), with very few projects (and associated budget allocations) focusing on mitigation. The overview of non-monetised support provided detail on the technical support and capacity building support received from developed countries and included detail on the donor, type of support, period of support, focus and a description of the

objective of the support received.

Further financial support needed for adaptation and mitigation was provided on a per sector basis, informed by the support component of the revised NDC. The section on capacity building and technical support needs, highlights current challenges and capacity gaps in climate action in various categories related to technical knowledge and skills, data management, technology transfer and diffusion, and effective MRV, among others. An overview of specific technical and capacity needs for adaptation and mitigation is provided based on priorities outlined in the country's Technology Needs Assessment (TNA). Prioritised technologies for adaptation and mitigation from the TNA are also described, and the high impact of the country's TNA on subsequent climate-related activities is highlighted.

ES5. Support received for the preparation of the BUR

The Kingdom of Eswatini, as a signatory to the UNFCCC, received financial support from the Global Environment Facility (GEF) to compile and publish its BUR-1, as well as the NC4. The preparation of the BUR was funded by the project on the Preparation of National Communications and Biennial Update Reports to the UNFCCC (Global Environment Facility (GEF)) with the UN Environment Programme (UNEP) as the implementing agency. The national executing agency was the Ministry of Tourism and Environmental Affairs (MTEA).

The project supported Eswatini to prepare and submit its fourth National Communication (NC4) and its first Biennial Update Report (BUR1) that complies with the UNFCCC reporting requirements while responding to national development goals. The chapters within this BUR1 were drafted by the Council for Scientific and Industrial Research (CSIR) with support from the Ministry of Tourism and Environmental Affairs and Inputs from various stakeholders as part of an extensive consultative stakeholder engagement process.

ES6. Institutional arrangements for MRV

The Ministry of Tourism and Environmental Affairs (MTEA) is the United Nations Framework Convention on Climate Change (UNFCCC) focal point responsible for the preparation of National Communications (NCs), Biennial Update Reports (BURs), and National Inventory Reports through the Department of Meteorology. The MTEA thus coordinates the activities needed to ensure that inputs and outputs required for reporting to the UNFCCC are prepared, and are of sufficient quality to meet Eswatini's commitments. The roles, responsibilities, and legal framework (organisation

mandates) supporting the compilation of the GHG inventory, reporting of mitigation actions and support received will be further formalised through the completion of current support programmes including the United Nations Development Programme (UNDP) Climate Promise Initiative, the NDC Partnership Climate Action Enhancement Package (CAEP), and the Capacity Building Initiative for Transparency (CBIT) programmes. A Measurement, Reporting, and Verification (MRV) Tool has been developed in consultation with relevant national stakeholders to enable the tracking of GHG inventory, mitigation actions, and implications for climate finance and SDG goals.

This chapter presents the existing institutional arrangements for the MRV of GHG emission inventories, mitigation actions, and financial support received. The national GHG inventory and mitigation potential analysis that formed part of the process of revising the country's NDC has provided a means to strengthen the country's capacity towards continuous reporting of its emission reductions. Specifically, national experts were trained in the compilation of GHG inventories with the inventory development also being in part undertaken by national consultants and thus moving the country towards institutionalisation of the process. Progress has been made in developing the institutional arrangements for GHG emissions from the energy sector with the Department of Energy, and similar arrangements are planned for the other sectors. The GHG inventory plays a key role in providing a basis for assessing progress in the implementation of mitigation actions, with existing data collection processes providing a basis for further development.

1 National Circumstances

1.1 Geography and Climate

The Kingdom of Eswatini is in the south-eastern part of the African continent, located between Mozambique and South Africa, with central geographic coordinates at 26.30°S and 31.30°E. Eswatini has four agro-ecological zones, namely: the Highveld, Middleveld, Lowveld, and the Lubombo Plateau. In the summer season (between October and March), the mean daily temperature range from 15.1°C to 29.4°C, and the winter season has average minimum temperatures of 7.5°C in June and maximum temperatures of 26.5°C in September (Figure 1-1). Temperatures in Eswatini can vary between a maximum of over 40°C in mid-summer (in the Lowveld region) and a minimum of 0°C at night in mid-winter (in the Highveld). The country has documented increasing average temperatures in the last decade with the period between 2010 and 2020 being the warmest on record. Furthermore, the frequency of cold nights (and frost where it occurs) has decreased and frequency of hot nights has increased (MTEA, 2021a). The Lowveld region may now typically record temperatures over 40°C in peak summer months. This is in line with climate change projections, which also depicts an increase in the occurrence of extreme weather events including droughts and flooding events. (MTEA, 2021a).

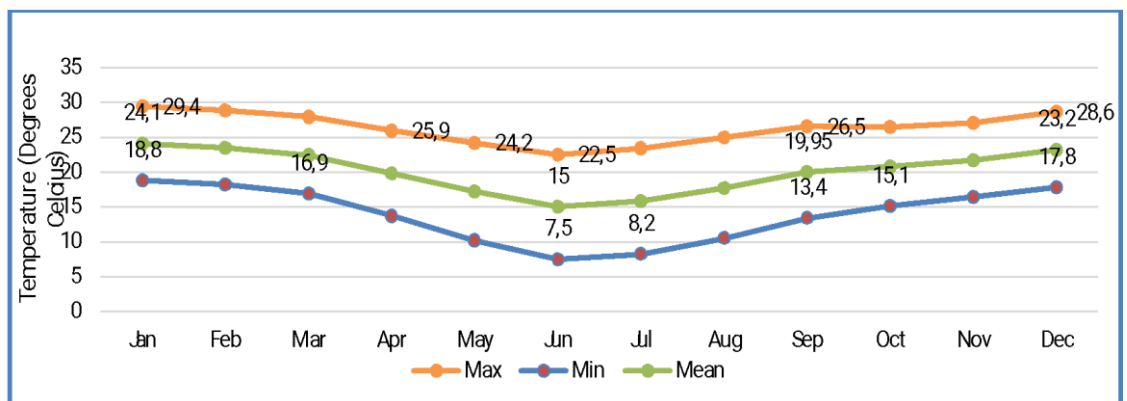


Figure 1-1: Temperature distribution (MTEA, 2021a).

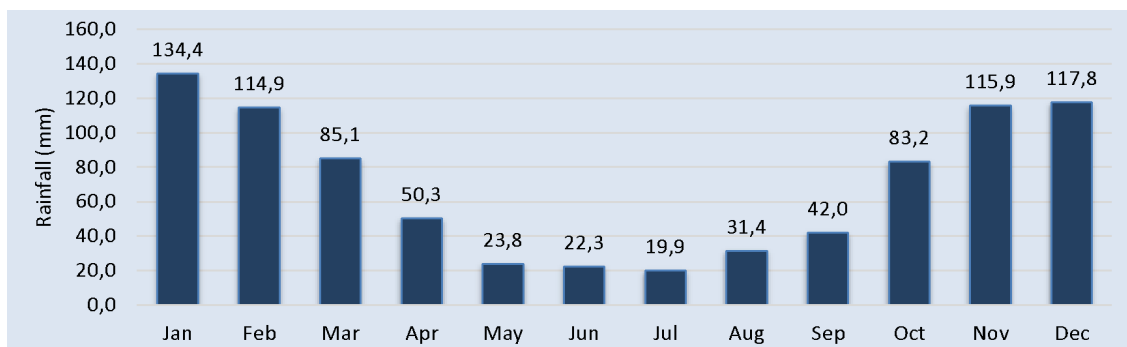


Figure 1-2: Rainfall distribution (MTEA, 2021a).

The mountainous Highveld region in the western part of the Kingdom receives the highest rainfall ranging from 900 mm to 1,500 mm. The Lowveld region, located in the east, receives the least rainfall with annual totals of less than 500 mm, making it prone to drought. The Lubombo Plateau is in the far east of the Kingdom and comprises the Lubombo mountain ranges. This area receives rainfall falling within the same range as the Middleveld (700- 1000mm). The rainfall distribution for the country is shown in Figure 1-2.

Over the years, Eswatini has had extreme weather variations experiencing heavy rainfall (1,095 mm) in 1983/84, just after the 1981/82 drought. Extreme dry spells were experienced in 1991/92 where only 431 mm of rainfall was received. Similarly, in 2015/16 Eswatini experienced another drought spell leading to the country receiving an average of 439 mm. However, more rains (961 mm) were experienced in the 1999/2000 season. Overall, the trend shows that rainfall is slightly declining, whilst there is observed increase in periodic dry spells.

Though a landlocked country, Eswatini has occasionally been hit by severe cyclones and other massive storm systems coming from the Indian Ocean (such as the severe tropical storm Domonia, in 1984). The country is severely affected by the El Niño phase of the El Niño–Southern Oscillation, and there are many examples of natural disasters in Eswatini. Between 1989 and 1994, Eswatini and other countries in the region experienced tropical cyclones and storms that had a massive impact on food security and livelihoods of rural dwellers. The recent 2015/2016 drought, stemming from a strong El Niño, also severely affected irrigation water, food production, and economic growth in Eswatini. The frequency, severity and uncertainty of these events stands to be greatly exacerbated by climate change (Knutsen et al., 2010), requiring coordinated efforts by the Eswatini Government and other stakeholders to implement policies and cohesive action plans that directly address mitigation and adaptation. (MTEA, 2021a).

1.2 Economic and Population Profile

1.2.1 Economy

Over the past ten years, Eswatini's economy has been growing only marginally at an average of 2%, largely due to the fiscal crisis in 2010 induced by the global economic recession in 2008. After the 2010/2011 fiscal crisis, there was an increase in Gross Domestic Product (GDP) growth rates with a slight peak at 3.9% in 2013 due to improvements in the secondary and tertiary sectors (Figure 1-3). These improvements were mostly driven by the production of iron ore and the implementation of government salary reviews which increased consumption in the tertiary sector. The economic decline from 2.3% to 1.3% in 2015 and 2016 respectively, is reflective of the effects of the 2015/16 El Niño induced drought which affected the primary sector. However, 2019 economic activity slumped to 1.3% due to the low contribution of the secondary and tertiary sectors.

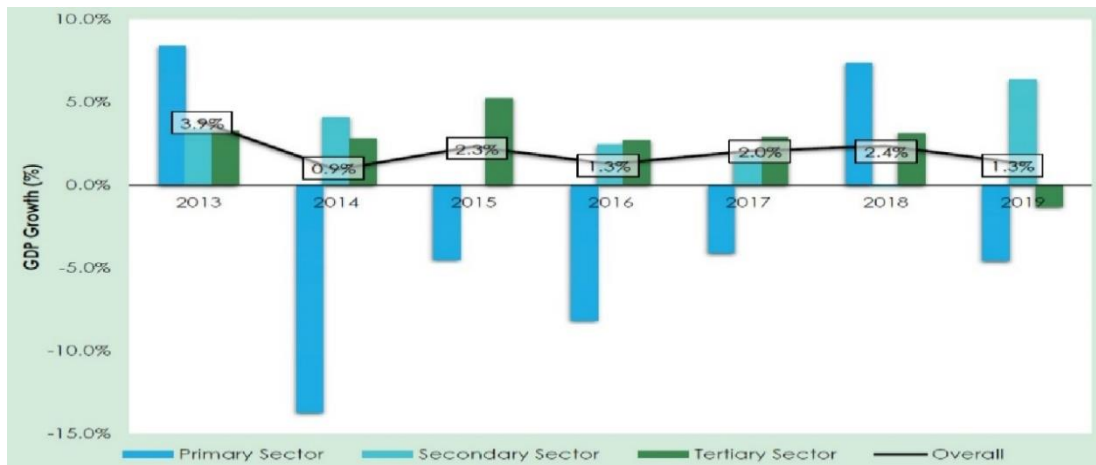


Figure 1-3: Growth of Eswatini's GDP for the period 2013-2019 (MTEA, 2021a).

With the global outbreak of COVID-19 in 2020, a contraction in economic activity was anticipated in 2020 and 2021 (MTEA, 2021a). The country's fiscal deficit, which was -8.6% of GDP in 2020, is associated with high public spending and the high reliance on the unstable Southern Africa Customs Union (SACU) revenue.

The economy is predominantly driven by agriculture-based industries which contribute nearly 6% of the country's GDP. Irrigated commercial agriculture dominates the economic activity in this sector, particularly sugar cane, citrus, pineapples and, to a lesser extent, cotton. Over three quarters of the population residing in rural areas derives its livelihood from rainfed subsistence agriculture, mainly maize and livestock (cattle and goats). The informal agricultural sector is also responsible for producing maize, legumes, sorghum, and sweet potatoes. Forestry is another very significant sub-sector which employs thousands of people in the country and plays a key role in the manufacturing sector. The manufacturing sector accounts for a notable portion (~27%) of GDP, primarily attributed to soft drink concentrates, sugar processing, textiles, and apparel. Services account for more than half of GDP.

Eswatini's primary sector has been shrinking over the years, resulting from an overall decline in domestic production alongside an increase in agricultural imports. Changes in crop production and forestry outputs are also affected by varying climatic conditions where, for example, economic growth was suppressed during the period of drought 2014-2017 but picked up in 2018.

Eswatini's GDP per capita reached \$4,146 in 2018 and has been growing at an annual average rate of 5.1% between 1971 and 2018. Slow economic growth, high levels of inequality and poverty, high youth unemployment rates, high incidence, and prevalence of

communicable diseases (HIV and TB) and non-communicable diseases are some of the factors contributing to the limited vibrancy of the economy. The agriculture sector is also increasingly being negatively impacted by, among other things, variable precipitation patterns, droughts, higher temperatures, and increased storm intensities. Crop production in the country is expected to be affected regardless of crop type or agro-ecological zone (MTEA, 2021a).

1.2.2 Overview of Trends in Population and Human Development Index

Between 2007 and 2017 Eswatini's population increased by 0.7%, while the average annual growth rate of the urban population increased from 0.5% to 0.7% (MTEA, 2021a). Life expectancy improved significantly from 43 years in 2007 to 58.3 years in 2017. Moreover, the death rate per 1,000 people decreased by almost half from 18 people per 1,000 people in 2007 to 8.7 people per 1,000 people in 2017 (CSO, 2017).

Eswatini's Human Development Index (HDI), which measures the average achievements in human development, health, education, and income shows an improvement over the years, moving from 0.46 in 2007 to 0.61 in 2018 (CSO, 2017). Conversely, Eswatini's Gini coefficient deteriorated from 0.51 in 2010 to 0.52 in 2018, representing an increase in income inequalities in the country. Consequently, an improvement in HDI does not necessarily translate to improved socio-economic status for most of the population. Increased socio-economic division driven by rising inequality, despite rising economic growth and living standards, is a global trend, as outlined by the World Social Report 2020.

These issues have been further impacted on by the COVID-19 pandemic. The Eswatini Vulnerability Assessment Committee (EVAC) Report, 2020 highlighted that COVID-19 has led to an estimated 37% of households with reduced income and 26.9 % reported loss of employment. Between June and September 2020, around 37,424 people (17% of the urban population) in Eswatini were experiencing high or acute food insecurity, with an additional 70,430 people classified as stressed (EVAC, 2020). Urban food security and access have also been negatively affected by COVID-19 related restrictions which continue to disrupt food supply chains and affect food prices. Access to food may be more challenging due to reduced or complete loss of livelihoods for some households. The greater impact of the pandemic weighs heavily on the rural poor due to the disruption of the informal sector – the rural areas have also been affected by returnees who have lost their jobs as well as their livelihoods in the urban areas around the country (EVAC, 2020,).

The "inequality challenge" is deeply connected to other pressing issues, most notably climate change, where greater inequality and vulnerability increases the risk and pressures felt by society (UN, 2020). Inequality and greater socio-economic wellbeing are issues that, therefore, need to be directly addressed in Eswatini as these issues will have significant

ramifications on the country's ability to effectively adapt to climate change.

1.2.3 Development Priorities and Objectives

In Eswatini, most of the land is held in 'trust' by the King who has the ultimate power to allocate or acquire land, often performing this mandate through local chiefs. Eswatini has two (2) land tenure systems: Swazi Nation Land (SNL), which accounts for 60% of total arable land, administered by chiefs; and titled or private land which is mainly used for commercial farming including forests and croplands. The title deed land contributes to nearly 80% of the agricultural GDP. Reference needed)

Eswatini has a National Development Strategy (NDS) (Vision 2022), developed in 1997 and running for 25 years until 2022. The aim of the NDS was to position Eswatini, by 2022, to be in the top 10% of the medium human development group of countries founded on sustainable economic development, social justice, and political stability. Underlying the vision is the focus on the quality of life, with critical dimensions such as poverty eradication, employment creation, gender equity, social integration, and environmental protection. The strategy entails promoting a sustainable, climate-resilient, and inclusive low-carbon green growth economy. Although, climate change has been highlighted as a cross-cutting issue, it is not mainstreamed in all the thematic areas of the NDS. The country is developing a new National Development Plan and revising its National Development Strategy.

1.3 Priorities Related to Mitigation of Climate Change

The country is not a significant contributor to global greenhouse gas emissions (GHG) but is disproportionately impacted by climate change. The country has several sectoral policies shown in Table 1-1 which inherently contain measures that can support efforts towards the reduction of GHG emissions.

Table 1-1 Sector policies that impact of key sectors for GHG emissions.

Sector	Regulation policy	Implementation and MRV policy
Energy	Electricity Act 2007; Energy Regulatory Act 2007 and Electricity Company Act 2007	National Energy Policy 2018; National Energy Policy Implementation Strategy (NEPIS) 2018 Energy Master Plan
	Petroleum Act No.18 of 2020	
IPPU	The Ozone Depleting Substance Regulations, 2003 amended in 2014	National Environmental Policy Swaziland Environmental Action Plan
Waste	Environmental Management Act of 2002: Part VI Waste Management	National Solid Waste Management Strategy 2003 (update is in progress)
	Waste Regulations 2000	
	Water Services Corporation Act No.12 of 1992	Wastewater masterplan to be developed National Sanitation and Hygiene Strategy 2019
AFOLU	Environmental Management Act of 2002	Swaziland National Biodiversity Strategic and Action Plan 2016; National Forest Policy Implementation

Sector	Regulation policy	Implementation and MRV policy
		Comprehensive Agricultural Sector Policy Implementation Strategy and Action Plan

Further to these, the National Climate Change Policy (2016) is aimed directly at reducing GHG emissions and helping Eswatini to adapt to climate change impacts. Specifically, the National Climate Change Policy (2016) supports the priorities outlined in the National Development Plan and seeks to guide the country's climate change response. The country's revised Nationally Determined Contribution (NDC) adopts an economy wide GHG emissions reduction target of 5% by 2030 compared to the baseline scenario (Table 1-2).

Table 1-2: Sectors covered in Eswatini's first and revised NDCs (MTEA, 2015; 2021b).

NDC iteration	Mitigation
First NDC	Energy, Transport, Substitutes for ozone depleting substances
Revised NDC	Energy, Transport, Waste, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Uses (AFOLU)

Further details on the country's GHG emissions profile, mitigation actions and institutional arrangements for monitoring, reporting and verification are detailed in the Chapters 2, 3, and 6 of this report.

1.4 References

MTEA (2015). Swaziland Intended Nationally Determined Contributions. The Ministry of Tourism and Environmental Affairs: Department of Meteorology, Mbabane, The Kingdom of Swaziland.

MTEA (2021a). National Circumstances on Climate Change Report. Draft Document. Ministry of Tourism and Environmental Affairs. Kingdom of Swaziland.

MTEA (2021b). Kingdom of Eswatini: Update of the Nationally Determined Contributions submitted to the United Nations Framework Convention on Climate Change. The Ministry of Tourism and Environmental Affairs: Department of Meteorology, Mbabane, The Kingdom of Eswatini.

2 National Greenhouse Gas Inventory

The GHG inventory for the year 2018 is presented in this chapter. The inventory covers sources of GHG emissions resulting from anthropogenic activities for direct greenhouse gases, including:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous oxide (N₂O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF₆).

The inventory also includes estimates of indirect GHG emissions from a limited number of sectors including:

- Nitrogen oxides (NO_x, as NO₂);
- Carbon monoxide (CO);
- Non-Methane Volatile Organic Compounds (NMVOC);
- Sulphur dioxide (SO₂).

The 100-year global warming potentials (GWPs) contained in the IPCC Second Assessment Report (SAR) (1995) have been applied to quantify the direct GHG emissions as carbon dioxide equivalents (CO₂e). Table 2.1 below illustrates the GWP value used for each gas. GHG emission sources and sinks in the 2018 GHG Inventory are reported according to the 5 IPCC emission categories:

- Energy;
- Industrial processes and product use;
- Agriculture;
- Land use, land use change and forestry; and
- Waste.

Table 2-1: Global warming potential (GWP) values applied in the inventory (IPCC SAR, 1995).

GHH		GWP
Carbon dioxide	CO ₂	1
Methane	CH ₄	21
Nitrous oxide	N ₂ O	310
HFC-32	CH ₂ F ₂	650
HFC-134a	CH ₂ FCF ₃	1300
HFC-125	CHF ₂ CF ₃	2800
HFC-143a	CH ₃ CF ₃	3800
Sulphur hexafluoride	SF ₆	23900

The GHG emissions trends per sector are shown in Figure 2-1, with 48% of emissions in 2018 attributed to the AFOLU sector, 40% from Energy, 11% from Waste, and IPPU provides the remaining 1%. In terms of total GHG emissions by gas, the 2018 inventory emissions show that CO₂ is responsible for 52% of emissions followed by CH₄ at 26%,

N₂O at 22% and the F-gases contribute less than 1%.

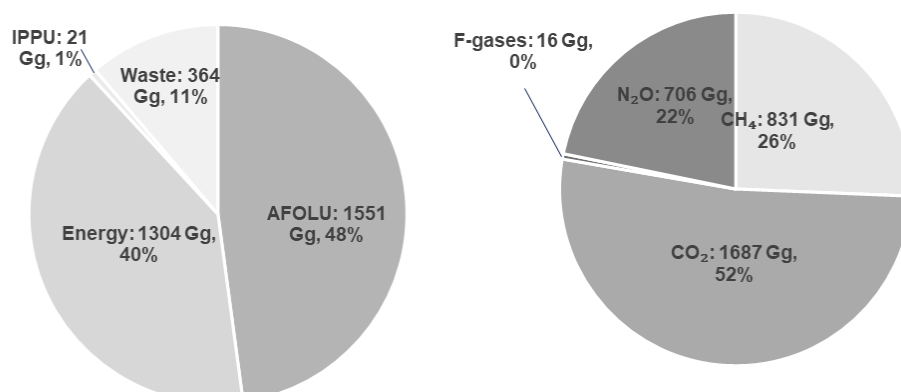


Figure 2-1: National GHG emission shares by sector for 2018.

2.1 2018 Summary

Emissions are estimated using the 2006 IPCC Guidelines for National GHG Inventories. Emission estimates are based on the sectoral approach and as per the guidelines. Table 2-2 provides a summary of sectoral emissions for 2018.

Table 2-2: Summary table of sectoral GHG emissions for 2018 as CO₂e.

Greenhouse gas source and sink categories	Total GHG	Net CO ₂	CH ₄	N ₂ O	HFCs	PFCs*	SF ₆	CO	NO _x	NMVOCs	SO _x
	CO ₂ equivalent (Gg)							(Gg)			
Total (including FOLU)	3240.10	1687.06	831.08	706.16	14.55	NA	1.24	14.21	0.66	15.71	NA
Total (excluding FOLU)	2765.05	1212.02	831.08	706.16	14.55	NA	1.24	NA	NA	NA	NA
1. Energy	1303.81	1131.68	120.01	52.12	NA	NA	NA	NE	NE	NE	NE
2. Industrial Processes and Product Use	20.84	4.95	NE	0.10	14.55	NE	1.24	0.00	0.00	16.30	0.00
3. Agriculture, Forestry, and other Land Use (AFOLU)	1551.13	482.88	421.29	646.97	NA	NA		14.21	0.66	NA	NA
4. Waste	364.31	67.56	289.78	6.97	NA	NA	NA	NA	NA	NA	NA
Memo items (3) International aviation	3.75	3.72	0.00	0.03				NA	NA	NA	NA

NO: Not Occurring;

NA: Not Applicable;

NE: Not Estimated

2.2 1990 -2018 Trends

Eswatini's GHG emissions from all sectors between 1990 and 2018 are depicted in Figure 2-2. The total GHG emissions have been steadily increasing since 1990 when the FOLU sector is included. This is related to the increasing emissions in the FOLU sector due to the deforestation of indigenous forests, harvesting timber in plantation forests, and infrastructure development.

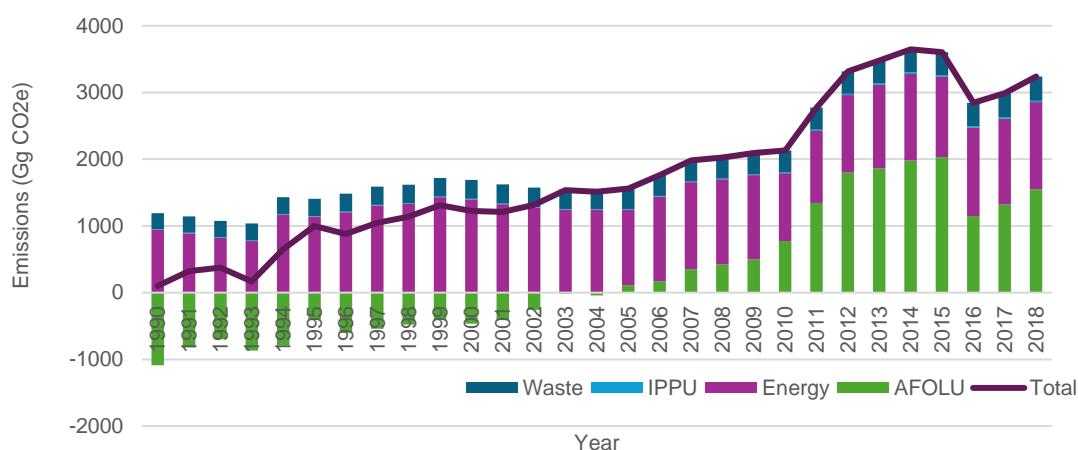


Figure 2-2: Time-series of total GHG emissions from 1990 to 2018 by sector

Table 3: Time-Series of Total GHG emissions from 1990 to 2018 by sector

Year	Energy	IPPU	Waste	AFOLU	Total
	CO2 equivalent (Gg)				
1990	942.3	9.8	238.9	-1090.6	100.3
1991	887.6	9.8	243.3	-819.6	321.1
1992	819.0	9.8	247.8	-702.1	374.5
1993	773.9	9.8	252.3	-867.6	168.3
1994	1165.8	9.8	256.8	-784.4	648.0
1995	1136.1	9.7	261.3	-407.8	999.3
1996	1206.6	9.6	265.7	-603.4	878.6
1997	1308.3	9.6	270.2	-543.5	1044.6
1998	1332.3	9.6	274.7	-477.6	1139.0
1999	1431.0	9.5	279.2	-407.2	1312.5
2000	1397.8	9.6	283.7	-464.3	1226.6
2001	1325.9	9.7	288.1	-412.5	1211.2
2002	1273.5	9.8	292.6	-258.5	1317.5

2003	1245.2	9.8	297.1	-17.1	1534.9
2004	1242.4	9.9	301.6	-43.6	1510.3
2005	1130.5	10.1	306.0	112.8	1559.5
2006	1273.5	9.7	310.5	167.6	1761.3
2007	1306.0	10.6	315.1	349.0	1980.7
2008	1276.5	10.5	319.4	420.8	2027.2
2009	1258.5	11.1	323.8	501.1	2094.4
2010	1018.9	13.0	328.1	773.4	2133.4
2011	1080.5	14.6	332.5	1346.0	2773.6
2012	1161.4	16.3	337.0	1801.2	3315.9
2013	1256.6	19.1	341.4	1860.7	3477.7
2014	1298.5	20.9	346.0	1982.0	3647.4
2015	1201.5	21.8	350.5	2032.8	3606.6
2016	1322.9	22.7	355.1	1147.7	2848.4
2017	1289.0	21.8	359.7	1318.4	2988.9

Energy sector emissions increased between 1990 and 2018 but have remained relatively constant since 1994, peaking in 1999 due to the expansion of the Royal Eswatini Sugar Corporation's mill to accommodate cane purchased from new independent cane farmers, which resulted in elevated demand for coal required to crush this sugar cane. Total GHG emissions peaked in 2015, dipped in 2016, before increasing again over the last two years of the time series. The drop in emissions in 2016 is driven by an increase in the carbon sinks in 3.B.1 Forest Land.

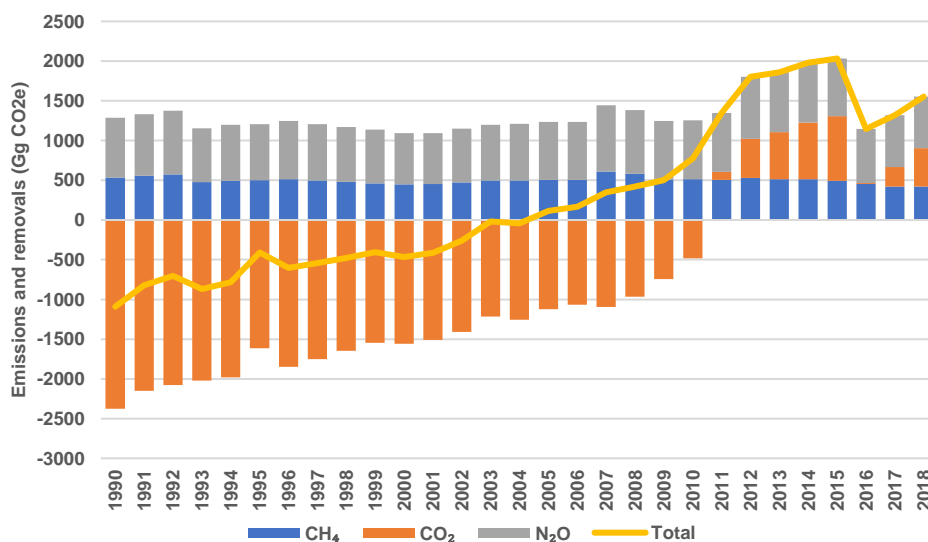


Figure 2-3: Time-series of total sectoral GHG emissions by gas from 1990 to 2018

Table 4: Time-Series of total sectoral GHG emissions by gas from 1990 to 2018

Row Labels	CH ₄	CO ₂	N ₂ O	Total
1990	535	- 2,376	751	- 1,091
1991	556	- 2,151	775	- 820
1992	574	- 2,076	800	- 702
1993	475	- 2,020	677	- 868
1994	493	- 1,983	705	- 784
1995	500	- 1,616	708	- 408
1996	514	- 1,849	731	- 603
1997	497	- 1,750	709	- 544
1998	480	- 1,647	690	- 478
1999	462	- 1,544	675	- 407
2000	447	- 1,558	646	- 464
2001	452	- 1,508	644	- 412
2002	472	- 1,408	677	- 258
2003	496	- 1,215	702	- 17
2004	499	- 1,256	713	- 44
2005	504	- 1,123	732	113
2006	504	- 1,068	732	168
2007	610	- 1,093	833	349
2008	580	- 964	805	421
2009	506	- 746	741	501
2010	512	- 482	743	773
2011	506	99	742	1,346
2012	528	493	779	1,801
2013	512	595	754	1,861

2014	513	712	757	1,982
2015	493	813	728	2,033
2016	451	14	682	1,148
2017	420	247	651	1,318
2018	421	483	647	1,551
Total	14513.4	-27977.1	20928.6	7464.9

2.3 Key Category Analysis

The key category analysis, as detailed in the 2006 IPCC Guidelines, provides a useful analysis of the inventory estimates by highlighting the more significant categories. By highlighting these categories, the inventory compilation team can better assess the prioritisation for improvement of data gathering and methodologies. Other users of the inventory can also clearly identify those categories that may be more applicable for mitigation to reduce national GHG emissions.

There are three ways of determining a key category:

- Level assessment – order the inventory categories from large to small in terms of emissions for a single year and highlight all categories that contribute to 95% of the total emissions.
- Trend assessment – order the inventory categories from large to small in terms of their contribution to the total trend and highlight all categories that contribute to 95% of the total trend.

Qualitative assessment – inventory team identifies categories in addition to those flagged by the Level and Trend assessment that are considered significant, and this could be due to expected growth or completeness of the inventory.

Table 2-3 below provides a summary of the key categories in the inventory, highlighting the absolute value in 1990 and 2018, as well as the percentage contribution over the assessment period.

Table 2-5: Summary of key category analysis results.

Rank	IPCC Category Code	IPCC Category	Greenhouse Gas	Identification criteria	1990 Absolute Value	2018 Absolute Value	1990 - 2018 Contribution (%) All sectors
1	3B1a	Forest land Remaining Forest land	CO ₂	L1_1990, L1_2018, T1	2147.88	94.64	31.06%
2	3B1b	Land Converted to Forest land	CO ₂	L1_2018, T1	38.02	1614.64	20.30%
3	3B2b	Land Converted to Cropland	CO ₂	L1_1990, L1_2018, T1	175.20	1118.81	11.83%
4	3D1	Harvested wood products	CO ₂	L1_1990, L1_2018, T1	630.10	98.24	8.20%
5	3B3b	Land Converted to Grassland	CO ₂	L1_1990, L1_2018, T1	248.35	877.73	7.61%
6	1A3b	Road transportation Liquid Fuels	CO ₂	L1_1990, L1_2018, T1	283.19	696.81	4.75%
7	1A2	Manufacturing Industries and Construction Solid Fuels	CO ₂	L1_1990, L1_2018, T1	370.09	120.08	4.01%
8	3A1a ⁱⁱ	Enteric Fermentation Non-Dairy Cattle	CH ₄	L1_1990, L1_2018, T1	463.84	323.29	2.79%
9	3B4b	Land Converted to Wetlands	CO ₂	L1_2018, T1	4.41	78.85	0.95%
10	3C4	Direct N ₂ O MS Organic inputs Manure application	N ₂ O	L1_1990, L1_2018, T1	219.84	185.86	0.90%
11	3A2a ⁱⁱ	Manure Management Non-Dairy Cattle	N ₂ O	L1_1990, L1_2018, T1	141.14	98.37	0.85%
12	1A3c	Railways Liquid Fuels	CO ₂	L1_2018, T1	14.31	78.35	0.80%
13	3C6	Indirect N ₂ O from MM Non-Dairy Cattle	N ₂ O	L1_1990, L1_2018, T1	127.25	88.69	0.77%

Note: L1_1990 = key category according to an approach 1 level assessment for 1990 data, L1_2018 = key category according to an approach 1 level assessment for 2018 data, T1 = key category according to an approach 1 trend assessment for 1990-2018. MM=Manure Management

2.4 Re-Calculations

A comparison between the GHG emissions quantified in this inventory is shown in Table 2.4. The most significant re-calculations for both 2000 and 2010 occur in the IPPU and AFOLU sectors. Large re-calculations in the IPPU sector are due to a change of data source of HFC blend imports/exports that significantly reduce the amount of F-gases released as part of refrigerator manufacturing. The large re-calculation in the AFOLU sector can be traced to category 3B emissions and removals from land which are estimated to be significantly lower than reported in the NC3. Major improvements were made in this category with the inclusion of consistent land change maps between 1990 and 2015, allowing for estimates of emissions and removals from all 6 land classes as well as conversion between land categories. In addition, carbon stock and biomass data were updated with the incorporation of

regional data.

Table 2-6: Comparison between total GHG emissions quantified in the 2018 inventory and the NC3 inventory

Eswatini GHG emissions	Total excluding FOLU from NC3 inventory	Total including FOLU from NC3 inventory	Total excluding FOLU from 2018 inventory (percentage difference between NC3 and 2018 inventories)	Total including FOLU from 2018 inventory (percentage difference between NC3 and 2018 inventories)
Year	Gg CO₂ equivalent			
1990	2053.78	-4221.22	2481.63 (20.83%)	100.28 (-102.38%)
2000	2688.62	-3463.38	2789.73 (3.76%)	1226.63 (-135.42%)
2010	3016.89	-2947.11	2622.51 (13.07%)	2133.40 (-172.39%)

2.5 Quality Assurance and Quality Control (QA/QC)

Quality assurance and quality control (QA/QC) implemented for the compilation of the inventory followed the quality elements as provided in the IPCC Guidelines, namely:

- Transparency – comprehensive and clear documentation;
- Completeness – inventories include all present sources and sinks;
- Comparability – inventories use international reporting methods and formats;
- Consistency – inventories use methods and data consistently across years;
- Accuracy – inventories minimise over- and under-estimates of emissions.

Together, these are known as the TCCCA principles, and were used to ensure the inventory system produced a high-quality output, with QA/QC activities performed by inventory compilers and, where applicable, inventory QA/QC co-ordinators and inventory coordinators. These quality objectives and activities are outlined in a QA/QC Plan which was developed at the beginning of the inventory cycle for the BUR1/NC4 project. The full plan is stored on the GHG Inventory Archiving Site being developed under the CBIT project. The plan includes:

- Defined roles and responsibilities as described above under Institutional Arrangements, defining which organizations contribute to the GHG Inventory compilation process in terms of data provision, calculations and compilation, QA/ QC and review, and coordination of the project.

- Work Plan outlining the steps required to produce the inventory, set deadlines and milestones, and assign responsibility for tasks.
- QA/QC Objectives defined at the start of the inventory compilation process, listing high level goals of the QA/QC system.
- QA/QC Activities defined during the compilation process, based on the UNFCCC Annex I Review Handbook 6 and input from the national and international experts. The quality activities should be reviewed throughout the compilation process to ensure that they are being performed. The full list has cross-cutting and sector-specific activities and is available on the GHG Archiving site.

The inventory was compiled by a team of national experts and international consultants. All calculations were checked by multiple individuals using a transparent documentation and commenting system.

2.6 Archiving

Throughout the inventory compilation process, the sector experts applied the good practice guidance from the IPCC Guidelines to review and incorporate data gathered in a consistent and accurate manner. Sectors approached data management and compilation using their preferred method, coordinated by the inventory coordination team within existing legal instruments and mandates supporting the national GHG inventory system. Energy, IPPU, and Waste experts documented all datasets and information using Excel compilation spreadsheets and through the method statements.

2.7 GHG Improvement Plan

The key areas for improvement of data collection are shown below in Table 2-5. Specifically, it outlines the proposed GHG improvements that will need to be implemented by the MTEA in conjunction with governmental departments, and other institutions to collect activity data and improve the tiers at which the emissions inventory is compiled.

Table 2-7: GHG data collection improvement needs.

Energy Sector	Responsibility
<ul style="list-style-type: none"> Collect actual data for fuel usage in the off-road vehicles used for agriculture and devise a better method to estimate fuel use. Improve coal usage data from agriculture. Collect data on the abandoned Mpaka Mine and verify coal mining data Collect data on fugitive emissions from transport and distribution of oil products, and transport and distribution of LPG Get data from missing years directly from the relevant industries or ask them to verify the extrapolations. Work with the Eswatini Railway to establish emissions factors for their locomotives to move to 1A3c estimates to Tier 2. Improve biofuel estimates for 1990-2009. Get sector specific fuel consumptions or improve accuracy of percentage splits. Collect data for different locomotive engine types to estimate emissions using Tier 2 methodology. Improve emission factors for specific ULP and Diesel 50ppm Collect information on the actual number of each type of vehicle on the road and include vehicle mileage and age of the vehicle during the annual licence renewal of all vehicles. Collection of disaggregated data for aviation fuel consumption is necessary to show data used in the agriculture sector, other domestic aviation, and international aviation. Obtain fuel use data directly from industries (particularly sugar industry) and improve collection of coal usage data from the manufacturing sector Obtain actual fuel use data for 1990 to 1994. Include charcoal production activity data in the inventory (obtain from producers or estimate). 	MTEA; Ministry of Public Works & Transport and Department of Treasury
IPPU	Responsibility
<ul style="list-style-type: none"> Improve data collection on lubricant use. Explore other sources of data to estimate the amount of paraffin wax used Develop a method of estimating country specific data for domestic solvent use. Verify data on the length of paved roads and amount of asphalt used. Conduct local studies on life span of refrigerators and air-conditioners to improve the data collection for future inventories. Develop a data collection strategy for N₂O from product uses. Verify data for the food and drinks category. 	MTEA, Eswatini Environmental Authority, and relevant industries.
Waste	Responsibility
<ul style="list-style-type: none"> Collect country specific information for waste generated per capita, national specific waste composition to be used in the IPCC waste model. Collect data on the quantity of waste produced in the country and the total amount of waste that is composted For the biological treatment of waste, the need for country specific chemical oxygen demand (COD) and biological oxygen demand (BOD) data was identified. The total quantity and composition of clinical waste incineration and technologies used will also need to be collected. Data on the Percentage of national population practicing open burning and country parameters composition burned waste also needs to be collected. 	MTEA, Eswatini Environmental Authority, Eswatini Ministry of Health Social Services, and municipalities.
AFOLU	Responsibility

- Improve land cover classifications for the period 1990 – 2020 using improved remote sensing techniques and field data.
- Refine plantations data with cadastral and species data from individual companies.
- Introduction of age class data in plantations
- Validation of biomass factors
- Inclusion of specific crop data and fallow croplands to move to a higher tier calculation for croplands
- Improve livestock data collection with reporting done at dip tank level rather than the current regional level
- Improve data collection and reporting on the application of urea and lime in both commercial agricultural areas and subsistence agricultural areas/farms of the country.
- Establish a platform for reporting in the hectarage of rice cultivation by farmers.
- Establish a platform for reporting on the hectarage and yields of cultivation of other crops by farmers.
- Develop a tool and platform for data collection on manure management in the country.
- Undertake local studies to determine local emissions factors rather than rely on South African (regional) factors.

MTEA, Ministry of
Agriculture, Sugar
cane growers,

2.8 Energy Sector

The total calculated emissions from the Energy sector, in Gg CO₂e, are shown in Figure 2-4 split by gas and split by IPCC category. The dominating GHG in the Energy sector is carbon dioxide, followed by methane and, lastly, nitrous oxide. The largest source categories in the Energy sector are 1A3b Road Transport and 1A2 Manufacturing and Construction Industries, followed by 1A4 Other sectors. A summary of the sub-category GHG emissions in the Energy sector for 2018 is shown in Table 2-6. GHG emissions from the Energy sector in 2018 were estimated at 1,303.81 Gg CO₂e, of which the main emission sources are fuel combustion activities (1A) that contributes 1,273.40 Gg CO₂e; with 246.41 Gg CO₂e from manufacturing industries (1A2) and construction and 799.42 Gg CO₂e from transport (1A3).

2.8.1 International Aviation and Marine

The government of Eswatini has held discussions with the aviation stakeholders in an effort to include detailed aviation related emissions data in subsequent future submissions. Previously, the country lacked both the relevant data and a dedicated section for aviation emissions. However, the upcoming reports will now include this data, enabling a more comprehensive analysis of the country's overall emission profile. Regarding marine emissions, due to the country's geographic location, there are no emission data points related to maritime activities. Consequently, marine-related emissions are not applicable to the country's report.

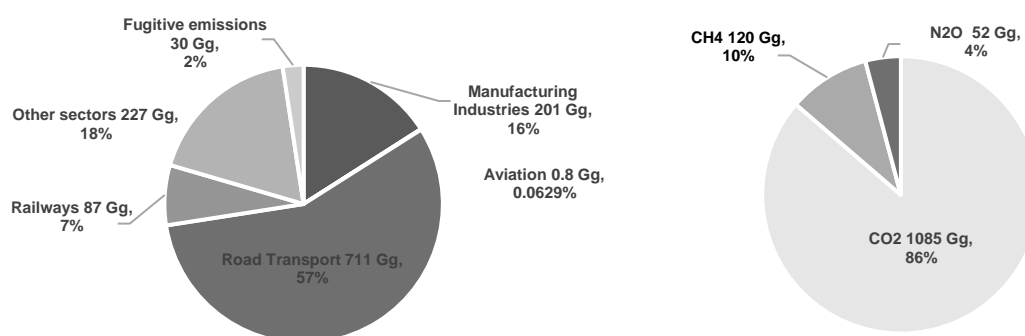


Figure 2-4: National GHG emission shares in the energy sector shown by a) sub-category and b) gas for 2018.

Table 2-8: Summary table of sub-category GHG emissions (as CO₂e) in the energy sector for 2018.

Greenhouse Gas Source And Sink Categories	Total GHG	CO ₂	CH ₄	N ₂ O	NOx	CO	NM VOC
	CO ₂ equivalent (Gg)				(Gg)		
1 ENERGY	1303.81	1131.68	120.01	52.12	NE	NE	NE
1A Fuel Combustion Activities	1273.40	1131.68	89.60	52.12	NE	NE	NE
1A1 Energy Industries	NO	NO	NO	NO	NO	NO	NO
1A1 b Petroleum Refining	NO	NO	NO	NO	NO	NO	NO
1A1 c Manufacture of Solid Fuels and Other Energy Industries	IE	IE	IE	IE	IE	IE	IE
1A2 Manufacturing Industries and Construction	246.41	222.36	8.07	15.98	NE	NE	NE
1A3 Transport	799.42	775.95	2.93	20.54	NE	NE	NE
1A3 a Civil Aviation	0.79	0.78	NO	0.01	NE	NE	NE
1A3 b Road Transportation	710.82	696.81	2.84	11.16	NE	NE	NE
1A3 c Railways	87.81	78.35	0.09	9.37	NE	NE	NE
1A3 d Water-borne Navigation	NE	NE	NE	NE	NE	NE	NE
1A4 Other Sectors	227.57	133.37	78.60	15.59	NE	NE	NE
1B Fugitive Emissions from Fuels	30.41	NE	30.41	NA	NE	NA	NE
1B1 Solid Fuel	30.41	NE	30.41	NA	NE	NA	NE
1B1 a Coal Mining and Handling	30.41	NE	30.41	NA	NE	NA	NE

NO: Not Occurring; NA: Not Applicable; NE: Not Estimated; IE: Included Elsewhere

The largest fluctuations in emissions as shown in Figure 2-5 are from category 1A2 Manufacturing and Construction Industries, driven by data on coal imports. The decline in emissions seen in 1990-1993 are due to the drought in 1992, which caused a bad harvest of sugar cane in 1993 and lowered the demand of coal in the sugar industry. In 1999 there was a peak in emissions which was due to expansion of the Royal Eswatini Sugar Corporation's mill to accommodate cane purchased from new independent cane farmers. This increased the demand for coal used in the

processing of the sugar cane.

The decline in emissions in 2005 was caused by an economic downturn which was experienced during that year due to a decline in the manufacturing sector. As a result, coal consumption in the sector declined leading to reduced emissions. Also, in 2005, the expiry of the Agreement on Textiles and Clothing affected several companies in the textile industry where many of them used coal to generate process heat for dyeing, spinning, and ironing of apparel¹. These companies could no longer compete with companies from other countries and several of them had to shut down. The global economic recession in 2008 caused a dip in emissions in 2010.

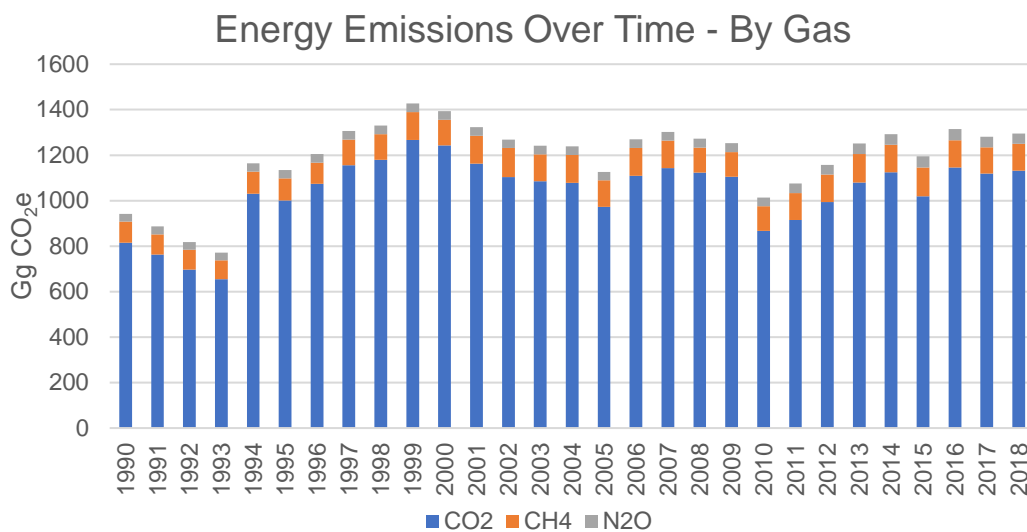


Figure 2-5: Energy Sector Emissions by Category for the 1990 to 2018 period.

As shown in Figure 2-5, overall, there is an increase in the emissions of CO₂ and CH₄. The increase in CO₂ emission also correlates with the fluctuations of emissions attributed to the Manufacturing and Construction category. Methane emitted from the coal mines over the years also shows a steady increase. However, there is an observed dip in CO₂ until 1993 which is attributed to the closure of Mpaka Mine in 1992 due to a decline in profits. A gradual increase in CH₄ emission was also seen due to the opening of the Maloma Colliery.

¹ <https://library.fes.de/pdf-files/iez/03796/17swaziland.pdf>

2.8.2 Comparison of Reference Approach to Sectoral Approach

The comparison of GHG emissions estimated using the sectoral approach and the reference approach is part of good practice to validate the Energy GHG inventory. The energy balance from the Ministry of Natural Resources & Energy was the source of energy supply data that was used to quantify GHG emissions using the reference approach. The energy balances from 2010 to 2018 were complete and, thus, were used in the reference approach.

A comparison between estimates using the sectoral and reference approaches is shown in Figure 2-6. There were no significant differences between the two estimations. The largest percentage error of GHG estimates between the two approaches are below 10% (between 2012 and 2014) as shown in Figure 2-7. This is attributed to the limited reporting coverage of fuel consumed in manufacturing sub-sectors in energy balances. The energy balances included data about fuel use in food, beverages, and tobacco; mining and quarrying; wood and wood products; textiles and leather; non-specified industry; and the total manufacturing sector fuel consumption. Fuel use in mining and quarrying, wood and wood products, and textiles and leather were not reported for all years.

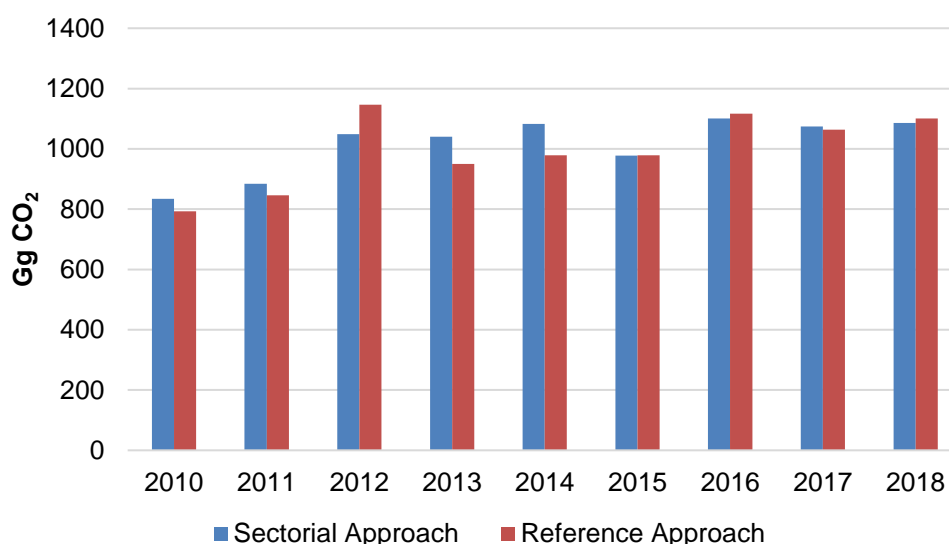


Figure 2-6: Energy sector emissions estimated using the reference approach compared to sectoral approach.

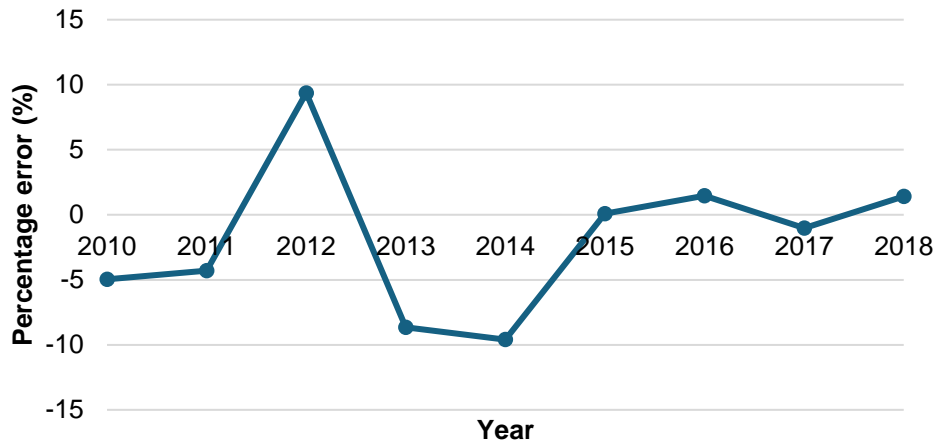


Figure 2-7: Percentage comparison of GHG emissions estimated using the reference approach compared to the sectoral approach.

2.8.3 Description of Methodologies and Data Sources

For all categories in the Energy sector, default emission factors were used from the 2006 IPCC Guidelines. The gases estimated are CO₂, CH₄ and N₂O and for all the sub-categories, Tier 1 method was used. The sub-categories included in the Energy sector are fuel consumption emissions from electricity production, manufacturing, agriculture, transport, commerce, and institutional and residential sectors and fugitive emissions from surface coal mining and handling. Default Net Calorific Values (NCV) were used throughout, except for conversion factors from litres to TJ for motor gasoline, diesel, and illuminating paraffin used from the South African Energy Statistics. Data were sourced from the national energy balances produced by the Department of Energy in the Ministry of Natural Resources and Energy. These data were sometimes incomplete, and, in some cases, other a sources had to be identified. Fuel consumption data for missing years was obtained from other sources such as an open-access international dataset, directly from relevant industries, and data provided by The University of Eswatini's Centre for Sustainable Energy Research (CSER).

2.8.4 Re-Calculations

All emission estimates in this sector were re-calculated as the data from the previous inventory calculations were not available.

2.9 IPPU Sector

Total direct GHG emissions from all source categories in 2018 were 21.33 Gg CO₂e in 2018 (Table 2.7). Product Uses as Substitutes for Ozone Depleting Substance Refrigeration and Air-Conditioning account for 68.24% of emissions or 14.55 Gg CO₂e, as shown in Figure 2-8. Non-Energy products account for 25.93% of emissions from lubricant use (4.14 Gg CO₂e); including paraffin wax use (0.81 Gg CO₂e) and solvent use (0.58 Gg CO₂e). The remaining 5.83% of emissions is from Other Product Manufacture and Use with Electrical Equipment estimated at 1.24 Gg CO₂e.

The indirect GHG emissions from NMVOC in 2018 is 16.30 Gg. Other Food and Beverages Industry account for 15.71 Gg of emissions. Non-Energy Products from Solvent Use account for 0.58 Gg of emissions. The emissions of CO, NO_x and SO₂ from Other Pulp and Paper Industry production is zero

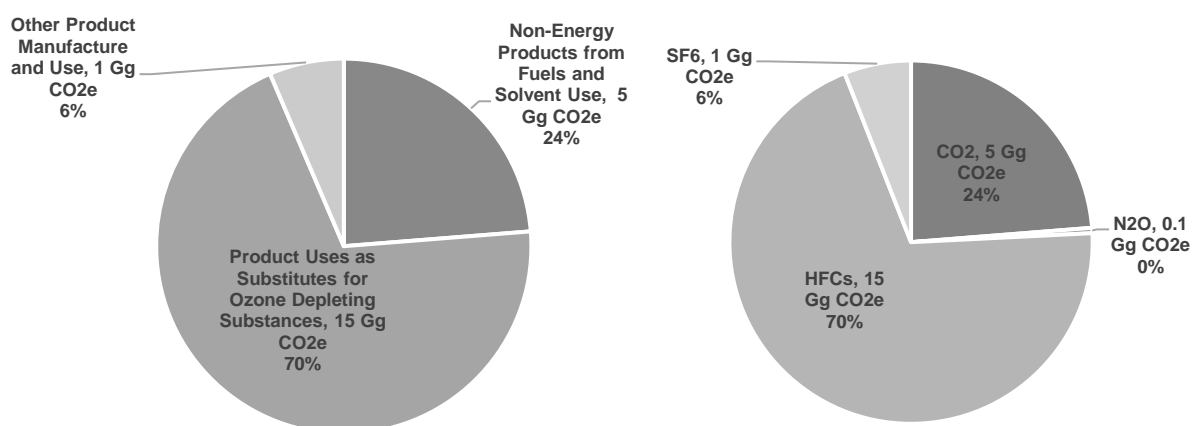


Figure 2-8: National GHG emission shares in the IPPU sector shown by a) sub-category and b) gas for 2018.

Table 2-9: Summary table of sub-category GHG emissions in the IPPU sector for 2018.

Greenhouse gas source and sink categories	Total GHG	Net CO ₂	CH ₄	N ₂ O	CO	NO _x	NMVOCs	SO _x	HFCs	PFCs*	SF ₆	
	CO ₂ equivalent (Gg)				(Gg)				CO ₂ equivalent (Gg)			
2. Industrial Processes and Product Use	20.84	4.95	NA, NE	0.1	NA, NE	NA, NE	16.30	NA, NE	15	NA, NE	1.24	
2D. Non-Energy Products from Fuels and Solvent Use	4.95	4.95	NA	NA	NA	NA	0.58	NA	NA	NA	NA	
2D1. Lubricant Use	4.14	4.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2D2. Paraffin Wax Use	0.81	0.81	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Greenhouse gas source and sink categories	Total GHG	Net CO ₂	CH ₄	N ₂ O	CO	NO _x	NMVOCS	SO _x	HFCs	PFCs*	SF ₆	
	CO ₂ equivalent (Gg)				(Gg)				CO ₂ equivalent (Gg)			
2D3. Solvent Use	NE	NA	NA	NA	NA	NA	0.58	NA	NA	NA	NA	
2F. Product Uses as Substitutes for Ozone Depleting Substance	14.55	NA	NA	NA	NA	NA	NA	NA	15	NA	NA	
2F1. Refrigeration and Air Conditioning	14.55	NA	NA	NA	NA	NA	NA	NA	15	NE	NA	
2G. Other Product Manufacture and Use	1.34	NA	NA	0.10	NA	NA	NA	NA	NA	NA	1.24	
2G1. Electrical Equipment	1.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.24	
2G3. N ₂ O from Product Uses	0.10	NA	NA	0.10	NA	NA	NA	NA	NA	NA	NA	
2H2. Food and Beverages Industry	NE	NE	NE	NA	NE	NE	15.71	NE	NA	NA	NA	

2.9.1 Trends in GHG Emissions: 1990-2018

Overall, direct GHG emissions from the IPPU sector have been steadily rising since 2000 to 2016 and then decreasing thereafter until 2018 (Figure 2-10). This is primarily due to the increasing emissions from HFCs in refrigeration and air conditioning (Figure 2-11) which were imported products. The decline in total emissions between 2016 and 2018 is attributable to brick manufacturing in the ceramics industry. The single brick manufacturing company closed in 2018. No more emissions are expected from this company or ceramics as there is currently no company that produces ceramics in the country.

Indirect GHGs are dominated by NMVOC as shown in Figure 2-11 from the food and beverages which show an increasing trend throughout the time series. Initially, the pulp and paper industry also contributed NO_x, CO, and SO₂. The company responsible for pulp and paper emissions closed in 2012 and hence there are no emissions from this category from 2012 onwards.

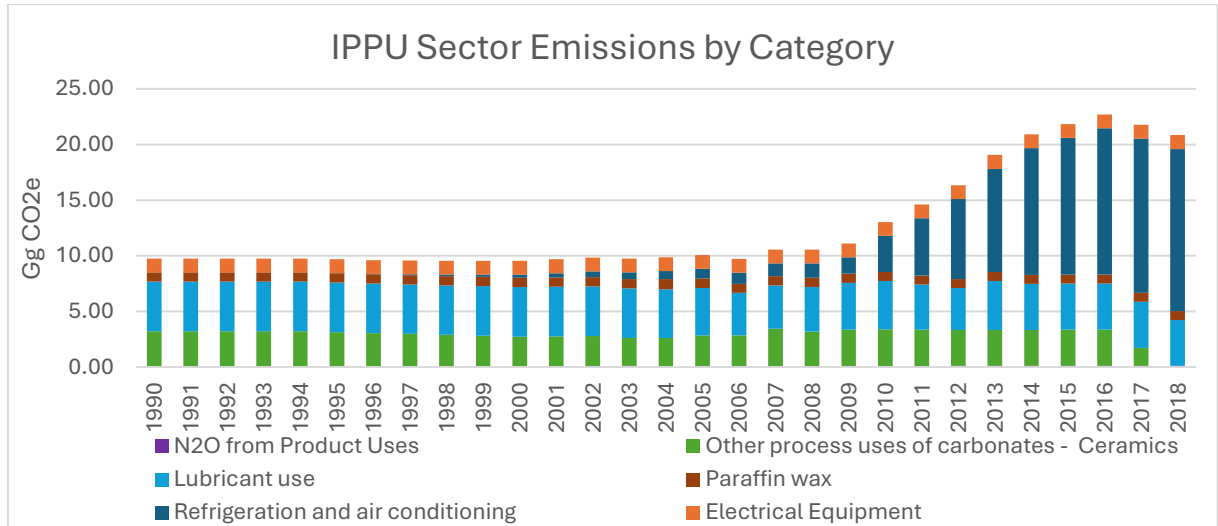


Figure 2-9: Timeseries of IPPU sector emissions from 1990 to 2018.

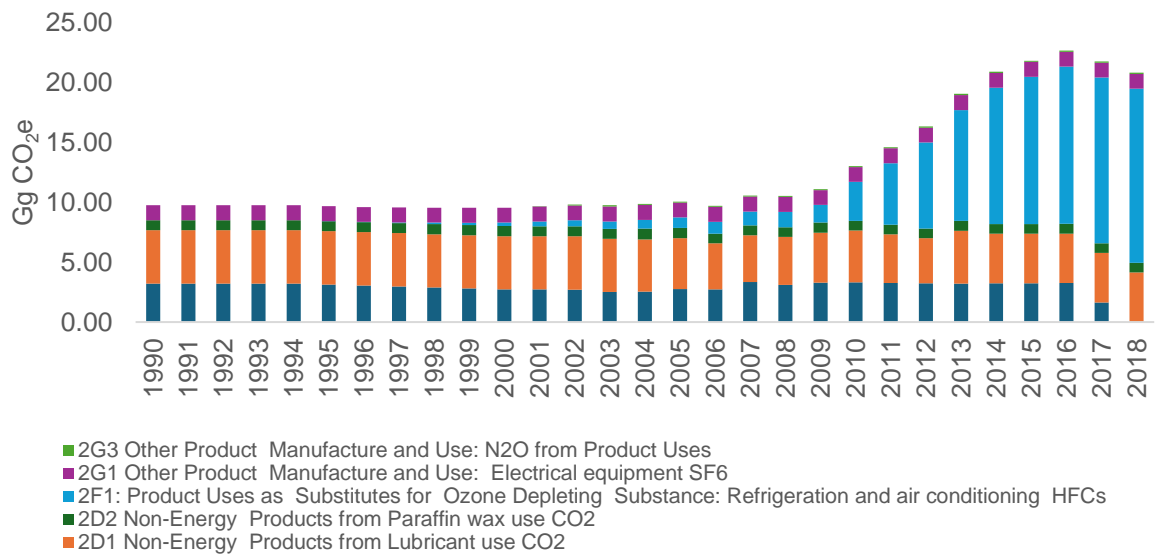


Figure 2-10: Direct GHG emissions of IPPU sector by gas in Gg CO₂ equivalent.

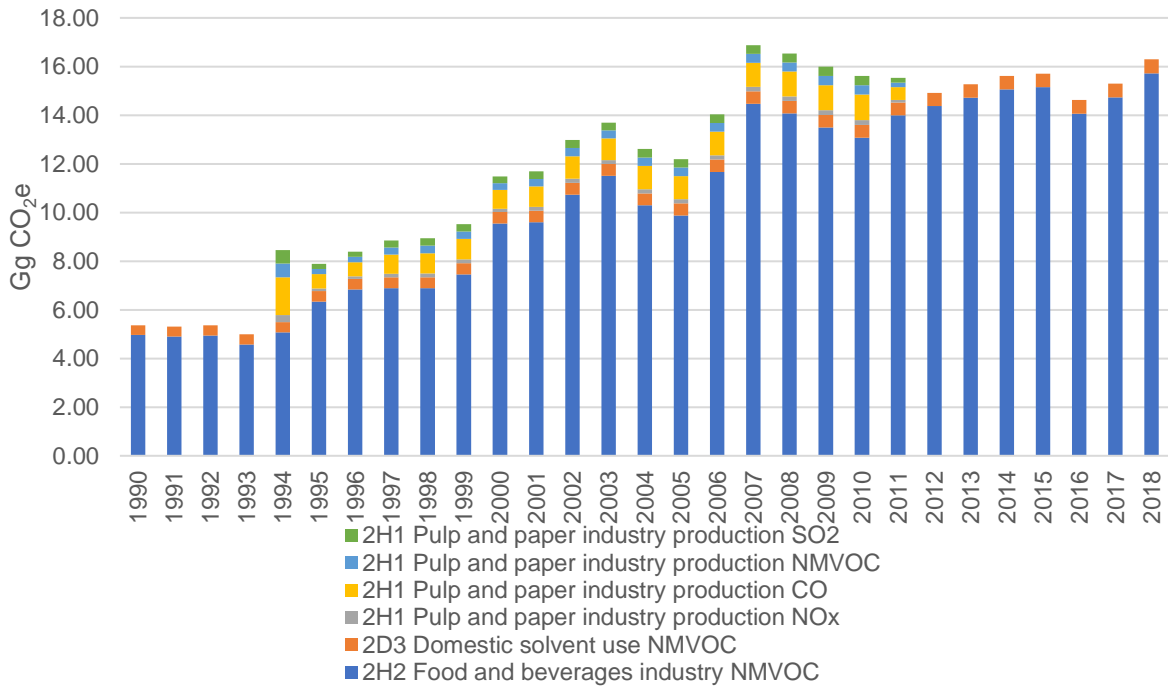


Figure 2-11: Indirect GHG emissions of IPPU sector by gas in Gg.

2.9.2 Description of Methodologies and Data Sources

The GHGs included in the IPPU sector are CO₂, HFCs, SF₆, and N₂O. The industries covered in this sector include mineral industry (ceramics), non-energy products from fuels and solvent use (lubricants and paraffin wax) and product uses as substitutes for ozone depleting substances (use of HFCs in the manufacture and servicing of refrigerators and air-conditioning), Other Product Manufacture and Use (electrical equipment), and other (N₂O from Product Uses). Indirect GHG emissions were also estimated. These were from non-energy products from fuels and solvent use (solvent use and asphalt), pulp and paper industry, and food and beverages industry. The gases from these industries include NMVOC, CO, NO_x, and SO₂. Tier 1 methodologies outlined in the 2006 IPCC guidelines were used for most of the categories, while Tier 2 was used for HFCs. Data was obtained from the 2010 inventory, national reports, the industries responsible, and expert judgement information from discussions with national experts. Other sources of data were the Eswatini Environment Authority (EEA) and Eswatini Revenue Authority. Where population data was used, the Central Statistics Office (CSO) was consulted.

2.9.3 Re-Calculations

There is a 4.82% reduction in the total emissions from IPPU due to re-calculations completed for the 2018 inventory compared to those in the NC3 (Table 2-9). The source emission categories 2A Mineral Industry and 2D Non-Energy Products from Fuels and Solvent Use accounted for 87.80% of total emissions in the 2010 inventory.

2F1 Refrigeration and air-conditioning only accounted for 12.2% to the total emissions in the previous inventory which was erroneously reported as 99.3%.

Emissions in the Mineral Industry decreased by 50.03% due to changes in quantification. 2A4 Other Process Uses of Carbonates, specifically use of soda ash and clay brick production, were included in the 2010 inventory. For soda ash, activity data was obtained from the sugar mill companies for the 2018 inventory which suggested no use of sodium carbonate (Na_2CO_3) in the sugar production process. This indicates that emissions coming from sugar production based on the use of Na_2CO_3 are not applicable. This is a change from the previous inventory that assumed some use of Na_2CO_3 . For clay brick production, the previous inventory submission did not account for a default factor of 1.1 for the ratio of total production of soda ash products to the amount of clay consumed with respect to total production ('loss factor').

There is a 4.52% decrease in emissions quantified for 2D Non-Energy Products from Fuels and Solvent Use due to re-calculations. For 2D1 and 2D2 – Non-Energy Product Use – Lubricants and Paraffin Wax; a Net Calorific Value (NCV) of 42 TJ/kt was applied in the previous inventory. The reference NCV of 40.2 TJ/kt (IPCC, 2006) is applied in the current inventory.

For 2F1 Refrigeration and Air-Conditioning, the data used in the previous inventory was obtained from Eswatini Revenue Authority and was associated with uncertainties as data from Eswatini Revenue Authority does not give quantities or specification of gas species. Emissions from aerosols were then not included as reliable data could not be obtained to use in the current inventory. Large re-calculations in this category are due to a change of data source of HFC blend imports/exports that significantly reduced the indicated amount of HFCs consumed by the refrigeration manufacturing industry and, therefore, the amount of F gases released.

For 2G Other Product Manufacture and Use, it is erroneously reported in the previous inventory that the emissions do not occur. Since the source category was not quantified in the previous inventory, its addition to the current inventory implies an enhancement rather than a re-calculation.

Although total indirect emissions per pollutant type were quantified in the previous inventory, emissions for each source category in IPPU were not specified. Emissions of NMVOC were quantified for 2D3 Domestic solvent use, 2H1 Pulp and paper industry production, and 2H2 Food and beverages industry. The total emissions of NMVOC estimated are 84.29% lower due to re-calculations in the current inventory compared to the previous one. For 2D3 Non-Energy Products from Domestic solvent use, a per capita usage method to model activity data is applied which is based on the EMEP/EEA Guidebook 2019 and is different to the method used previously. A higher quantity of solvent usage is re-calculated in the current inventory which results in greater emissions. For 2D3 Non-Energy Products from Road paving with

asphalt the total surface area of roads paved was re-calculated in the current inventory and a correction factor used in the re-calculation of the emission factor which resulted in a decrease in emissions. For 2H2 Food and beverages industry, re-calculations were only done for sugar production where new datasets were obtained and used. All other food and beverages categories used data from the previous inventory.

Emissions for NO_x, SO₂, and CO were quantified for 2H1 Pulp and Paper Industry Production. In the current inventory, the emission factors were updated to be in line with Tier 2 values in EMEP/EEA Guidebook 2019. The emission factor for NMVOCs was 3.7 kg/Mg air dried pulp in the previous inventory, while it is 2 kg/Mg air dried pulp in the EMEP/EEA Guidebook 2019. This resulted in the reduction of emission estimates from pulp production. The estimated NO_x and SO₂ emissions decreased by 33.8% and 93.6%, respectively, compared to the previous inventory, while CO emissions increased by 5.59%.

Table 2-10: Comparison of emission estimates between the previous inventory of NC3 and the current inventory.

Greenhouse gas source categories	NC3: 2010	BUR-1: 2010	Percentage difference (%)
	Total GHG (Gg CO ₂ equivalent)	Total GHG (Gg CO ₂ equivalent)	
2. Industrial Processes and Product Use	13.69	13.03	-4.82
2A. Mineral Industry	6.64	3.32	-50.03
2D. Non-Energy Products from Fuels and Solvent Use	5.38	5.14	-4.52
2F. Product Uses as Substitutes for Ozone Depleting Substance	1.67	3.25	95.31
2F1. Refrigeration and Air Conditioning	1.67	3.25	95.31
	NO	1.32	Not estimated in NC3
2H. Other	NE	NE	Indirect GHG emissions estimated only

2.10 Waste Sector

Emissions from the Waste sector contributed a total of 364.3 Gg CO₂e in 2018 (Table 2-10). The most significant source of emissions in the sector is solid waste disposal (SWD) which contributed 49% (Figure 2-13). This was followed by wastewater treatment (28%), open burning (23%), biological treatment of waste (1%), and incineration (0.04%) respectively.

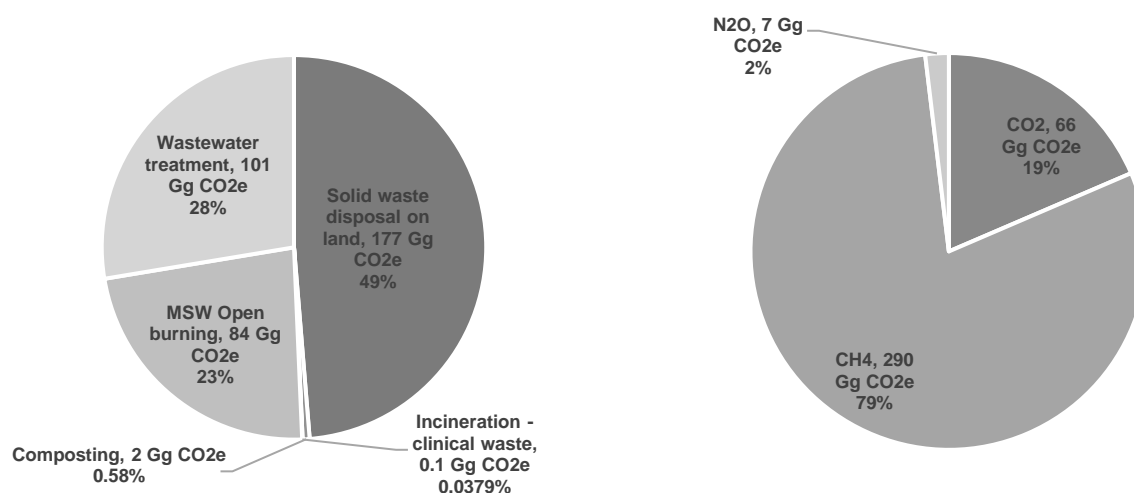


Figure 2-12: National GHG emission shares in the waste sector shown by a) sub-category and b) gas for 2018.

Table 2-11: Summary table for sub-category GHG (as CO₂e) emissions in the waste sector for 2018.

Greenhouse gas source and sink categories	Total GHG	Net CO ₂ Emissions/ removals	CH ₄	N ₂ O	CO	NOx	NMVOCs	SOx
4. Waste	364.31	68	289.78	7	NA, NE, NO	NA, NO	NA, NE, NO	NA, NO
4A. Solid Waste Disposal	177.41	NA	177.41	NA	NA	NA	NA	NA
4A1 Managed Waste Disposal	177.41	NA	177.41	NA	NE	NA	NE	NA
4A2 Unmanaged Waste Disposal Sites	NE	NA	NE	NA	NE	NA	NE	NA
4A3 Uncategorized Waste Disposal Sites	NE	NA	NE	NA	NE	NA	NE	NA
4B. Biological Treatment of Solid Waste	2.13	NA	1.13	1.00	NA	NA	NA	NA
4B1 Composting	2.13	NA	1.13	1.00	NA	NA	NA	NA
4C. Incineration and Open Burning of Waste	84.16	67.56	12.38	4.22	NA	NA	NA	NA
4C1 Waste Incineration	0.14	0.13	NA	NA	NA	NA	NA	NA
4C2 Open Burning of Waste	84.03	67.43	12.38	4.22	NA	NA	NA	NA
4D. Wastewater Treatment and Discharge	100.60	NA	98.85	1.75	NA	NA	NA	NA
1 Domestic Wastewater Treatment and Discharge	100.60	NA	98.85	1.75	NA	NA	NA	NA
2 Industrial Wastewater Treatment and Discharge	IE	NA	IE	IE	NA	NA	NA	NA
4E. Other	NO	NO	NO	NO	NO	NO	NO	NO

NO: Not Occurring; NA: Not Applicable; NE: Not Estimated

2.10.1 Trends in GHG Emissions: 1990-2018

Total estimated GHG emissions from the Waste sector increase across the timeseries, from 238 Gg in 1990 to 507 Gg in 2018 (Figure 2-14). The solid waste disposal emissions have gradually increased over the years due to an increase in the national population. This is also the reason for the trend seen in biological treatment, open burning, and wastewater treatment.

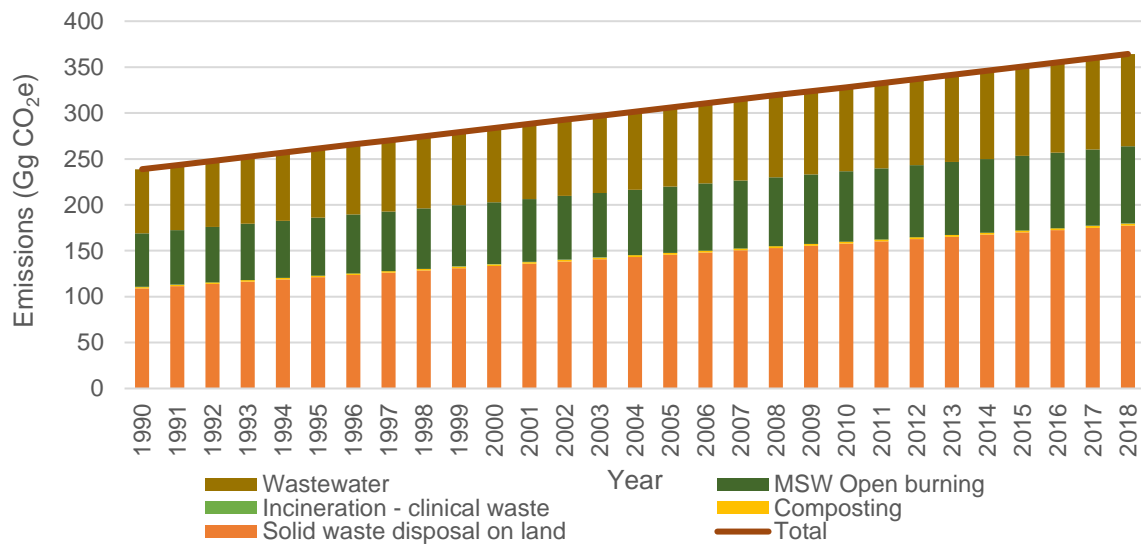


Figure 2-13: Total Waste Sector Emissions by Category 1990-2018 (Gg CO₂e).

The emissions of CO₂, CH₄ and N₂O from the Waste sector have shown a steady increase from 1990 to 2018. The emissions are presented in Gg CO₂e in Figure 2-14. CH₄ was the leading gas emitted by the sector estimated to be 186.98 Gg CO₂e in 1990, 260.24 Gg CO₂e in 2010, and 289.78 Gg CO₂e in 2018. The second highest gas emitted by the sector was estimated to be CO₂. In 1990 the CO₂ emitted was 47.03 Gg, 61.53 Gg in 2010, and was estimated to be 67.56 Gg in 2018. The least emitted gas from the Waste sector was N₂O with 4.85 Gg CO₂e emitted in 1990, 6.35 Gg CO₂e emitted in 2010, and 6.97 Gg CO₂e emitted in 2018.

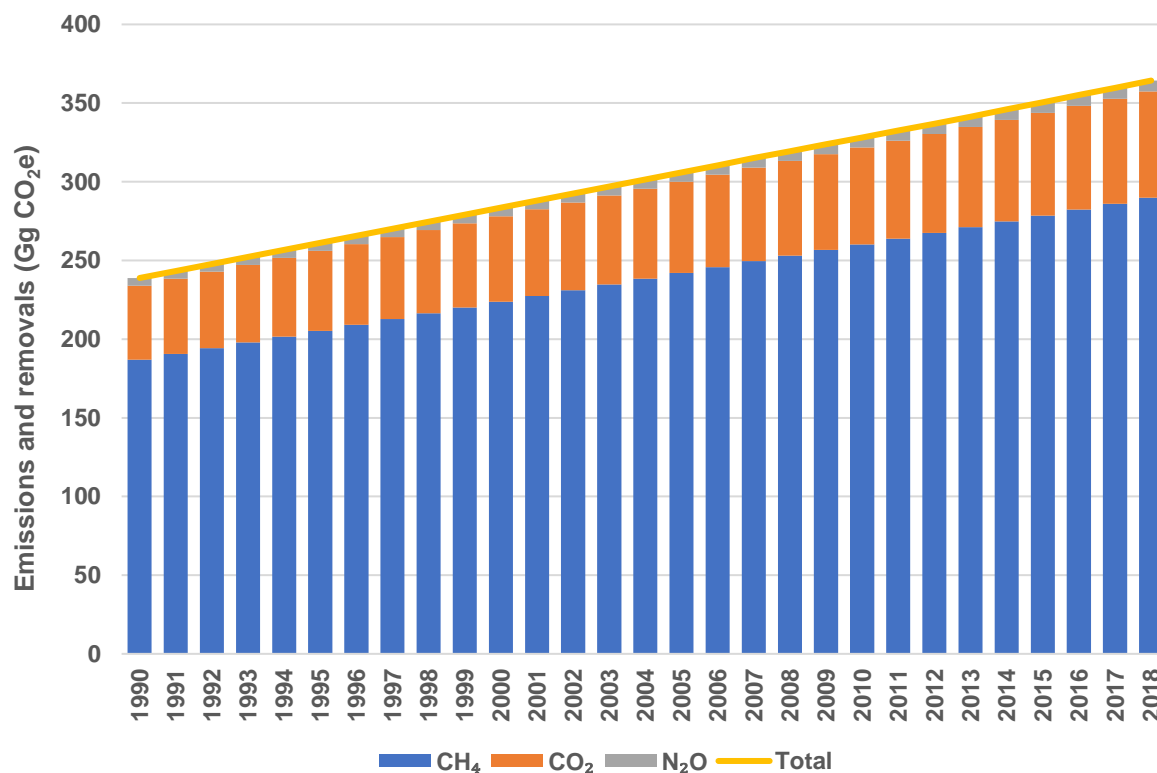


Figure 2-14: Total Waste Sector Emissions by gas 1990-2018 (Gg CO₂e).

2.10.2 Description of Methodologies and Data Sources

The GHGs included in the Waste sector are CO₂, CH₄ and N₂O. The sub-categories in the waste sector are solid waste disposal into landfill; biological treatment of waste; incineration; open burning, and wastewater treatment. A Tier 1 methodology was applied in all emission sub-categories. The main activity data in this sector were population, solid waste generation and composition, quantities of waste composted, incinerated, or burnt and the utilization of waste-water treatment streams. Key data sources included Eswatini Central Statistics Office (CSO), Eswatini Environment Authority (EEA), municipalities, company towns, and Eswatini Water Services Corporation (EWSC).

2.10.3 Re-Calculations

There were substantial improvements in the 2018 inventory to estimate waste sector emissions specifically for waste disposed in landfill, wastewater treatment, treatment, and open burning and incineration. A comparison with NC3 is shown in Figure 2-15. Updated population statistics from the Central Statistics Office from 2007 to 2018 were used to compile a timeseries between 1990 and 2018. Compared to the 2010 inventory, the population numbers used in the 2018 inventory were

higher, which increased GHG emissions across all sub-categories. All other assumptions and characteristics of the waste management practices, and population distribution were assumed to be constant across the timeseries. This resulted in the Waste sector emissions trend being defined by the population trend. Emissions from incineration are estimated to be constant across the time series due to the assumption that there has been a constant number of hospital beds and thus hazardous waste output across the timeseries. In the previous inventory the amount of clinical waste incinerated was based on a fraction of the total waste generated that was incinerated. In the current inventory, the number of hospital beds and the national rate of clinical waste generation per bed were used to estimate the amount of waste incinerated.

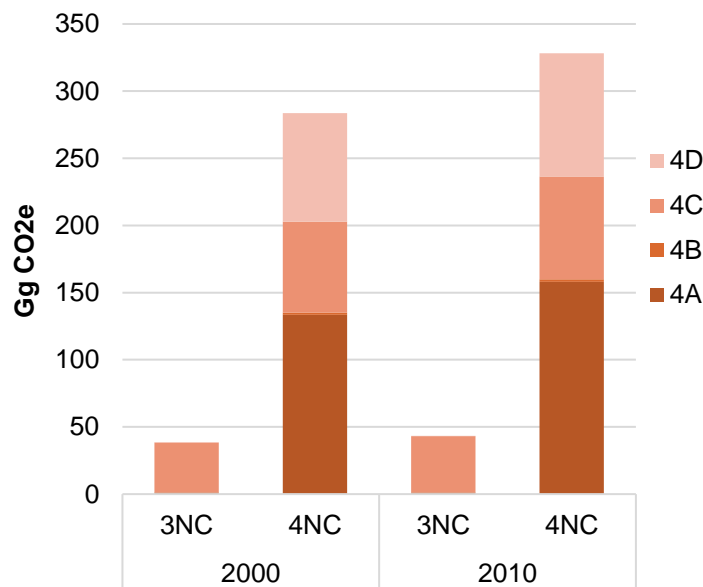


Figure 2-15: Comparison of estimated GHG emissions for 2000 and 2010 estimated in the 2010 inventory and the 2018 inventory.

2.11 AFOLU Sector

The emissions/removals from the AFOLU sector are influenced by a combination of factors including implementation of national policies, available technologies, and management practices. The aggregate effects of how policies, technologies and management practices are used largely determine land use practices and the associated emissions or removal of GHG from the AFOLU sector. Some of the practices include: (a) livestock rearing, (b) land use change via forest conversion (deforestation), (c) afforestation, (d) wood-fuel extraction, (e) wildfire disturbance, (f) application of nitrogen-based fertilisers.

FOLU accounts for 37% of the AFOLU sector emissions, as shown in Figure 2-16. Aggregate sources and Non-CO2 Emissions Sources on Land account for 29% of the total emissions. Cumulatively, 3A1. Enteric Fermentation and 3A2. Manure Management accounts for 34% of AFOLU sector emissions.

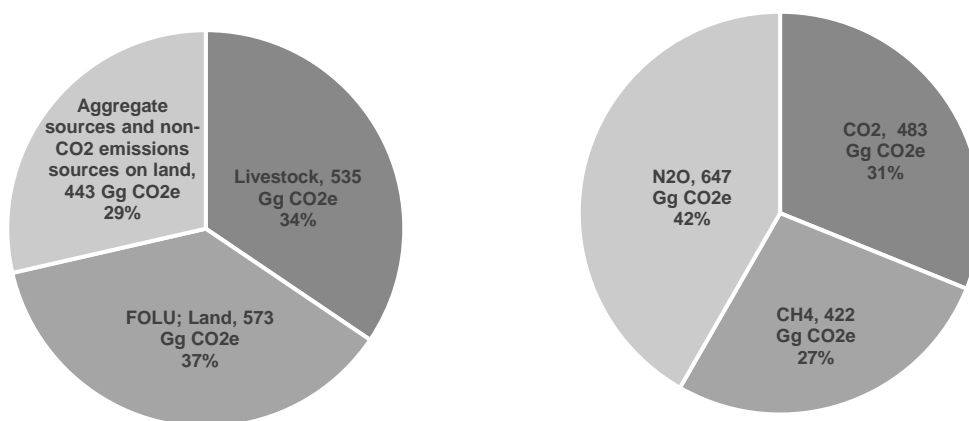


Figure 2-16: National GHG emission shares in the AFOLU sector shown by a) sub-category and b) gas for 2018.

Total direct GHG emissions from all AFOLU source categories in 2018 was 1,551.13 Gg CO₂e including FOLU and 977.85 Gg CO₂e excluding FOLU (Table 2-10). The difference between these two totals is 573.28 Gg CO₂e from FOLU. Indirect GHG emissions from SLCPs were quantified for CO and NO_x in 3C1 Biomass burning and were 14.21 Gg for CO and 0.66 Gg for NO_x. SLCP emissions are not required to be reported for livestock and land use categories according to the 2019 refinement to the 2006 IPCC guidelines since the potential for significant emissions is lacking for some land categories.

Table 2-12: Summary table of sub-category GHG emissions in the AFOLU sector for 2018.

Greenhouse gas source and sink categories	Total GHG emissions	Net CO ₂ Emissions/ removals	CH ₄	N ₂ O	CO	NO _x
	CO ₂ equivalent (Gg)			(Gg)		
3. Agriculture, Forestry, and other Land Use (AFOLU)	1551.13	482.88	421.29	646.97	14.21	0.66

Greenhouse gas source and sink categories	Total GHG emissions	Net CO ₂ Emissions/ removals	CH ₄	N ₂ O	CO	NO _x
	CO ₂ equivalent (Gg)				(Gg)	
3A. Livestock	534.59	NA	409.15	125.44	NA	NA
3A1 Enteric Fermentation	383.41	NA	383.41	NA	NA	NA
3A2. Manure Management	151.18	NA	25.74	125.44	NA	NA
3B1. Forest Land	-1520.00	-1520.00	NA	NA	NA	NA
3B2. Cropland	1121.49	1121.49	NA	NA	NA	NA
3B3. Grassland	877.73	877.73	NA	NA	NA	NA
3B4. Wetlands	78.85	78.85	NA	NA	NA	NA
3B6. Other Land	0.30	0.30	NA	NA	NA	NA
3C. Aggregate Sources and Non-CO₂ Emissions Sources on Land	541.50	7.83	12.15	521.53	14.21	0.66
3C1. Biomass Burning	24.73	NE	12.15	12.58	14.21	0.66
3C2. Liming	0.02	0.02	NA	NA	NA	NA
3C3. Urea Application	7.81	7.81	NA	NA	NA	NA
3C4. Direct N ₂ O Emissions from Managed Soils	306.41	NA	NA	306.41	NA	NA
3C5. Indirect N ₂ O Emissions from Managed Soils	105.97	NA	NA	105.97	NA	NA
3C6. Indirect N ₂ O Emissions from Manure Management	96.56	NA	NA	96.56	NA	NA
3D. Other	-98.24	-98.24	NA	NA	NA	NA
3D1. Harvested Wood Products	-98.24	-98.24	NA	NA	NA	NA

2.11.1 Trends in GHG Emissions: 1990-2018

Overall, the AFOLU sector remained a net sink from 1990 until 2010, thereafter it became a net emissions source. The changes in emissions was driven mainly by removals of indigenous forest lands (Figure 2-18) (Figure 2-19). The shift from sink to source and increase in emissions relates to activities and management practices such as deforestation and biomass burning. The trend seen in the AFOLU sector is predominantly from emissions and removals from 3.B Land, which are driven by land use change. Land changes between 2000 and 2010 are driven by increased rates of deforestation on the indigenous forests, harvesting of timber in the plantation forests, infrastructure development including creation of dams for hydropower, and irrigation and application of fertilisers in agriculture.

The Harvested Wood Products category experienced a downward trend from 1990 with the sink declining over the time series (Figure 2.20). This category remained a

removal category, even though it had a very low annual value of less than 100 Gg CO₂e, compared to values of approximately 1 000 Gg CO₂e in the late 90s and 2000s. The 2007/2008 wildfires in the country adversely affected the forestry industry such that the major plantation forestry company, Usutu Forest Products Company Limited, closed its operations. This was also in response to falling demand for pulp and paper as recession in the world's largest economies caused job losses and curbed consumer spending. Since that time, there has been a gradual decline in the production of wood products in Eswatini.

Livestock emissions, which is mainly through CH₄, in Eswatini between 1990 and 2018 generally shows a downward trend with declines recorded in the years Eswatini was faced with droughts, namely: 1992, 2001, and 2016. The country recorded the highest emissions from both enteric fermentation and manure management in 1992 but went down by approximately 100 Gg CO₂e the following year when the country experienced a very severe drought.

The aggregated and non- CO₂ emissions on land category also notably contributed about 600 Gg CO₂e annually, except for the years 2007 and 2008 where emissions increased to about 700 Gg CO₂e. This was because of high incidences of wildfires experienced in the country.

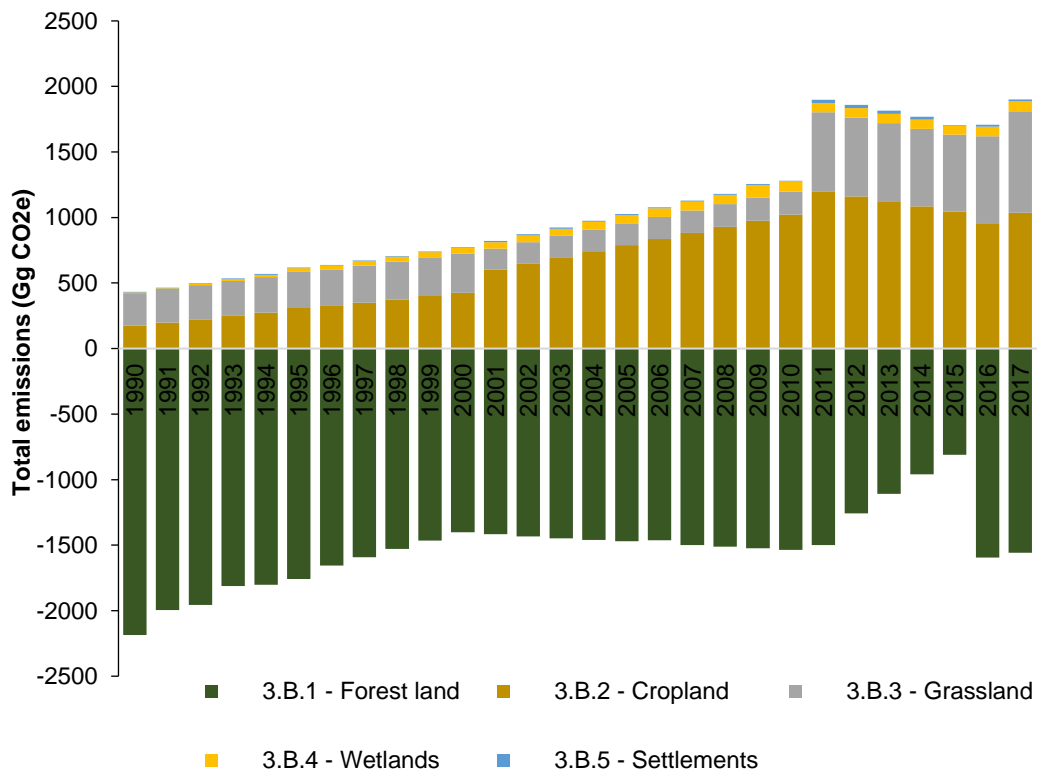


Figure 2-17: Land category emissions by land use type from 1990 to 2018.

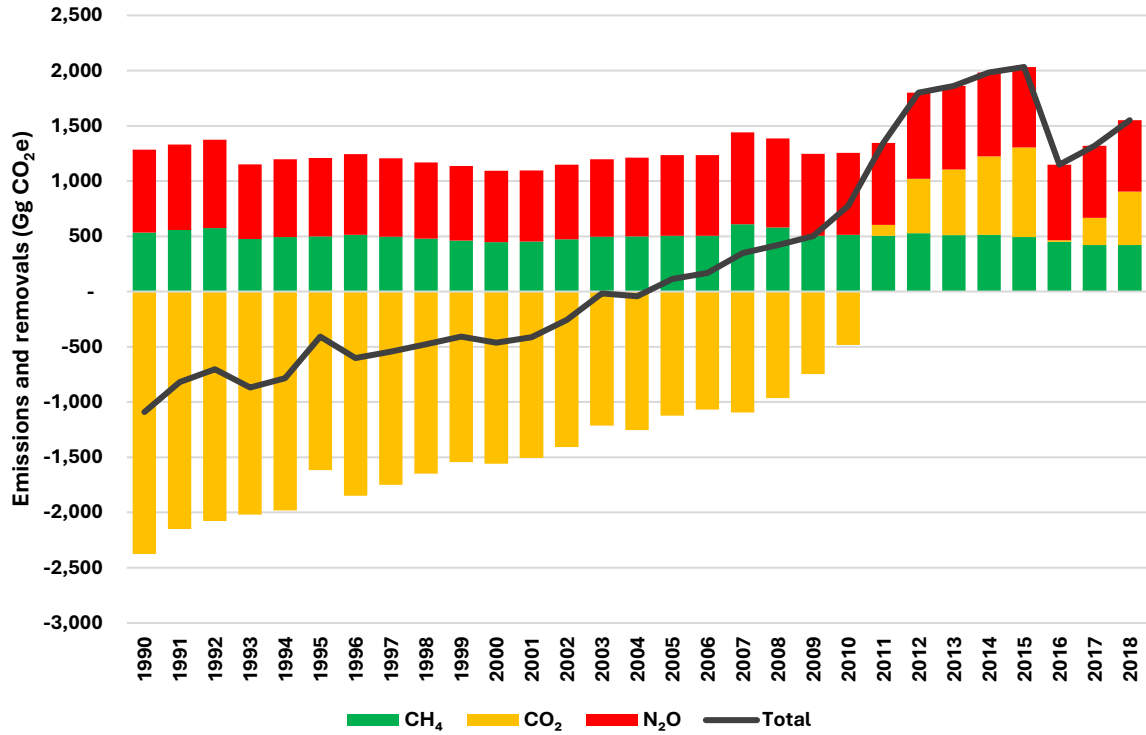


Figure 2-18: AFOLU Sector emissions by Gas from 1990 to 2018.

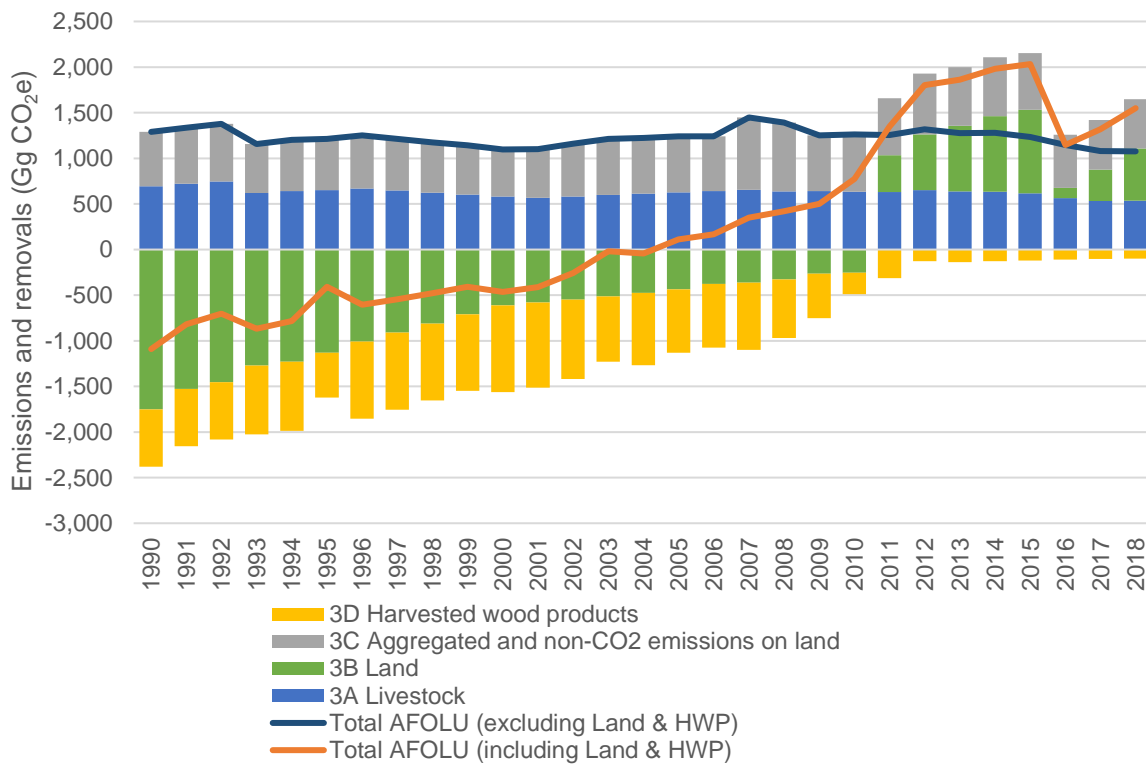


Figure 2-19: AFOLU Sector emissions by Category from 1990 to 2018.

2.11.2 Description of Methodologies and Data Sources

The GHG emissions estimated in the AFOLU sector include those for CO₂, CH₄, and N₂O. The three clusters of emission/removal categories are: livestock, land and aggregated sources, and non-CO₂ emission sources from land. Both Tier 1 and Tier 2 methodologies were used to quantify emissions in the livestock sector from enteric fermentation and manure management. For livestock emissions, livestock population activity data were sourced from the Ministry of Agriculture and Food and Agriculture Organization (FAO) for dairy cattle, non-dairy cattle, sheep, goats, horses, mules, asses, swine, and poultry.

Land cover maps are the main source of activity for land use emissions which were mostly sourced from the Eswatini National Trust Commission (ENTC), Eswatini Sugar Association (ESA), and Ministry of Agriculture (MoA). The activity data needed for aggregated sources and non-CO₂ emission sources from land are more varied. Annual burned area maps were produced from the MODIS Collection 6 Monthly Burned Area Product (MCD64A1 v006) and used to quantify biomass burning emissions. Lime and urea import data from the Eswatini Revenue Authority were used to quantify emissions from lime and urea application to soils. Livestock population, crop statistics and production, import and export statistics for wood products from FAO and Ministry of Agriculture data sources were used to quantify the emissions from managed soils and harvested wood products.

2.11.3 Re-Calculations

In the 2010 inventory, the 1996 IPCC Guidelines were used, and the Agriculture and Land sectors were treated separately. In this inventory for the BUR-1/NC4, the 2006 IPCC Guidelines were used. As a result:

- Region specific (Southern Africa) emission factors were used in this inventory submission for some categories.
- Manure management data was adjusted to include region specific data from Moeletsi et al. (2015) and expert judgement on manure management in Eswatini.
- Overlay of GIS-based land cover/land use raster maps with soil, climate, and ecoregion maps.
- Re-calculation of the annual change in land cover using these new map overlays.
- New biomass and soil carbon calculations due to the improved map overlays and new region-specific (South African) emission factors.
- Update of biomass and stock change factors.
- Improvement of calculations of biomass stock changes in converted land to move towards a Tier 2 approach in all land categories.
- Inclusion of litter data for all land categories.

- In the urea application category, country import data was sourced from Eswatini Revenue Authority, which was then used to re-calculate emissions because of urea application. Updated biomass burning fuel loads and emission factors and updated Harvested Wood Products (HWP) data due to an update in the FAO data.

Small changes in Category 3A emissions from livestock are due mainly to the incorporation of regional emission factors. Category 3B emissions and removals from land were estimated to be significantly lower than those reported in the NC3 due to the use of consistent land change maps between 1990 and 2015 and the inclusion of updated carbon stock and biomass data. Improved manure management data and updates in the methods for calculating managed manure availability and crop residue inputs resulted in a decline of Category 3C emissions.

3 Mitigation Actions and Their Effect

This chapter reports on the current implementation of mitigation actions and the progress made in reducing GHG emissions from 2010 to 2020. The Kingdom of Eswatini's National Climate Change Policy (2016) sets the basis for the country's response to climate change and the need to advance mitigation measures. The intent and ambition of these mitigation goals are outlined in the updated Nationally Determined Contributions (NDC) of the country, which sets an economy-wide target of reducing GHG emissions by 5% by 2030 compared to the baseline year of 2010.

The mitigation actions prioritized in Eswatini's initial Nationally Determined Contributions (NDC) included doubling the share of renewable energy in the national energy mix by 2030, relative to 2010 levels; to introduce the commercial use of 10% ethanol blend in petrol by 2030 and to phase out the use of HFCs, PFCs, and SF6 gases. Additional mitigation actions prioritized in the NDC update include:

- improving energy access and energy intensity of the residential sector;
- reducing energy intensity of industrial, agricultural, commercial and public services sectors;
- conducting studies to assess the adoption of electric mobility options;
- to reduce GHG emissions in the Waste sector by 2030 through improvements in waste treatment (including landfilling) across urban and rural areas;
- reducing land degradation through restoration including tree planting and improving livelihoods through better livestock management.

The proposed phase-out of F-gases has been revised in the NDC update to address the phase out of HFCs only as per international commitments of the country to the Kigali Amendment.

Mitigation actions were included in the ex-post assessment if implementation occurred prior to 2020 and there was sufficient activity data available from online publicly available reports. The mitigation actions considered in the ex-post mitigation assessment include doubling the renewable energy share in the energy mix; reducing the energy intensity of the residential, industrial, agricultural, commercial, and public services sectors; reducing GHG emissions in the Waste sector through improvements in waste treatment; and reducing land degradation. The mitigation actions not considered in the ex-post mitigation assessment included improving energy access in the residential sector, commercialisation of 10% ethanol fuel blend in petrol, exploring electric mobility options, and the phase out of HFCs. The activity data collected to quantify GHG emission reductions ex-post were from government reports published online. For the next cycle of reporting, it is expected that the activity data to be used in mitigation assessments will be sourced from the operational MRV information system that is currently under development.

The evaluation of achieved GHG emissions reductions for the reporting period 2010

to 2020 is described in relation to the GHG emissions in the ex-post “with policy” scenario (computed as NDC “without policy” GHG emissions minus achieved GHG emissions) for the period 2010 to 2020 as shown in Figure 3-1. The “with policy” scenario is the GHG emissions in the business-as-usual scenario for the 2010 to 2020 period. The achieved GHG emission reductions exceed planned NDC levels from 2010 to 2015 and then from 2019 to 2020 when annual achieved GHG emission reductions exceed the desired GHG emission reductions from the NDC. Achieved GHG emission reductions in the ex-post “with policy” scenario are less than planned emission reductions from 2016 to 2018 due to a decline of carbon sinks from forestland.

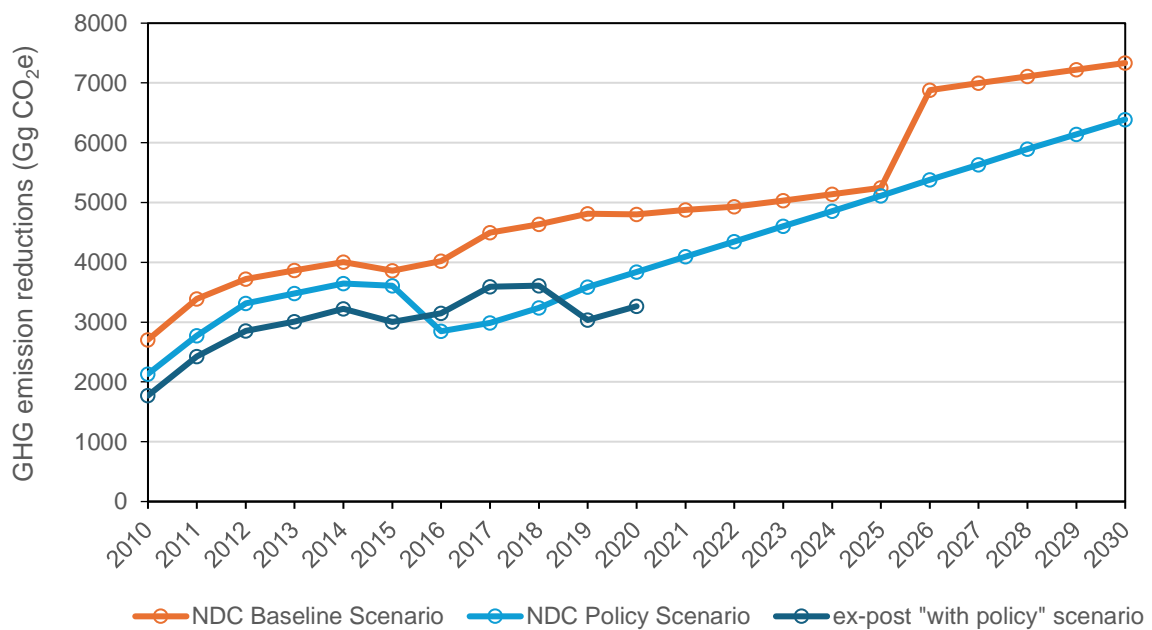


Figure 3-1: Total GHG emissions in the NDC “with policy” and “without policy” scenarios compared to the total GHG emissions in the ex-post “without policy” scenario.

As indicated in Figure 3-2; actions in the AFOLU sector contribute to 73.41% of total GHG emission reductions, actions in the energy sector contribute to 25.89% of the total emission reductions, while the remaining contributions are from actions in the waste sector (0.70%). No emission reductions occur in the IPPU sector, as no implementation was planned in the current period.

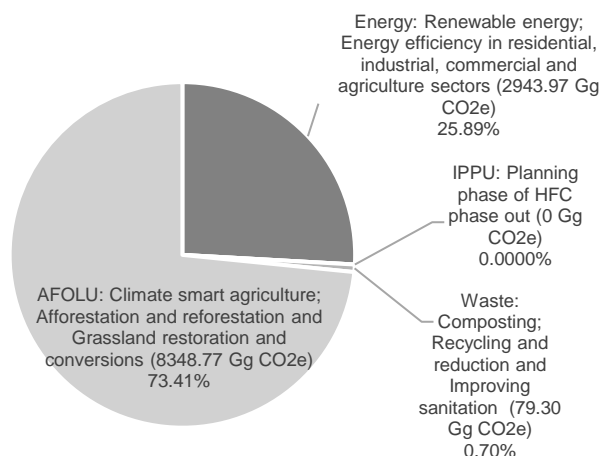


Figure 3-2: Sectoral contributions to ex-post cumulative GHG emission reductions from 2010 to 2020.

3.1 Overarching Mitigation Policies to Support Implementation

3.1.1 National Development Plans

The overarching development plan of the government is the National Development Strategy 1997-2022 (NDS). The NDS outlines Eswatini's developmental goals for a period of 25 years from 1997-2022 and is viewed as the highest-level policy document. The country's developmental priorities, as outlined in the NDS, have influence on GHG emissions as priority developments and production activities will be a source of emissions. The NDS highlights seven (7) micro strategic areas that include: (i) governance and sound economic management, (ii) economic acceleration, industrialisation, and diversification, (iii) agricultural development, (iv) research and development, (v) human capital development, (vi) strategic infrastructure development, and (vii) environmental management.

Therefore, any climate action must contribute towards sustainable development and should be compatible with the NDS. Key strategic development priorities relevant to climate change mitigation identified by the NDS mainly focus on sustainable energy and include research and development for energy systems, promotion of renewable energy technologies, and afforestation/ reforestation. In Eswatini, energy issues are intricately linked to the forest sector, as traditional biomass is widely used for cooking and heating in rural areas and represents 90% of the energy needs (MNRE and International Renewable Energy Agency [IRENA], 2014).

A national development plan for the period 2019 to 2021 and a development roadmap policy for the period 2019-2022 were also introduced. The Ministry of Economic Planning and Development has presented a draft NDP for the period 2023 to 2027 for stakeholder consultation.

3.1.2 Environmental Management

The NDS is supported by the Eswatini Environment Action Plan (EEAP) of 1997. The EEAP is the environmental equivalent of the Strategy and outlines the environmental issues relating to Eswatini's sustainable development, with recommendations for actions to promote environmentally sustainable development. It lays down the principles of harmonisation for environmental legislation; the use of environmental guidelines and procedures; EIAs and market-based mechanisms; and the formulation of sectoral policies and strategies. The Environment Management Act (EMA), No. 5 of 2002, replaced the *Eswatini* Environment Authority Act of 1992. The Act is intended to provide and promote the enhancement, protection and conservation of the environment, the sustainable management of natural resources, and all other relevant matters.

The main objectives of the EMA are as follows:

- Establish a framework for environmental protection and the integrated management of natural resources on a sustainable basis;
- Transform the EEA into a body corporate;
- Establish the Eswatini Environment Fund;
- Provide for matters incidental to the above objectives.

The Environmental Audit, Assessment and Review Regulations (EAARR), 2008, establish the guidelines and requirements for environmental and social impact assessment (ESIA) and environmental audit reports. The EAARR require any new projects that are deemed to have an impact on the environment to obtain an Environmental Compliance Certificate (ECC) or an Environmental Authorisation Letter from the EEA. This requires the submission of an Initial Environmental Evaluation (IEE) report and a Comprehensive Mitigation Plan (CMP), or an ESIA report that contains a description of the mitigation measures to reduce the environmental impacts of the proposed project.

3.1.3 National Climate Change Policy, 2016

The National Climate Change Strategy and Action Plan (NCCSAP) was introduced in 2013. Over a five-year period between 2015 to 2020, the intention of the NCCSAP was to build institutional capacity for the development and implementation of climate actions, while building awareness and understanding of climate change. The NCCSAP's short timeframe implied that long-term actions were not prioritised. The NCCSAP identified strategic focus areas for mitigation that were related to:

- Integration of climate change mitigation measures into various sectoral policies and national development planning.
- Prioritisation of mitigation actions that contributed to the achievement of

sustainable development, poverty eradication, and the enhancement of adaptive capacity in sectors such as agriculture and food security, biodiversity and ecosystems, and water resources.

- Provision of mechanisms for mobilising and accessing support for technology development, capacity building, and financial resources.

The National Climate Change Policy (NCCP) was introduced in 2016 and is the enabling framework for the country's planning to address climate change. The framework has a longer time frame than the NCCSAP but also prioritises mitigation actions which have greater co-benefits for sustainable development. For example, an integrated approach is intended to enhance synergies in the implementation of the three Rio Conventions, namely: (1) the United Nations Framework Convention on Climate Change, (UNFCCC), (2) the Convention on Biological Diversity (CBD), and (3) the Convention to Combat Desertification (CCD). Key sectors emphasised in the framework include AFOLU, energy, industry, transport, waste management, and buildings. The objectives of the NCCP include:

- Providing an enabling policy framework for the effective implementation of climate change adaptation and mitigation measures.
- Enhancing climate-resilient and inclusive low-carbon green growth investments.
- Promoting public education, information, and awareness on climate change.
- Providing mechanisms for coordination and building of partnerships in addressing climate change.

The Nationally Appropriate Mitigation Action Plan is outlined in the framework as part of the process of formalizing institutional arrangements for periodic reporting on progress, MRV, financing, technology development and transfer, and capacity building. The NCCP is to be reviewed periodically, no later than after every five years, which is ongoing.

3.1.4 Technology Needs Assessment and Action Plans

The Technology Needs Assessment (TNA) project was conducted by MTEA through the Department of Meteorological Services in 2016 and supported by the United Nations Environment Programme (UNEP) through the UNEP partnership with the Technical University of Denmark (DTU). A National Climate Change Committee (NCCC) was established, with representatives from the private sector, public sector, and civil society. The NCCC took the role of the steering committee for the TNA exercise.

The project involved the identification of technologies for climate change mitigation in Eswatini that are in line with national development priorities. The technology options were identified through analysing the activities in the economic sectors of the country and identifying possibilities for mitigation. The prioritisation of the

identified technologies was carried out using Multi Criteria Decision Analysis (MCDA). The criteria were based on the social, economic and environmental impacts and benefits of the technologies and measures.

In the Energy sector the top 5 ranked technologies were hydropower, combined heat and power using biomass (bagasse and wood chips), solar PV, energy efficient buildings, and efficient public transport. Even though the Energy sector is not the highest emitter in Eswatini, there are several technologies for mitigation, due to the large variety of subsectors. Furthermore, the energy sector has more accurate data in terms of quantities of the various energy sources consumed. The four technologies prioritised in the waste sector included separation/reuse/recycle, composting and semi-aerobic landfill. It is important to note that the separation of waste is key to reuse, recycle, composting, and semi-aerobic landfill technologies. The separation of waste was highlighted to be the most important of all the technologies. Composting is a familiar technology but to undertake it at large scale for municipal waste would need technical assistance.

The technologies prioritised in the AFOLU sector were agroforestry, urban forestry, and grazing land management. It was noted that agroforestry is being practised by some subsistence farmers. Grazing land management is needed mostly in Eswatini Nation Land where signs of land degradation have been observed. The barrier analysis and enabling framework outlined enabling mechanisms to ease implementation of mitigation technologies.

Urban forestry will have the challenge of space, for example, but there are niche areas in an urban environment where this technology is needed.

3.2 Sectoral Domestic Actions

There is considerable potential for Eswatini to reduce GHG emissions for which notable targets for mitigation have been set in the NDC. Eswatini has taken progressive measures to define economy-wide GHG targets covering all priority sectors.

Further, Eswatini intends to generate 50% power from renewable energy by 2030 relative to 2010 levels, and this measure alone will lead to 9% reduction in total GHG emissions in 2030. Most of the mitigation measures identified across sectors have been aligned with the policies and strategies that are outlined in this chapter and lead to sustainable development co-benefits. In summary, the following sectoral targets have been identified to reduce GHG emissions according to the NDC assessment:

- Energy – Reduce 23% GHG emissions by 2030 compared to baseline year;
- Waste – Reduce 16% GHG emissions by 2030 compared to baseline year;
- IPPU – Achieve net emissions reductions of 5.96 Gg CO₂e by implementing

- the Kigali Amendment to the Montreal Protocol and other measures;
- AFOLU – identify mitigation potential based on revised actions.

The NDC GHG targets have been estimated based on Intergovernmental Panel on Climate Change (IPCC) 2006 emission inventory methodological guidelines and, where required, the refinement to the guidelines published in 2019 were also applied.

3.2.1 Energy

Table 3-1: Overview of action to increase power generation from renewable energy in the total energy mix.

Name of mitigation action	Scope; nature of action; and status	Duration	Implementing institution	Sector	Quantitative goals by 2030 in relation to 2010 baseline year	GHGs covered
Increase power generation from renewable energy in the total energy mix	Regulations and standards; Subsidies and incentive, implemented	1997-2030	MNRE	Renewable energy	50% renewable energy penetration in the energy mix by 2030 (MNRE, 2016a). Increase installed capacity of solar power generation to 55.85 MW by 2030 (MTE, 2021a). Increase installed capacity of biomass power generation to 95 MW by 2030 (MTE, 2021a). Increase installed capacity of hydro power generation to 80 MW by 2030 (MTE, 2021a).	CO ₂

Actions have been identified across the supply and demand side. The major share of emission reductions shall be achieved through increasing renewable electricity generation from 16% in 2010 to 50% by 2030. This involves considerable expansion of capacities from biomass, solar, hydro, and wind. Several policies have been institutionalized to initiate this transition and a synergetic approach with various

stakeholders from the government and private sector will be required to meet the desired outcome. A summary of the mitigation actions identified for the sector are provided in Table 3-1, Table 3-3, and Table 3-4.

3.2.1.1 Action to increase power generation from renewable energy in the total energy mix

3.2.1.1.1 ..Objective of the mitigation action

To meet the energy needs of the country in a sustainable manner that contributes to economic growth and well-being of the population.

3.2.1.1.2 Description and policy steps taken or envisaged to achieve the action

Greater CO₂ emissions from fossil fuel power plants are avoided due to the increasing number of renewable energy power plants built that are linked to the grid countrywide. Renewable electricity power generation projects will directly contribute to increasing installed capacity in solar, wind, biomass, and hydro sources in the national energy mix instead of new capacity from fossil fuel energy sources. Potential GHG emissions reductions achievable are 9.08% of GHG emissions in 2030 compared to a baseline scenario. Commitments to securing increasing renewable energy sources in the national energy mix by 2030 are described in detail in the National Energy Policy 2018 and aligned with the National Development Strategy. There are numerous policy and regulation milestones which have been adopted to ease implementation including:

- 1997: Adoption of the Swaziland Utilisation of Renewable Energy Action Plan;
- 1999: A research and development strategic objective was included for the development and dissemination of appropriate renewable energy technologies in the NDS
- 2003: First national energy policy published;
- 2007: Electricity Act; Energy Regulatory Act and Electricity Company Act implemented;
- 2013: Joined the SEforALL initiative and Eswatini committed to a 50% renewable energy target by 2030;
- 2009: First national energy policy implementation strategy adopted;
- 2016: Electricity licensing by-laws under the Electricity Act introduced, Independent Power Producer Policy adopted;
- 2018: The Energy Policy and implementation strategy was updated. The Short- Term Generation Plan for Eswatini was adopted to guide the relevant authorities on the amount of the various possible types of generation capacity including renewables that will need to be procured

and the envisaged timeframes . The development of an integrated resource plan aligned to the current energy masterplan that was also published is on-going to guide medium to long term energy supply planning.

3.2.1.1.3 Development progress

The underlying development milestones for renewable energy is communicated through the SEforALL initiative. The Energy Policy of 2018 is informed by:

- 2016: Solar and wind maps developed;
- Completed in 2015 as part of the Africa Clean Energy Corridors Renewable Energy Zones study (Grace et al. 2015);
- 2017: 46 MW solar PV power plant (IPP) online;
- Not achieved, with only 11 MW online by 2021;
- 2019: 134 MW hydro (SEC) and 40 MW online from wood waste;
- Not achieved with only 63 MW of hydro online by 2021;
- 2020: 130 MW co-generation from bagasse (IPP);
- Not achieved total generation capacity by 2021 is 106 MW;
- 2030: 80 MW from wood waste from IPPs and 50% renewable energy penetration in the energy mix.

Current renewable energy penetration in total energy supply is 24% in 2021. The bulk of energy is imported from South Africa which remains fossil fuel dominant.

3.2.1.1.4 Annual emission reductions from 2010 to 2020

The total annual emission reductions from biomass, solar, and hydropower increased from 58 Gg CO₂e in 2010 to 101 Gg CO₂e in 2020 (Figure 3-3).

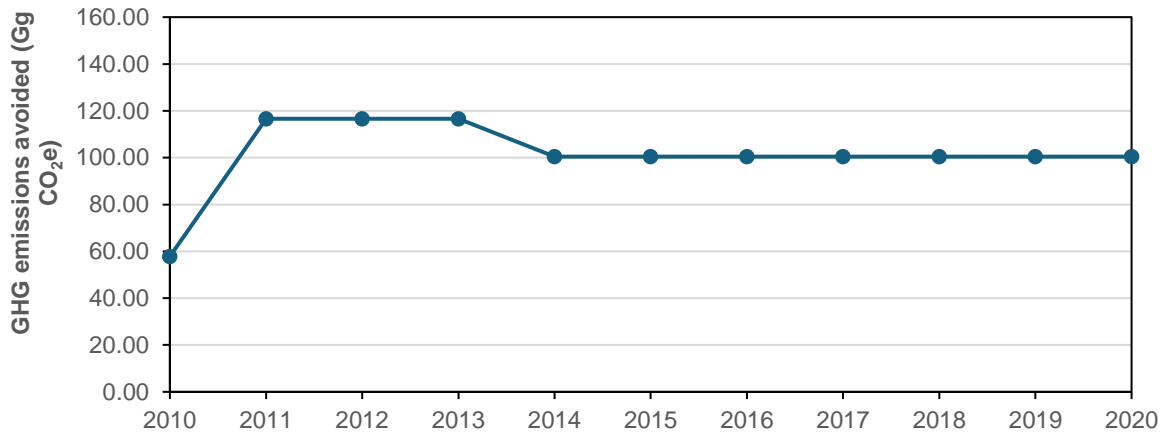


Figure 3-3: Annual emission reductions from GHG emissions avoided due to increasing renewable electricity generation capacity.

3.2.1.1.5 Methodologies and assumptions

Annual renewable electricity generation capacity statistics were collated from IRENA statistics as shown in Table 3-2. Capacity for renewable energy includes solar PV from 2015. Solid biofuels and diesel energy sources are emission sources.

Table 3-2: Installed electricity capacity by renewable technology in MW.

Year	Hydro	Solar PV	Solid biofuels
2010	60.9	0	61
2011	60.4	0	123
2012	60.4	0	123
2013	60.4	0	123
2014	60.4	0	106
2015	60.4	0.026	106
2016	60.4	0.126	106
2017	60.4	0.126	106
2018	60.4	0.126	106
2019	60.4	0.126	106
2020	60.4	0.126	106

3.2.1.1.6 General description of the monitoring and reporting system

- Annual renewable energy capacity installed per energy type in MW;
- CO₂e Southern African Power Pool combined margin emission.

3.2.1.2 Actions to improve electric energy efficiency for domestic use

Table 3-3: Overview of improving energy efficiency in the residential sector.

Scope; nature of action; and status	Duration	Implementing institution	Sector	Quantitative Goals	GHGs covered
Regulations and standards; implemented	1999-2030	MNRE	Energy efficiency	Reduce residential energy intensity (electricity) by 20% by 2030 relative to 2010 (MTE, 2021a). Achieve 100% access to cleaner energy at household-level by 2030.	CO2

3.2.1.2.1 Objective of the mitigation action

Promote greater electric energy efficiency amongst domestic consumers to improve affordability and increase the security of supply.

3.2.1.2.2 Description of steps taken or envisaged to achieve the action

Electricity energy efficiency and conservation measures are implemented which target residential electricity demand and consumption, lower energy use, and can, therefore, reduce GHG emissions. Important policy and regulatory milestones which support the implementation of energy efficiency and conservation measures include:

- The subsidy framework guidelines under the Electricity Act of 2007 were published in 2018 which establish cost-reflective pricing policies for all types of consumers which make energy affordable yet encourage conservation and efficient use of resources. The subsidy framework was adopted in 2020.
- The National Energy Policy and implementation strategy were updated in 2018, followed by the Energy Efficiency and Conservation Policy in 2019. An energy efficiency implementation strategy in the form of the National Energy Efficiency Strategy and Action Plan was published in 2020.
- Minimum Energy Performance Standards (MEPS) labelling is described as a short-term action in the National Energy Efficiency Strategy and Action Plan to promote the uptake of energy efficient electrical appliances in the residential sector. A detailed market review through the Climate Technology & Centre Network was completed to calculate the potential savings of implementing MEPS for lighting. Development and adoption of MEPS for

refrigerators and distribution transformers were set for 2020 but this is still ongoing.

- The Rural Electrification Access Fund Regulations were gazetted in 2021. The regulations will operationalise a funding programme to increase access to electricity in rural areas through a levy scheme of existing electricity tariffs.
- The Programme Framework for Affordable Renewable Energy in Swaziland (PARES) concept was published in 2018 (UNDP, 2018) and the programme aims to also support government actions to improve rural energy access but for both off-grid and on-grid renewable energy technologies.

The population relies on multiple fuel sources to meet its domestic and productive energy needs. In rural areas, biomass is used for cooking and heating, and candles, paraffin, and electricity for lighting. Approximately 90 per cent of total rural energy is provided by fuelwood. In urban areas, households rely less on biomass and more on electricity for lighting, heating, and cooking. Despite relatively good access to the electricity grid (estimated at 80 per cent for 2020), there is still large-scale use of biomass energy, which reflects the level of poverty and affordability of other energy sources.

3.2.1.2.3 Annual emission reductions from 2010 to 2020

The total annual emission reductions from GHG emission savings due to energy efficiency measures at household level range from 50 Gg CO₂e in 2010 to 60 Gg CO₂e in 2019 (Figure 3-4).

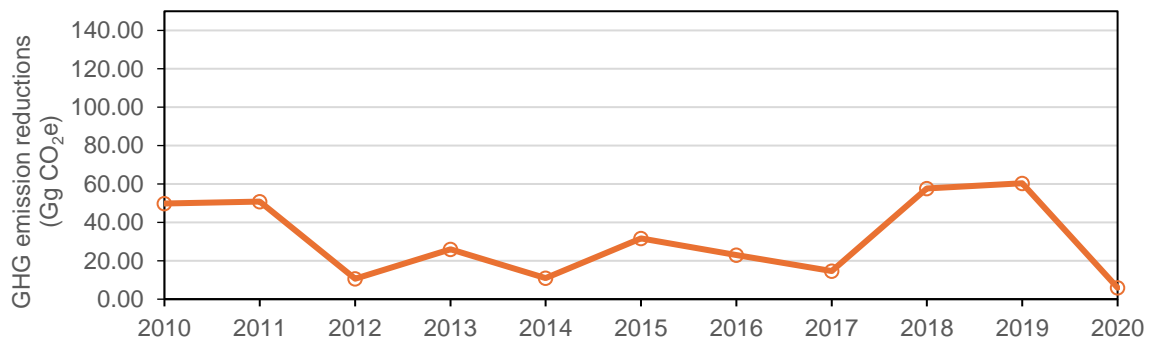


Figure 3-4: Annual emission reductions from overall demand side measures in households to improve electricity energy efficiency.

3.2.1.2.4 Methodologies and assumptions

The method used to estimate GHG emission reduction from energy efficiency measures was derived from SDG Indicator 7.3.1: Energy intensity measured in terms of primary energy and GDP (UNSD, 2022).

Residential electrical energy intensity is measured in terms of electricity demand and revenue generated from Eswatini Electricity Company electricity sales data. Electricity sales data collected from Eswatini Electricity Company Annual Reports for 2009- 2021 were published online. There are gaps in the data record for 1999 to 2006 Timeseries for energy intensity of residential electricity demand (Figure 3-5).

The CO2e Southern African Power Pool combined margin emission factor was applied to compute GHG emission savings.

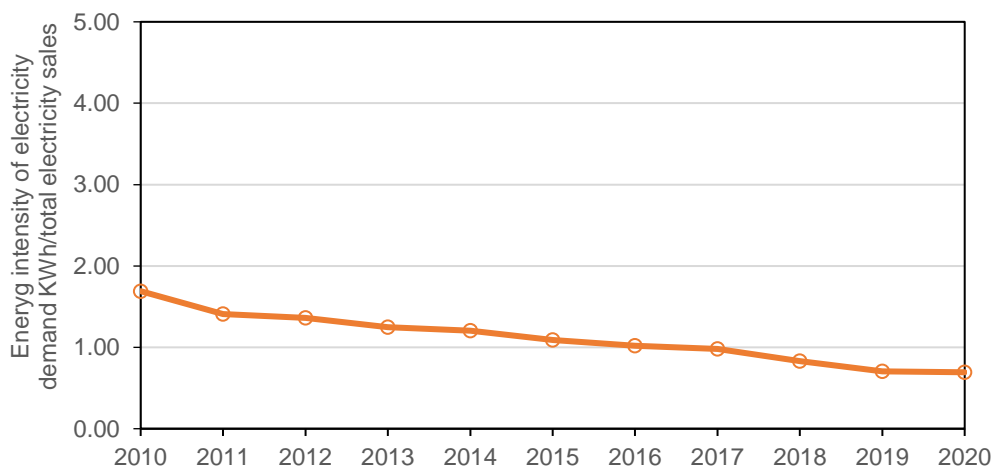


Figure 3-5: Energy intensity of domestic electricity demand between 2010 and 2020

3.2.1.2.5 General description of the monitoring and reporting system

- Annual electricity sales to domestic consumers in MWh;
- Annual electricity sales to domestic consumers in E;
- Total number of domestic consumers each year ;
- CO2e Southern African Power Pool combined margin emission factor.

3.2.1.3 Actions to improve energy efficiency in the commercial, manufacturing and agriculture sectors

Table 3-4: Overview of action to improve energy efficiency in the commercial, manufacturing sectors and agriculture sectors.

Name of the mitigation action	Scope; nature of action; and status	Duration	Implementing Institution	Sector	Quantitative Goals	GHGs covered

Improving energy efficiency in agriculture, commercial and manufacturing sectors	Regulations and standards; implemented	1999-2030	MNRE	Energy efficiency	<p>Reducing manufacturing energy intensity (electricity) by 5% by 2030 relative to 2010 (MTEA, 2021a).</p> <p>Reducing commercial and public energy intensity (electricity) by 3% by 2030 relative to 2010 levels (MTEA, 2021a).</p>	CO ₂
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3.2.1.3.1 Objective of the mitigation action

Implementation of energy efficiency policies, as well as the other conservation measures proposed will play a critical role in contributing to industrial productivity, global competitiveness of goods, and reduction of greenhouse gas emissions. Policy steps taken or proposed to achieve electricity demand side measures of improving energy efficiency are promoted in non-residential sectors. These contribute to reducing GHG emissions amongst bulk energy users.

Implementation of energy efficiency measures is ongoing. It is a focal area for action in the Energy Policy of 2018 and a key strategic fuel and energy objective of the NDS. The implementation strategy of the energy policy is aligned to the short to long term plans outlined in the National Energy Efficiency and Conservation Policy of 2019 through the National Energy Efficiency Strategy and Action Plan.

3.2.1.3.2 Annual emission reductions from 2010 to 2020

The annual emission reductions from energy efficiency measures in non-residential sectors range from 40 Gg CO₂e from agriculture to 130 Gg CO₂e in the commercial and industry sectors in 2010 (Figure 3-6).

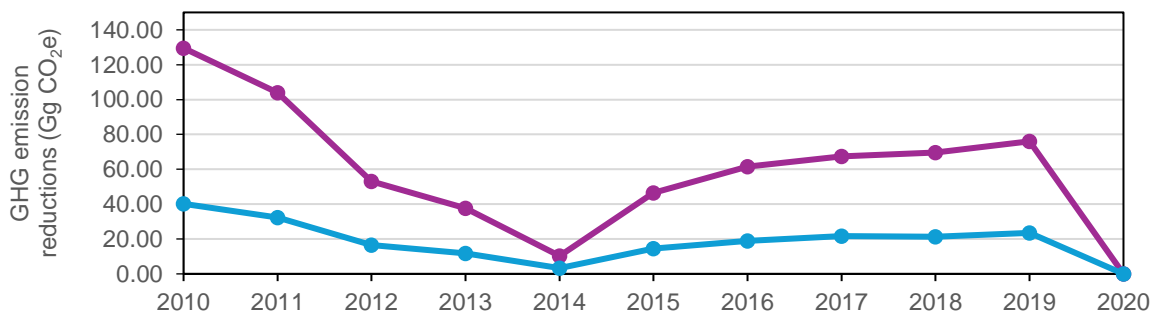


Figure 3-6: Annual emission reductions from overall demand side measures in non-residential sectors to improve energy efficiency.

3.2.1.3.3 Methodologies and assumptions

Non-residential electrical energy intensity is measured in terms of electricity demand and revenue generated from Eswatini Electricity Company. Electricity sales data were collected from Eswatini Electricity Company Annual Reports for 2009 – 2021 that were published online. There were gaps in the data record for 1999 to 2006. Interpolation was used to fill in the gaps in the timeseries for the energy intensity of non-residential electricity demand between 2010 and 2021 (Figure 3-7). The CO₂e Southern African Power Pool combined margin emission factor was applied.

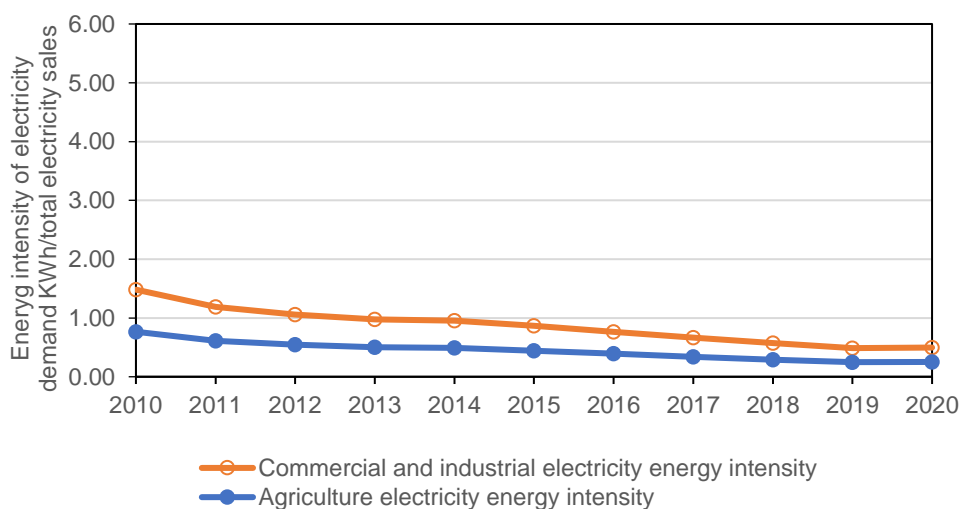


Figure 3-7: Energy intensity of commercial, industrial and agriculture electricity demand between 2010 and 2020.

3.2.1.3.4 General description of the monitoring and reporting system

- Annual electricity sales to non-residential consumers in MWh;
- Total number of non-residential consumers each year;
- CO₂e Southern African Power Pool combined margin emission factor.

3.2.2 IPPU

Although the IPPU sector contributes to only 1% of Eswatini's emissions, the country still intends to set a relative GHG target to achieve net emissions reductions of 5.96 Gg CO₂e by implementing the Kigali Amendment to the Montreal Protocol to reduce HFC usage (Table 3-5). Refrigeration and air-conditioning product use contributes to the highest emissions in the sector and hence mitigation actions are focused towards improving their usage (Figure 3-8). The emissions of HFCs are expected to increase until they reach a peak in 2028, then gradually reduce. After 2031, emissions should

only come from HFCs in equipment already in use/manufactured. The growth of GHG emissions from refrigeration and air conditioning is indicated in Figure 3-8 for the period of 2000 to 2021.

Additional mitigation opportunities which have not been assessed through mitigation potential analysis are associated with upgrading value chain participation by moving up-market from low-technology activities and/or developing or expanding the service sector value chains, particularly for:

- Sugar;
- Meat products (poultry and beef);
- Dairy products;
- Other food and drinks;
- Horticulture (Fruits, Vegetables and Flowers);
- Forestry – Timber and non-timber forest products (medicinal, cosmetics, essential oils, and other herbal products);
- Coal;
- Ferrous Minerals (Iron/Steel);
- Leather, Leather Goods and Footwear;
- Clothing and Textiles.

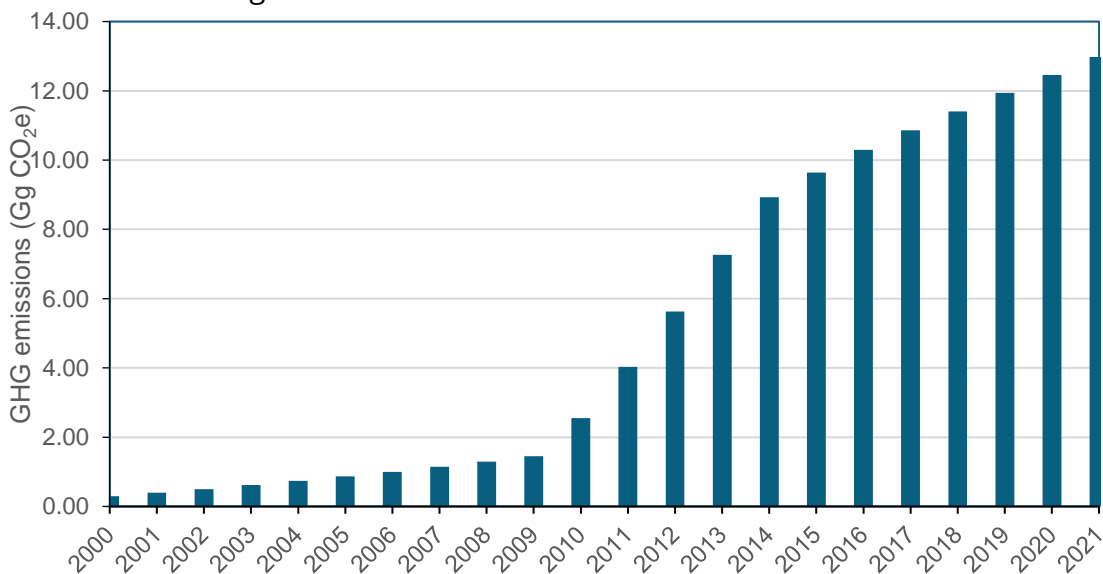


Figure 3-8: GHG emissions from HFC usage in Refrigeration and air-conditioning.

3.2.2.1 IPPU sector actions to mitigate climate change

Table 3-5: Overview of IPPU sector actions to mitigate climate change.

Name of the mitigation action	Scope; nature of action; and Status	Duration	Implementing Institution	Sector	Quantitative Goals	GHGs covered

Reducing synthetic GHG emissions in the public and private sector	National; voluntary national targets; Regulations and standards; planned for implementation	2024 - 2030	EEA	Product Use	Decrease consumption of HFCs by 80% of baseline levels by 2045 (UNEP, 2016)	HFCs
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3.2.2.2 Objective of the mitigation action

To gradually reduce the use of HFCs by 80% by the late 2040s and thus developing the value chain for alternative zero global warming potential (GWP) gases in the country.

3.2.2.3 Description of steps taken or envisaged to achieve the action

The country is part of the group of A5 (developing countries) Group 1 which have the flexibility to prioritize HFCs, define sectors, select technologies and alternatives, and design and implement their own strategies for HFC phase-down. These countries also have the flexibility to freeze HFC growth in 2024 relative to baseline levels and to begin reducing product use from 2029 with a 10% reduction and an 80% reduction in 2045. The baseline is calculated from the average product use in 2020, 2021, and 2022 plus 65% of this average.

Steps taken and planned as part of building capacity to initiate enabling activities for the HFC phase-down:

1. The Kigali Amendment was ratified in 2020.
2. The current data reporting and inventory system for HFCs was reviewed as part of the Climate Action Enhancement Programme (CAEP) of the NDC Partnership in 2021.
3. The review of licensing and quota systems indicates that these are operational with 2022 being the date the HFC licensing system was last reported.
4. Institutional arrangements were reviewed and the Ozone Depleting Substance Regulations of 2003 were amended in 2014 to cover the HCFC baseline freeze of 2013. However, further revisions are planned to cover the commitments under the Kigali Amendment.

3.2.2.4 Development Progress

- Training of Customs and other border enforcement agencies: Capacity building for 150 Customs officers undertaken; ODS issues incorporated into customs protocols.
- Strengthening of technical colleges and Refrigeration Association: The Eswatini National Refrigeration Association was formed at a training workshop for refrigeration technicians held from the 22nd to 26th August

2011 at Manzini Industrial Training Centre (MITC), Manzini. The role of the association is envisaged to organize the profession of refrigeration; assist the National Ozone Unit in data collection in the refrigeration sector; raise awareness of their members on the harmful effects of refrigeration ODS on human health and the environment; strengthen the capacity of refrigeration sector to reduce emissions and consumption of ODS and participate in the implementation of policies, strategies, programs and projects for the implementation of the Montreal Protocol.

- Three vocational training institutions: Gwamile Vocational and Commercial Training Institute, Manzini Industrial Training Centre, and Eswatini College of Technology were identified to serve as referral centres for training of technicians, and management of sets of equipment for the technicians in the country. They are also used to collect data on ODS consumption. UNEP and UNDP have been strengthening these institutions through the provision of equipment.
- Training of refrigeration technicians: EEA has trained 200 service technicians on good refrigeration practices in the country and continues to do so every year to build capacity. These technicians are from the formal and informal servicing sector throughout the country. With the high number of refrigeration technicians, and the expanding of the refrigeration industry, continuous training to sustain the ODS phase out is being done.
- Conversion of HCFC141b Palfridge Ltd completed: Palfridge is a manufacturer of domestic and commercial refrigerators. Palfridge Limited has phased out the use of HCFC 141b in its polyurethane insulation foam production for domestic and commercial refrigerators. The company completed the project of transitioning from refrigerants HCFC22 and HFC 134a to isobutene and propane refrigerants at Palfridge.

3.2.2.5 Annual emission reductions from 2010 to 2020

Annual GHG emission reductions from HFCs from 2010 to 2020 is 0 Gg CO₂e.

3.2.2.6 Methodologies and assumptions

In Eswatini, F-gases are mainly used as refrigerants in air-conditioning and refrigeration. There is only one refrigeration manufacturing company (Palfridge Ltd) and there is no company that manufactures air-conditioners; hence refrigerator manufacturing data were easily obtained from Palfridge. Eswatini Revenue Authority data on the import of refrigerators and air-conditioners were obtained and used to calculate the number of refrigerators and air conditioners in the country. There are several fridge and air-conditioning installation and servicing companies. This data is important to calculate the quantity of F-gases in equipment using a charge value obtained from Palfridge.

In addition, emissions also occur during servicing. There are many companies that service refrigerators and air-conditioners in Eswatini. These companies import the required refrigerants, which include ODS alternatives, into the country because they are not manufactured locally. The manufacturing company and some of the servicing companies import the ODS alternatives. A few companies import and distribute HFCs to local customers. Data on imports was obtained from a national report on the inventory of ODS alternatives in Eswatini done under the Montreal Protocol. This data was then extrapolated to cover the required time series.

Assumptions:

- ODS alternatives were introduced in the early 1990s in Eswatini, around 1995.
- Their use increased gradually from then until recently where it has slowed down.
- Most of the use of these alternatives imported are for servicing already in-use equipment as the refrigeration company has reduced the amount of ODS alternatives used.
- The life span of both refrigerators and air-conditioners was assumed to be 15 years.
- For the aerosols, the data was not included as there was no reliable data that could be obtained.

3.2.2.7 General description of the monitoring and reporting system

Key indicators for monitoring and reporting are under-development as part of revisions to national regulations for ODS.

3.2.3 Waste

Eswatini has set a relative GHG target of reducing emissions by 16% in 2030 compared to the 2010 baseline scenario through improvements in waste treatment and landfilling across urban and rural areas. The mitigation actions identified for the Waste sector have emerged from the 'Draft Waste Strategy' which has identified improvement in the collection process as an essential strategy to curb emissions from open burning of waste.

The following mitigation actions have been identified as implemented in the Waste sector (Table 3-5 and Table 3-6) which are directly linked to the NDC mitigation measure to reduce GHG emissions in the Waste sector:

- Avoiding, minimizing, and recycling solid waste;
- Improving wastewater treatment and control through expanding sanitation coverage.

Several progressive measures are being considered by the government to introduce sustainable waste management practices through enhanced policies such as the National Solid Waste Management Strategy (NSWMS), the Waste Regulations Act of 2000, revision of the Environmental Management Act (EMA) of 2002, national level initiatives such as 'Clean Eswatini Campaign', amongst others. The Climate Change Policy of 2016 mentioned the following actions in waste management for low carbon development including:

- Increase rates of:
 - waste minimization;
 - recycling;
 - waste-to-energy;
- Implement affordable, effective, sustainable, and integrated waste management strategies;
- Enhance home composting at household level to turn generated waste into useful rich compost for vegetable gardens and agriculture;
- Improve the management of existing waste disposal facilities to control GHG emissions.

The key tool for implementing waste management in Eswatini is the NSWMS. The strategy gives effect to the Environmental Management Act of 2002 and the Waste Regulations Act of 2000. It details the goals and action points for all relevant government agencies for adopting and implementing a holistic approach to waste management. Most importantly, EMA of 2002, Waste Regulations of 2000 and the NSWMS together mandate all municipalities and regions to develop an 'Integrated Waste Management Plan (IWMP)' for efficient on-ground waste management.

The Waste Regulations Act of 2000 provides the regulatory framework for managing waste in the country. The Regulations introduce instruments, such as waste management licensing and controls, waste management services, remediation of contaminated land, national waste information system, and compliance and enforcement mechanisms to enforce effective waste management.

The Waste Regulations Act of 2000 outlines the duties and responsibilities of relevant stakeholders such as EEA, local authorities, and waste generators and waste service providers (recyclers, sorters). The responsibility for waste management is divided among different line ministries which are responsible for regulating waste management within their legal jurisdictions. The Ministry of Health (MoH) is responsible for monitoring and control of biomedical waste generated from hospitals, health centres, clinics, and medical retailers. The Ministry of Housing and Urban Development (MHUD) is the principal national agent for supervising household and commercial waste under the auspices of urban local government bodies such as city councils, town councils, and town boards.

3.2.3.1 Waste sector action: avoiding, minimizing and recycling solid waste actions to mitigate climate change

Table 3-6: Overview of avoiding, minimizing, and recycling solid waste actions to mitigate climate change.

Name of the mitigation action	Scope; nature of action; and status	Duration	Implementing institution	Sector	Quantitative Goals	GHGs covered
Avoiding, minimizing, and recycling solid waste	Regulations, Research, development, and deployment policies	2000-2030	EEA	Solid waste	SDG 12.5. Quantitative goal to be determined in forthcoming National Solid Waste Management Strategy Capturing 30% of the organic waste generated within the country by 2030 (MTEA, 2021a)	CH ₄

3.2.3.1.1 Objective of the mitigation action

Increasing integrated waste management practices represents a move away from waste management via impact management to a proactive management system which focuses on waste prevention, minimization, and recovery to move towards a circular economic model for waste management.

3.2.3.1.2 Description of steps taken or envisaged to achieve the action

By 2030, Eswatini aims to substantially reduce waste generation through prevention, reduction, recycling, and reuse. Key policies for governing waste management in Eswatini include the Environmental Management Act (EMA) of 2002, the Waste Regulations Act of 2000, and the NSWMS.

Part VI of EMA lays down provisions for effective waste management in the country, to protect health and environment by providing for institutional arrangements for the same. The Waste Regulations Act of 2000 provides the regulatory framework for managing waste in the country. The Regulations introduce instruments, such as waste management licensing and controls, waste management services, remediation of contaminated land, national waste information system, and compliance and enforcement mechanisms to enforce effective waste management. The Regulations also lay down the duties and responsibilities of relevant stakeholders such as EEA, local authorities, waste generators and waste service providers (recyclers, sorters).

3.2.3.1.3 Development Progress

- Enforcement of regulations has been weak. As a result, existing recycling activities are mainly undertaken in the informal economy.
- The waste information system is not in place. Most cities started collecting

waste activity data up to 3 years ago. The historical record for solid waste management data is, therefore, very limited.

- Composting is mostly practiced at domestic level and rarely documented. Looking at the domestic and commercial composting activities, only the Municipal Council of Mbabane is known to practise food waste composting through a European Union funded program called the Mbabane Municipal Council - European Union Project on Waste Minimization and Management Initiatives that started in 2018.
- Data reported online for recycling activities in urban areas suggest that these activities started in Mbabane from 2012, Manzini from 2020, and Matsapha from 2017.

3.2.3.1.4 Annual emission reductions from 2010 to 2020

GHG emission reductions from food waste composting and paper recycling and wood-waste reclamation are observed to pick up from 2018 onwards. Food waste composting emission reductions increase from 0.08 Gg CO₂e in 2018 to 0.43 Gg CO₂e in 2020. Paper recycling and wood-waste reclamation emission reductions increase from 0.10 Gg CO₂e in 2018 to 0.61 Gg CO₂e in 2020 (Figure 3-9).

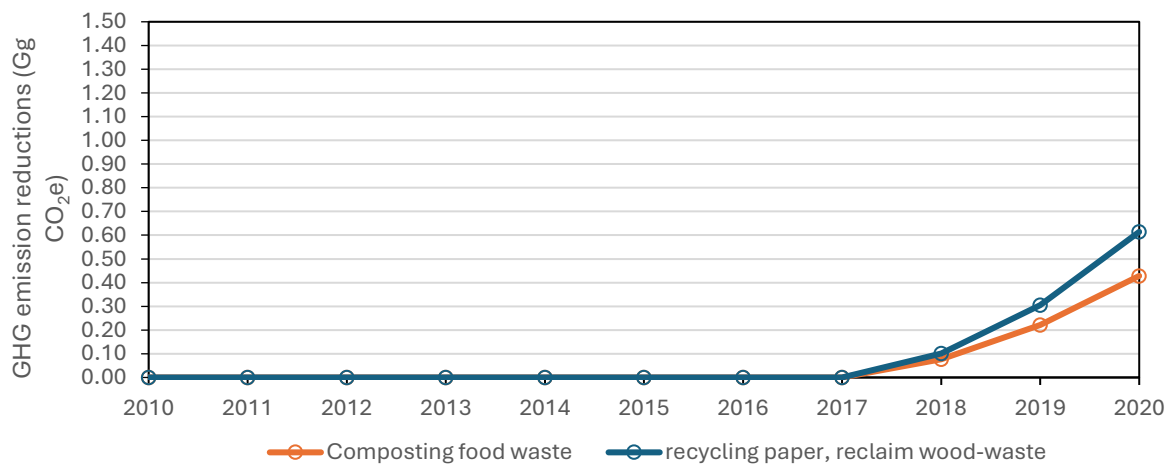


Figure 3-9: Annual emission reductions from food waste composting, paper recycling and wood-waste reclamation.

3.2.3.1.5 Methodologies and assumptions

The methodology used was the 2006 IPCC waste model based on the following assumptions;

- GWP value for CH₄ applied was from the SAR;
- Historical population and projections for baseline and policy scenario were

the same as that used in the 2018 GHG inventory;

- No methane recovery factor is applicable to any of the landfills in Eswatini;
- Total solid waste generated is extrapolated based on 2016 and 1996 data to calculate waste generation per capita;
- It is assumed that for waste management activities after 2016 in the baseline scenario that the fractions of waste disposed, recycled and burnt remain the same as 2016 as these are the latest reported values for Eswatini;
- Total solid waste generated in 2016: 238,341 tonnes (Dlamini et al. 2017);
- Total waste generated in 1996: 86,323 (Swaziland Government, 2000);
- Fraction of waste generated that is disposed into landfill in 2016: 0.26 (Dlamini et al. 2017);
- Fraction of waste generated that is recycled in 2016: 0.29 (Dlamini et al. 2017);
- Fraction of waste generated that is burnt in 2016: 0.45 (Dlamini et al. 2017);
- It is assumed that the waste disposal and burnt fractions are capped at 0.71 and 0.29 respectively, as there are no earlier reported values for Eswatini;
- Fraction of waste generated that is disposed into landfill in 1991: 0.71 (Ohnesorgen, 1991);
- Fraction of waste generated that is burnt in 1991: 0.29 (Ohnesorgen, 1991).

3.2.3.1.6 General description of the monitoring and reporting system

Minimum requirements for country specific activity data to be used in the IPCC Waste Model are as follows;

- Historical population and projections;
- Quantities of waste generated by the population in tonnes;
- Fraction of waste generated that is disposed into landfill or dumpsites;
- Fraction of waste generated that is recycled;
- Fraction of waste generated that is burnt;
- Fraction of waste generated that is food waste, garden waste, paper, wood, plastic, metals, glass, industrial, and construction waste.

3.2.3.2 Improving sanitation coverage that co-benefits for mitigation

Table 3-7: Improving sanitation coverage that has co-benefits for mitigation.

Name of the mitigation action	Scope; nature of action; and status	Duration	Implementing institution	Sector	Quantitative Goals	GHGs covered
Reduce CH4 emissions from wastewater	Regulations, Research, development, and deployment policies	1969-2030	MNRE and MoH	Sanitation	SDG 6.2	CH4

3.2.3.2.1 Objective of the mitigation action

To ensure safe management of human excreta, urine, faecal sludge, and wastewater from domestic, industrial, and institutional origins along the value chain.

3.2.3.2.2 Description of steps taken or envisaged to achieve the action

Eswatini aims to expand access to improved sanitation facilities to 100% of the population including latrines, septic tanks, sewerage, and wastewater treatment technologies.

An improved sanitation facility is defined as one designed to hygienically separate human excreta from human contact. Improved sanitation facilities include wet sanitation technologies such as flush or pour flush toilets connected to sewer systems, septic tanks, or pit latrines; and dry sanitation technologies such as dry pit latrines with slabs (constructed from materials that are durable and easy to clean), ventilated improved pit (VIP) latrines, pit latrines with a slab, composting toilets, and container-based sanitation.

However, for sanitation projects to have mitigation impact there needs to be greater household access to treated wastewater systems in urban areas. Therefore, mitigation is a co-benefit for improved sanitation coverage as an adaptation action, and it is more likely for emission reductions to be lower since there is greater government prioritization of increasing rural sanitation access.

The relevant existing legal and regulatory instruments that frame the development of the sector are listed below:

- Eswatini Water Act, 2003;
- Public Health Act, 1969. This act is currently being refined and updated;
- Environment Management Act, 2002;
- Water Services Corporation Act, 1992;
- Wastewater Regulations, 2000;
- Water Pollution Control Regulations, 2010;
- Eswatini National Sanitation and Hygiene Policy, 2019.

Roles and responsibilities are relatively well distributed amongst several institutions. However institutional leadership, institutional cooperation, and coordination are not fully defined, and enforcement of policies, standards, and laws remains an issue. The present roles distribution is as follows:

- MoH-Environmental Health Department: Responsible for the coordination of the overall sanitation and hygiene sector. It elaborates strategic

documents and guidelines and monitors the sector. It mainly focuses on the development of rural sanitation, such as promotion of adequate hygiene practice and behaviour change and support for the construction of individual sanitation facilities. It provides subsidised material and equipment to rural communities as well as provision of temporary toilet for special events.

- EHD regional units: Provide faecal sludge emptying service mainly in the small and medium size towns where there is a need for septic tank desludging. Provide training and technical support to rural communities to increase access to improved sanitation facilities and services.
- MNRE-DWA: The Department of Water Affairs (DWA) of the Ministry of Natural Resources and Energy (MNRE) is responsible for supplying water in rural areas and to a lesser extent coordinating and improving the link between water supply projects and sanitation development.
- MHUD-DUG: According to the MHUD portfolios, the Department of Urban Government (DUG) is responsible of urban local government administration, infrastructure development and maintenance, refuse collection and disposal, building plans approvals and vacuum tanker services (including sewerage disposal).
- Municipal Councils (Mbabane and Manzini): Provide faecal sludge emptying service and public toilet service; in a few cases the service is outsourced to the private sector. Promotion of individual sanitation and hygienic practices within town boundaries. Enforcement of sanitation and hygiene practice. Issue construction permit.
- Town Councils and Rural Growth Centres: Enforcement of sanitation and hygiene practice. Issue construction permit.
- NSTWG: The National Sanitation Technical Working Group (NSTWG) is a temporary structure to support the development of the National Sanitation and Hygiene Strategy. Its role was extended to support the development of the NSHP and the Sanitation Regulatory Framework. It is composed of key ministries, municipalities, public agencies, international organizations, development partners, and NGOs.
- EWSC: The Eswatini Water Services Corporation (EWSC) is accountable for the provision of sewerage services as well as wastewater and faecal sludge treatment in urban areas throughout the country. It defines sewerage and treatment tariffs.
- The EEA: regulates and enforces sewerage services and develops effluent discharge standards. It also reviews and approves ESIA and enforces mitigation plans.
- Development partners: Capacity building and development of strategic documents at national level. Involved in the provision of equipment and facilities to rural communities.
- Private sector: Provision of faecal sludge emptying service, operation of public toilet and provision of temporary toilets for special events, construction, and operation of wastewater treatment package plants.
- WatSan Committees: Operate and maintain water points through elected

WASH committees.

3.2.3.2.3 Development progress

- 86% of the population had access to improved sanitation facilities in 2020 compared to 70% in 2000.
- 4% of the total population did not have access to any sanitation facilities and use open defecation in 2020.
- Most urban areas are partially covered by a sewer network. There are 24 sewerage systems including wastewater treatment plants in the country. These systems collect grey water, black water, and industrial wastewater, but do not collect rainwater. The total population connected to a sewer line is about 12,000 units (or about 60,000 equivalent-persons) including households, commercial buildings, public buildings, and industries. Treatment technologies used in Eswatini are waste stabilization ponds, vertical constructed wetlands (or reed beds), activated sludge, trickling filter, chlorination, etc.
- In urban areas, most inhabitants rely on flush toilet either to a piped sewer system or a septic tank with a soak pit. In peri-urban, rural areas, and informal settlements, the population mainly uses septic tanks, VIPs, and pit latrines.

3.2.3.2.4 Annual emission reductions from 2010 to 2020

Figure 3-10 indicates that annual emission reductions from sanitation improvement declined from 2010 to 2020 as household access to flush toilets and treated sewerage drops over this period overall relative to septic tanks and latrines for which effluent does not enter wastewater treatment.

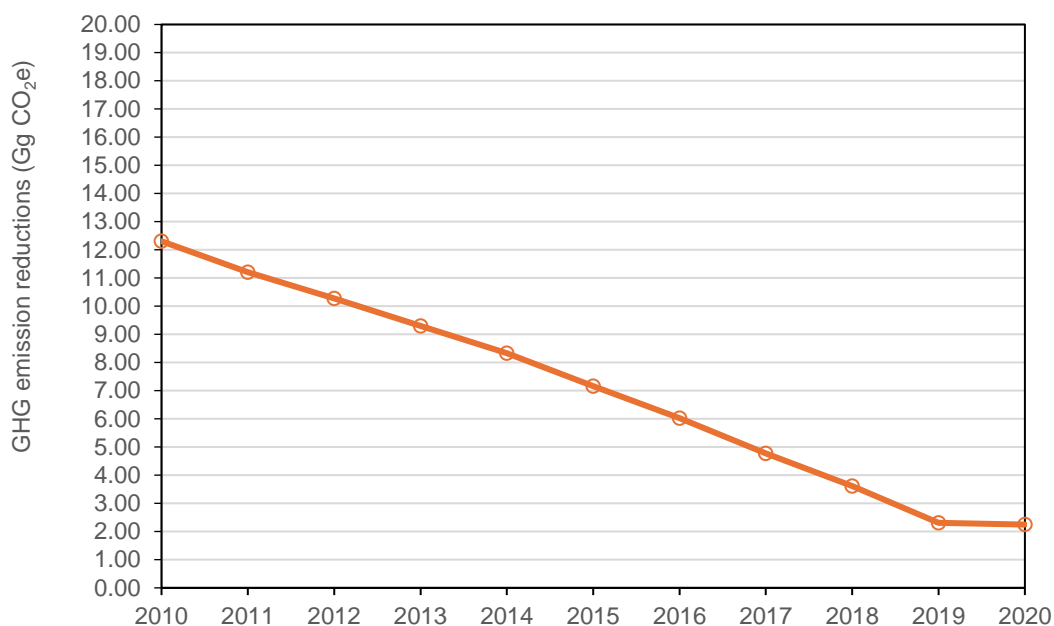


Figure 3-10: Annual emission reductions from improving sanitation coverage in wastewater handling.

3.2.3.2.5 Methodologies and assumptions

The methodologies are based on the existing wastewater handling worksheet for the 2018 GHG inventory. Population estimates are the same as the estimates used in GHG inventory.

Extrapolated fractional urban rural population by income for the period 1990 to 2021 is based on:

- Swaziland Demographic and Health Survey 2006-07;
- Swaziland Multiple Cluster Indicator Survey (MICS) 2014;
- Eswatini Household Income and Expenditure Survey 2016/17.
- Extrapolated fractional urban rural population by income degree of utilisation of treatment/discharge pathway system for the period 1990 to 2021 based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene estimates for 2000 to 2020.

The methane correction factors applied were the same as the factors applied in the GHG inventory. The GWP applied for CH₄ is from the SAR.

3.2.3.2.6 *General description of the monitoring and reporting system*

Minimum requirements for country specific activity data to be used in the wastewater handling worksheet include:

- fractional urban rural population by income;
- fractional urban rural population by income degree of utilisation of treatment/ discharge pathway system.

3.2.4 AFOLU

There is far more potential to reduce emissions in forestry and sustainable land management activities, compared to the livestock sector which was the initial focus for the mitigation assessment. In the case of the AFOLU sector, the government's plan to increase productivity of livestock is leading to an increase in emissions by 15% in 2030 as compared to the baseline scenario. The reason for this increase is due to the improvement in fertility rates, animal weights, and mortality parameters because of the projected increase in the quantity of livestock available within the country in 2030.

As such, forestry and sustainable land management activities offer more effective mitigation opportunities. This can support the broader national environmental and climate change adaptation agenda, which benefits communities and contributes towards the national environmental management goals. These actions are summarised in Table 3-7 and Table 3-8.

The UNFCCC convention as well as the United Nations Convention to Combat Desertification (UNCCD) were ratified in 1996. The following year, several major milestones were achieved regarding signing of soft laws. The Flora Protection Act was gazetted in 1997 and the Swaziland Environment Action Plan was also developed that year. In year 2000, the National Environment Policy was approved, and a National Greenhouse Gas inventory was completed. In 2001, The National Action Programme of the Convention to Combat Desertification was approved. In year 2002, the National Forest Policy, the Swaziland Biodiversity Strategy and Action Plan were approved, and the Environment Management Act was gazetted in the same year. In 2003, the National Forestry Programme was implemented.

The following are additional policies in the AFOLU sector:

- Private Forests Act 1951;
- Grass Burning Act 1955;
- Dairy Act 1968;
- Veterinary Public Health Act 2013;
- Comprehensive Agriculture Sector Policy;
- The Food Security Policy;
- Livestock Development Policy;
- Irrigation Policy;

- Rural Resettlement Policy;
- Fisheries Policy;
- National Agricultural Research Policy.

3.2.4.1 Forestland and grassland

Table 3-8: Forestland and grassland land cover change.

Name of the mitigation action	Scope; nature of action; and status	Duration	Implementing Institution	Sector	Quantitative Goals	GHGs covered
Forestland and grassland land cover change	National; voluntary agreements or measures; Research, development, and deployment policies; under implementation	2002 - 2030	Ministry of Agriculture; Ministry of Natural Resources and Energy	Forestry	By 2030, increase forest cover through reforestation and agroforestry in existing forests; increase areas of shrubs/grassland; wetlands and croplands by 465,290 ha (MA, 2017). Achieve zero forest loss by 2030 (MA, 2017) Improve by 50% productivity and SOC stocks in cropland and grasslands by 2030. Increase by 10% net land productivity in all land cover categories through SLM practices by 2030	CO ₂

3.2.4.1.1 Objective of the mitigation action

To reduce land degradation on forestland and grasslands through reforestation, afforestation, and grassland restoration projects for sustainable livelihoods.

3.2.4.1.2 Description of steps taken or envisaged to achieve the action

The country aims to reduce GHG emissions in the FOLU sector by combating land degradation of forestland and grasslands. The NDS revision, 2014, recognizes the essential role of the National Biodiversity Strategy and Action Plan (NBSAP) in reversing or halting the alarming loss of biodiversity and the associated impacts. Eswatini prepared its first NBSAP in 2001; however, implementation has been limited and challenged by several factors including mainstreaming of the NBSAP into the National Development and Economic Planning Processes.

The second National Biodiversity and Action Plan (NBSAP 2) has been prepared in a highly participatory and consultative manner involving multiple national stakeholders. Several consultative meetings were held throughout the various stages of the development of the strategy. Stakeholders made inputs and validated several

reports throughout the various stages. A national think-tank of local experts involved in biodiversity issues also met on several occasions to deliberate on specific technical biodiversity issues. Special stakeholder groups, for example chiefs, were consulted at special regional workshops. Consultations were held with experts in South Africa to ensure adequate coverage of both local and regional biodiversity issues. Building from the lessons learnt from the implementation of the first NBSAP as well as from the national prioritization exercise, the NBSAP 2 has been formulated to capitalize on the following issues:

- Improving the status of the country's biodiversity by monitoring, reduction of threats and pressures, safeguarding ecosystems and encouraging sustainable utilization.
- Generation of reliable information and data for continued monitoring of the status of biodiversity.
- Mainstreaming and integration of biodiversity into national plans and strategies and contribute to the National Development objective.
- Building and strengthening human capacity in all aspects pertaining to conservation and management of biodiversity.
- Strengthening the existing legislative and policy framework to improve the management and sustainable use of biodiversity and ecosystem.
- Exploitation of synergies with other Multilateral Environmental (MEAs).
- Increasing awareness on biodiversity to the citizenry of Eswatini.

The forestry sector are articulated in the National Forest Policy (NFP), 2002 (MoA, 2002). The vision of the NFP is "to achieve efficient, profitable and sustainable management and utilisation of forest resources for the benefit of the entire society, and to increase the role of forestry in environmental protection, conservation of plant and animal genetic resources and rehabilitation of degraded land". Actions are pursued across four strategic areas including natural forest and woodland management; community forestry (woodlots, wattle, and agroforestry); urban forestry; and industrial forestry.

The National Forest Policy (NFP) 2002 represented the first step in the development of a comprehensive forestry sector level policy and legislative framework. The NFP is linked to the overarching NDS, as are the draft National Land Policy (NLP), draft National Environmental Policy (NEP) and the 1997 Swaziland Environment Action Plan (SEAP). As such the broader policy context was considered when framing the vision of the NFP. The NFP has given guidance to developing forest management regulations and the draft forest bill which is currently under revision with UNDP's support and in consultation with relevant stakeholders.

International commitments reinforce implementation for sustainable forest management, with the country having ratified conventions such as the Convention on Biodiversity (CBD) of 1992, United Nations Framework Convention on Climate Change (UNFCCC) of 1996, United Nations Convention to Combat Desertification (UNCCD) of

1994 - and Land Degradation Neutrality Target Setting Programme - and the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) of 1973.

3.2.4.1.3 Annual emission reductions from 2010 to 2020

The total annual emissions reductions from forest and grassland restoration actions increased from 584 Gg CO₂e in 2010 to 1367 Gg CO₂e in 2020 (Figure 3-11)

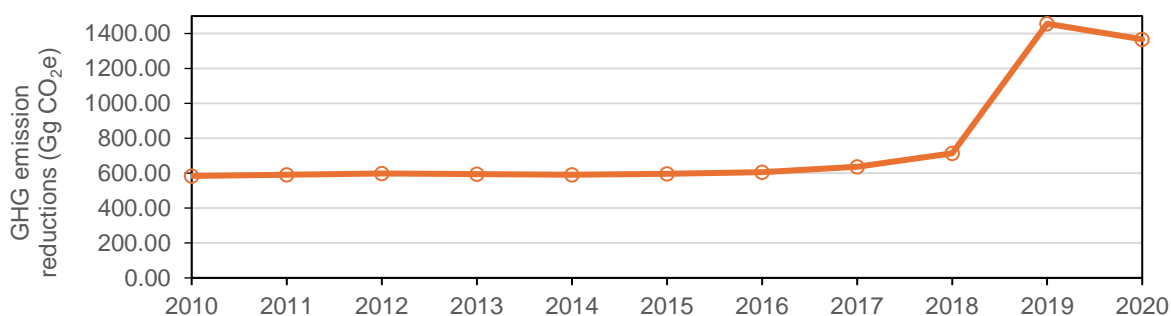


Figure 3-11: Annual emission reductions from forest and grassland restoration actions.

3.2.4.1.4 Methodologies and assumptions

Annual emission reductions due to land cover change were informed by land cover change analysis using HYBMAP data (Zhu et al. 2022) and adjusted based on the GHG inventory. Mitigation potential emission intensities applied were from DEA (2015).

3.2.4.1.5 General description of the monitoring and reporting system

- Annualised area of land cover change conversions and land remaining the same land cover type;
- Annualised land use emission intensities of reforestation, afforestation, grassland conversion, and restoration based on existing land cover data.

3.2.4.2 Climate smart agriculture

Table 3-9: Climate smart agriculture.

Name of the mitigation action	Scope; nature of action; and status	Duration	Implementing institution	Sector	Quantitative Goals	GHGs covered
Climate smart agriculture	National; voluntary agreements or measures; Research, development, and deployment policies; under implementation	2002 - 2030	Ministry of Agriculture; Ministry of Natural Resources and Energy	Agriculture	Improve by 50% productivity and SOC stocks in cropland and grasslands by 2030 as compared to 2015 (MA, 2017). Rehabilitate 115,000 ha of degraded and abandoned land for crop production by 2030 (MA, 2017). Increase by 10% net land productivity in all land cover categories through SLM practices by 2030	CO ₂

3.2.4.2.1 Objective of the mitigation action

To promote sustainable agrarian livelihoods through sustainable land management practices including climate smart agriculture.

3.2.4.2.2 Description of steps taken or envisaged to achieve the action

Climate smart agriculture is articulated in several national policy documents – including the National Strategic Development Plan (2018/19-2022/23), the Comprehensive Agricultural Sector Plan (CASP) (2005), National Drought Plan (2020), and the National Agricultural Investment Plan (2015). As indicated in the Ministry of Agriculture's Strategic Plan (2020), at the centre of the programme is the organisation of systems for transformative change in Eswatini's smallholder agriculture and allied sectors through catalytic private investment in agricultural and food sectors and in

associated services industries—along agricultural value chains. This includes supporting small-scale food producers to adopt inclusive climate resilient value chain approaches in agriculture and allied sectors.

Agroforestry is a suite of agricultural land practices that integrate the cultivation of crops or livestock with trees and shrubs on the same piece of land with the NFP being the primary policy driver. The actions are prioritised in the NFP for the sustainable utilisation, development and management of forest resources that helps to improve livelihoods and tenure while conserving biodiversity and achieving a balance between forestry and other uses of land and water resources.

3.2.4.2.3 Development progress

Eswatini Water and Agriculture Development Enterprise (ESWADE) has built the capacity of farmers on climate-smart agriculture practices, which have subsequently enhanced the adoption of sustainable agriculture. The organization has further promoted land rehabilitation, ecosystem restoration, and the sustainable use of water through various interventions that engage communities. Several other projects have been initiated, including the Lower Usuthu Sustainable Land Management Project (whose objective is to decrease biodiversity loss), Komati Basin Water Authority, Komati Downstream Development Project, and Lower Usuthu Smallholder Irrigation Project.

Through ESWADE, the Kingdom of Eswatini has facilitated the development of over 10,000 hectares with irrigation infrastructure to enhance farmers' resilience to climate change. A new phase is underway in the Lower Usuthu where over 5,000 hectares are being developed with irrigation infrastructure and is expected to be in full production by 2023. The country and the host communities for these projects have experienced significant transformation of their economies through direct earnings from the agriculture enterprises, and they also realized significant benefits from indirect positive externalities such as employment opportunities.

Eswatini's National Agriculture Marketing Board (NAMBOARD) has implemented the Climate-Smart Market-Oriented Agriculture Project that supports farmers with climate-smart agriculture techniques. The Climate-Smart Market-Oriented Agriculture Project is supporting farmers' irrigation schemes, such as Mavulandlela under Ntfontjeni Inkhundla in the Hhohho region and Intamakuphila under Ngwempisi Inkhundla in the Manzini region, to create jobs for several Emaswati, with an emphasis on opportunities for women and youth. These schemes, for example, are focused on producing baby vegetables for the export market but also encourage the growth of conventional vegetables during the off-season period. However, a lack of capacity has meant a slow adoption of climate-smart agriculture practices by farmers and not all are reaping the rewards of climate-smart agriculture and enjoying increased profits from their enterprises.

3.2.4.2.4 Annual emission reductions from 2010 to 2020

The total annual emissions reductions from climate smart agriculture actions increase from 1.20 Gg CO₂e in 2010 to 1.58 Gg CO₂e in 2020 (Figure 3-12).

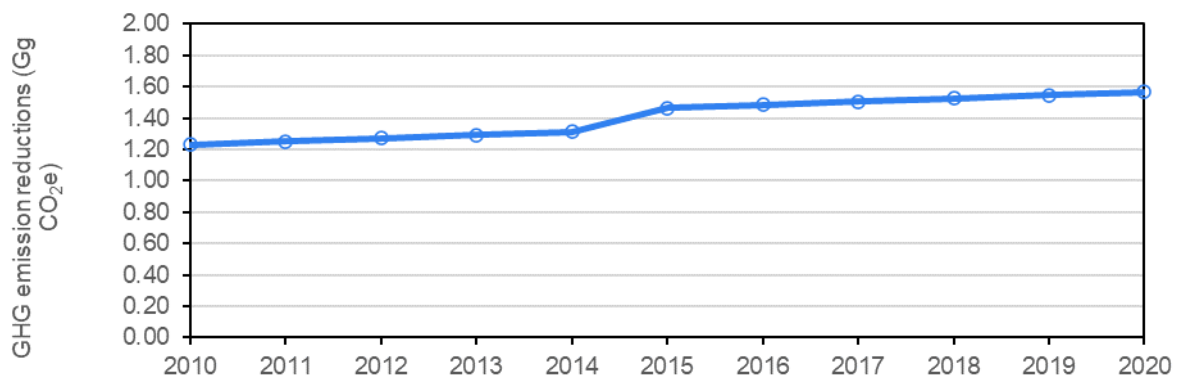


Figure 3-12: Annual emission reductions from climate smart agriculture actions.

3.2.4.2.5 Methodologies and assumptions

The following techniques were used to calculate the variables below;

- Area under conservation agriculture (Kassam et al. 2019);
- Area under agroforestry (FAO Global Forest Resources Assessment Eswatini, 2020);
- Mitigation potential emission intensities applied from the DEA (2015);
- General description of the monitoring and reporting system;
- Annualised area of land cover conversions and land remaining the same land cover type;
- Annualised land use emission intensities for climate smart agriculture activities based on existing land cover data.

3.3 Indicators for Monitoring GHG Impacts and Progress Mitigation Actions

As part of the interventions for a Nationally Appropriate Mitigation Action Plan mentioned in the National Climate Change Policy of 2016, is the establishment of a robust national MRV framework. Implementation of this framework is expected to enable the tracking of progress to implement mitigation actions. The specification of indicators in the MRV framework is necessary as minimum data prerequisites to assess the impact of policies on GHG emissions. Inclusion of the same indicators into sectoral policies is also important for the effective coupling of climate change with development policy, thus aligning ministerial performance indicators with mitigation priorities. The scope of indicators for mitigation actions includes those for implementation, impact, and effectiveness (Table 3-9). Implementation indicators include guidance on how to track progress towards implementation and the various phases of implementation. Impact indicators are related to estimating GHG effects and non-GHG co-benefits. Effectiveness indicators are related to the assessment of cost effectiveness.

Table 3-10: Essential mitigation action indicators to be tracked in an MRV system (South Africa Department of Environmental Affairs; 2018).

Indicator group	Indicator narrative	Indicator title	Description
Implementation indicators	Indicators of the phases or stages of implementation of the policy/group of policies	Achieved progress in implementation (which can be tracked using the Climate Policy Implementation Tracking Tool)	Implementation stages or phases because of the policy etc. achieved, these can include administrative activities that are implemented to support the policy under assessment, resource allocation, financing etc.
Impact indicators	Indicator of the climate change mitigation impact of the policy/group of policies.	Net GHGs reduced, avoided and/ or sequestered – total net change in GHG emissions resulting from the policy or action (tCO ₂ e)	Equal total net policy scenario emissions (tCO ₂ e) minus total net baseline scenario emissions (t CO ₂ e).
	Indicators of impact(s) on other relevant sustainable development priorities, including job-creation – also known as co-benefit or co-cost indicators. To be defined together with the owner/implementer	Jobs created	Number & type of jobs created directly by the response actions
		Other social, environmental, and economic co-benefits	(As appropriately defined)
Effectiveness indicators	Key indicators of the effectiveness of the policy in responding to climate change	Cost-effectiveness	CO ₂ e / US\$

Indicator group	Indicator narrative	Indicator title	Description
		Job-creation effectiveness (Jobs created per amount spent)	Number of jobs / CO ₂ e Number of jobs / US\$

Setting a baseline and target value for an indicator is necessary for the evaluation of progress. For example, the baseline value of NDC mitigation commitments is set against the 2010 baseline scenario, and the target value is set against 2030. For effective inter-ministerial coordination and commitment to sectoral MRV by the Eswatini government, indicators for mitigation actions should not be reported unless these are regulated. Presently, climate change actions and GHG emissions thereof are not regulated directly. This would be the first step before formalising the monitoring and reporting of implementation, impact, and effectiveness indicators. Progress has been made to develop the SDG- based national M&E system in 2017-2018 by the Ministry of Economic Planning and Development (UNDP, 2020). Set up of the SDG M&E system has been further strengthened by the setup of ICT infrastructure and hardware installation, development of user training manual and training of 18-line ministries planners, through UNDP support (UNDP, 2018).

3.4 Mitigation Potential Analysis of the Nationally Determined Contribution

3.4.1 Mitigation Potential Analysis

The assessment of GHG mitigation actions for Eswatini quantifies the potential to reduce GHG (including SLCP and air pollutant) emissions from 13 mitigation measures included in existing plans and strategies in Eswatini. Overall, the full implementation of the mitigation measures could reduce GHG emissions by 20% for the period 2010 to 2030 compared to the “without policy” scenario (Table 3-11). These same actions were also shown to substantially reduce SLCP and air pollutant emissions, bringing substantial co-benefits from their implementation.

Table 3-11: Sectoral reductions in GHGs in 2030 compared to the “without policy” scenario (negative values indicate net GHG emission source).

Sector	Cumulative GHG emission reductions ex-post from 2010 to 2030 in Gg CO ₂ e	Cumulative GHG emissions in the “without policy” scenario	Cumulative GHG emission reductions NDC from 2010 to 2030 in Gg CO ₂ e
Energy	1818.97	15992.40	2394.81
IPPU	NE	179.61	-35.21

Sector	Cumulative GHG emission reductions ex-post from 2010 to 2030 in Gg CO ₂ e	Cumulative GHG emissions in the "without policy" scenario	Cumulative GHG emission reductions NDC from 2010 to 2030 in Gg CO ₂ e
Agriculture, Forestry and Other Land Use	8348.77	25594.29	7806.25
Waste	79.30	2547.04	-1310.04
Total	10247.03	44313.34	8855.81

Table 3-11 lists the GHG emission reduction potential of the individual mitigation measures included in the mitigation assessment. This is due to interactions between individual mitigation measures that reduce the combined GHG emission reduction potential. For example, the implementation of energy efficiency measures can reduce the overall emission reductions from implementing renewable electricity generation measures due to the lower demand for electricity compared to a baseline scenario in which the energy efficiency measures are not implemented. The expansion of renewable energy for electricity generation is the single measure with the largest GHG emissions reduction potential, resulting in a 9% reduction in total GHG emissions in 2030 compared to a baseline scenario individually.

For the measures in the agriculture sector, there is an increase in overall GHG emissions from this sector (2.2% increase in GHG emissions in 2030 compared to a baseline scenario). The agriculture measures included in the GHG mitigation assessment involve an increase in the intensity of production in the agriculture sector (e.g., through genetic improvements, and improvements in the digestibility of the animal feed).

Table 3-12: Summary of mitigation measures evaluated for GHG emission reduction potential from plans and strategies in Eswatini.

Number	Sector	Mitigation Measure	Source: Plan/ Strategy/ Regulation	Percent GHG reductions vs 2030 end year (%)	Absolute GHG emission reduction 2030 vs baseline (thousand tonnes)
1	Transport	Introduction the commercial use of 10% ethanol blend in petrol by 2030	Eswatini's Intended Nationally Determined Contribution	1.35	99.24
2	Residential	50% improvement in efficiency of biomass stoves used for cooking	Energy Master Plan 2034	0.92	67.13
3	Residential	The most inefficient wood-based water heating is replaced by other more efficient options, reducing its share by 13 % by 2034. Reflecting its promotion	Energy Master Plan 2034	NE	NE

Number	Sector	Mitigation Measure	Source: Plan/ Strategy/ Regulation	Percent GHG reductions vs 2030 end year (%)	Absolute GHG emission reduction 2030 vs baseline (thousand tonnes)
		under the SE4ALL initiative, the share of solar water heating is assumed to reach 50 % of households (25 % with back-up and 25 % without back-up).			
4	Residential	100% access to clean energy at household level attained by 2030	Sustainable Energy for All Action Agenda	0.12	8.86
5	Electricity Generation	To achieve 50% renewables target: biomass-based co-generation: 140-165MW hydro: +40-60MW Solar: +100-120MW Wind: +20-50 MW	National Energy Policy 2018	9.08	665.8
6	Sugar	15% (95.84 GWh) reduction in electricity consumption in 2034	National Energy Efficiency Strategy and Action Plan	NE	NE
7	Other Agriculture	10% (41.66 GWh) reduction in electricity consumption in 2034	National Energy Efficiency Strategy and Action Plan	NE	NE
8	Industry	10% (38.89 GWh) reduction in electricity consumption in 2034	National Energy Efficiency Strategy and Action Plan	0.061	4.47
9	Commercial and Public Services	10% (16.67 GWh) reduction in electricity consumption in 2034	National Energy Efficiency Strategy and Action Plan	0.004	0.27
10	Residential	20% (205.7 GWh) reduction in electricity consumption in 2034	National Energy Efficiency Strategy and Action Plan	0.096	7.05
11	Ozone Depleting Substances	Implement HFC phase-out with the corresponding schedule for Annex 5 countries (freeze consumption in 2024 compared to average 2019-2021 levels, 10% reduction in consumption compared to 2019-2021 levels in 2029)	Kigali Amendment to Montreal Protocol IPPU Sector NDC update mitigation assessment	0.15	11.36
12	Livestock	Improvements in productivity of cattle, sheep and goat production through artificial insemination,	Agriculture Sector NDC update mitigation	2.2% increase in emissions	165 increases in emissions

Number	Sector	Mitigation Measure	Source: Plan/ Strategy/ Regulation	Percent GHG reductions vs 2030 end year (%)	Absolute GHG emission reduction 2030 vs baseline (thousand tonnes)
		improved digestibility of feed, and improved manure management	assessment		
13	Solid Waste	Implement best practices in solid waste management considering i) reduction in open burning of waste, ii) increase composting of organic waste, and iii) increase landfill gas recovery at solid waste disposal sites	Waste Sector NDC update mitigation assessment	0.62	45.26

3.4.2 Economic Assessment

To understand the nature of the costs and benefits that may accrue from the proposed mitigation measures in the NDC, a cost-benefit analysis was completed. This assessment covered the four sectors and compares the GHG earnings “without revised NDC” and “With revised NDC” scenarios. The results indicated in Figure 3-13 highlight that the “with revised NDC” scenario could yield 14% savings, more than USD \$10 million, if emissions are valued at USD \$10 per tonne of CO₂ (COMESA, 2021).

Table 3-13: GHG emission cost savings between baseline and policy scenario in US\$.

Mitigation measures	US\$ / tonne (CO ₂ @ US \$10)	Without NDC (BAU) – 2030 (GHG emissions in million tonnes CO ₂ e)	With revised NDC – 2030 (GHG emissions in million tonnes CO ₂ e)	GHG earnings from implementing NDC (Value of CO ₂ emission saved US\$)
Transport and Energy (Electricity Generation and energy efficiency)	10.00	4 082 600.00	2 917 700.00	11 649 000.00
AFOLU	10.00	2 947 000.00	3 112 000.00	-1 650 000.00
IPPU	10.00	23 320.00	11 940.00	113 800.00
Waste	10.00	281 130.00	235 860.00	452 700.00
Total		7 334 050.00	6 277 500.00	10 565 500.00

3.5 Data/Information Gaps

Some of the key data and information gaps are discussed below by sector, noting that some of these are also identified as key areas for improvement for the compilation of future GHG emission inventories:

3.5.1 Energy

- The energy balance does not provide the additional information on the amounts of electricity used in each of the end use categories.
- Scarcity of detailed transportation statistics is a challenge for the assessment of potential mitigation actions in road transport. Vehicle population data collected could include year of manufacturing, year of registration, model, size of engine, vehicle usage, weight and type of fuel.
- Energy end use in agriculture, manufacturing, commerce, and households is currently not reported in energy balances. Energy use for sub-sectors in manufacturing also needs to be reported at a disaggregated level.

3.5.2 IPPU

- Detailed import data for ODS gases for different gas species used in air-cons and refrigerators is needed to estimate charge rate.
- Production and product related emissions are not reported at a disaggregated level in manufacturing which can support tracking of mitigation activities amongst smaller industries.

3.5.3 Waste

- In Eswatini, it should be noted that the Municipal Solid Waste (MSW) data is still very limited as most municipalities started about three years ago to record data on waste collected and there is still no segregation of the data, and no waste stream analysis is performed.
- The extent of composting in landfills and at source is not documented.
- The data for off grid waste-water treatment is not recorded, in peri-urban and rural areas, where individual septic tanks are common, and wastewater is treated on- site or in underground compartments/tanks with anaerobic conditions.
- There is a legal mandate to collect data on waste management, monitoring compliance and enforcement. However, the Waste Information System for the same is yet to be implemented (Singh, 2021).

3.5.4 AFOLU

- Emission intensities of land use change function as “emission factors” that should be quantified from ex-post assessment of wall-to-wall series of land cover data.
- When wall to wall land cover data are not available from the GHG inventory, then alternative data is used; however, mitigation potentials of emissions intensities of land use change are used. To improve future ex- post assessments of land-based mitigation, wall to wall land cover data should be compiled for the GHG inventory.
- Tracking of progress indicators against land-based mitigation requires tracking of additional metrics for land management practices that are not necessary for a GHG inventory. Such metrics should be specified in a

nationally appropriate mitigation action plan under monitoring and evaluation arrangements and integrated thereafter into the monitoring and evaluation frameworks of implementation policies related to land based mitigation projects.

3.6 Suggestions and Needs for Improvement of Reporting

3.6.1 Energy

- There is currently no existing legal framework between MNRE and data providers for efficient data exchange. Establishing a MoU with a clear data sharing agreement between MNRE and data providers is a long-term solution that will ensure sustainable data collection. A transparent data management process should be established between MNRE and data providers with emphasis on documentation, archiving, QC protocols, QA programme and uncertainty management procedures (Mkhonta et al. 2022).

3.6.2 AFOLU

- Analysis made use of the Landsat satellite images archive and other ancillary data via the Continuous Change Detection and Classification (CCDC) to produce annual land use maps for Eswatini from 2000 to 2020 to be used for the next GHG inventory. The data was validated using a collection of over 6,000 reference samples collected independently using Collect Earth and field validation (Dlamini, 2022).

3.6.3 Agriculture sector GHG inventory

- Agriculture sector GHG inventory updated with Tier 2 methodology based on expert judgement as part of the NDC Partnership project, and proposals have been made to improve with activity data collected directly from farmers for livestock and cropland GHG inventory (Mabaso and Tfwala, 2022). This will improve monitoring and evaluation of land use and agricultural intensity related emission reductions.

3.6.4 IPPU and Waste

- The Capacity Building Initiative for Transparency (CBIT) project which is ongoing includes objectives to assess the MRV of mitigation in IPPU and Waste sectors. Suggestions for improvements in reporting for these sectors will be included in the next biennial report.

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4 Financial Resources, Technology Transfer, Capacity Building and Technical Support Received and Needs

4.1 Introduction

This chapter assesses the financial, capacity, and technical support received by Eswatini and further required with regards to climate change up to 31 December 2020. This includes an analysis of international and domestic climate-related finance flows, as well as non-monetized support received within the reporting period. Climate finance sources for Eswatini can be classified into bilateral finance, multilateral finance, domestic public finance, and private sector finance. Support is classified as 'bilateral' if it comes from one donor country and as 'multilateral' if more than one country/entity provides the support and it is channeled through one donor agency. Bilateral assistance for climate change comes in different forms; through individual donors, through donor agencies, directly in the form of Official Development Assistance (ODA) and through bilateral finance institutions.

4.2 Support Received

The financial support committed, and non-monetised capacity building and technology support received from international donor funding sources, as well as domestic funds committed, though government grants and loans are reported in the sections that follow.

4.2.1 International Financial Support Received

Support received during the 2007–2019 reporting period is shown in this section for international (bilateral and multilateral) donor funding sources. This information was included in the Government of Eswatini's Climate Public Expenditure and Institutional Review (CPEIR) (GoE-MTEA, 2021a). Several sources of bilateral assistance have significantly decreased over the past 5-year period. However, the total volume of official development assistance has continued to grow through multilateral aid.

International funding coming into the country is tracked through the Aid Coordination Management Section (ACMS) of the Ministry of Economic Planning and Development (MEPD) (GoE-MTEA, 2021b); however, only a few funding sources are tracked. Climate finance provided by some donors to government ministries; domestic public climate finance; external and domestic social and private climate finance are not included. It also does not include climate finance received by public institutions other than ministries (i.e., parastatals and subnational governments) and climate finance received by non-public institutions, including NGOs, academia, and the private sector (GoE-MTEA, 2021a).

According to Eswatini's GCF country program, Eswatini received a total of US\$320M in climate finance between 1997-2020, mobilised through 36 climate change related projects (Table 4-1, Figure 4-1, Annex 4.1). A breakdown of the funding received for projects funded through international support per funding organisation is presented graphically in Figure 4-1. Out of the 36 projects, 23 focused on adaptation, 6 on mitigation, while 7 were cross-cutting (both adaptation and mitigation). The main sources of climate finance were the Global Environmental Facility (GEF) (US\$ 116.9M), European Development Fund (EDF) through the Delegation of the European Union (EU) to Eswatini (US\$76M), and the World Bank (WB) (US\$45M). Annexes 4.1 provides further detail on international funding received by Eswatini. Bilateral funding was received from the Italian Government. In terms of number of projects, the GEF and AfDB had the highest number of approved projects. Note: A GCF Climate Finance Facility for a loan (USD 170 600 000) with The Development Bank of Southern Africa (DBSA) as the implementing agency was not included in the total international climate finance amount calculation since the total amount allocated is for a regional project and the amount dedicated for Eswatini is not known, and Eswatini is not guaranteed to receive funding from this facility; funds can be obtained by submitting bankable proposals.

Table 4-1: International funding received (USD).

Funder		No. of projects	Total funding (USD) (/Million)	Total funding (USD)	No. of Grants	No. of LOANS
Global Environmental Facility	GEF	10	116.9	116 928 409	10	
European Development Fund	EDF	4	76.9	76 937 771	4	
World Bank	WB	1	45.0	45 000 000		1
African Development Bank	AfDB	6	27.4	27 376 844	3	3
International Fund for Agricultural Development	IFAD	1	24.5	24 510 000	1	1
Organization of the Petroleum Exporting Countries Fund for International Development	OFID	1	15.9	15 910 000	1	
Cooperation for the Development of Emerging Countries	COSPE	3	4.5	4 481 668	3	

Italian Government	Italian Govt.	2	4.0	4 017 931	2	
Green Climate Fund	GCF	3	3.4	3 424 187	3	
Common Market for Eastern and Southern Africa	COMESA	1	0.8	836 363	1	
Food and Agriculture Organization	FAO	1	0.3	263 000	1	
Global Facility for Disaster Reduction and Recovery	GFDRR	1	0.2	200 000	1	
United Nations Development Programme	UNDP	2	0.1	137 143	2	
TOTAL		36	319.9	320 023 316	32	5

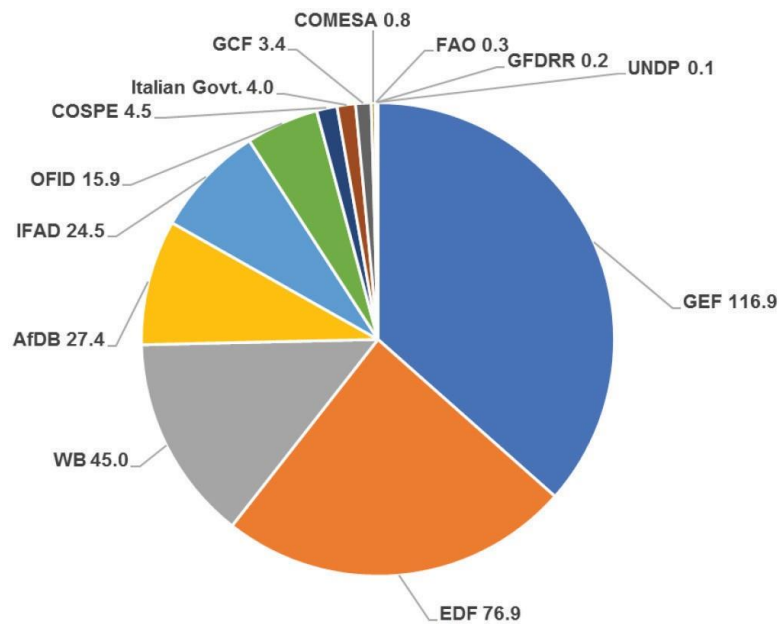


Figure 4-1: Funding received for projects funded through international support per funding organisation (USD Millions).

4.2.2 National Budget-Based Climate Expenditure

The Ministry of Finance compiles climate change budget allocations and actual expenditures data which includes a yearly breakdown of projects and programmes approved through national budgets, implementing agency, total budget allocation, actual expenditures incurred, and whether the projects contain mitigation and/or adaptation components (GoE-MTEA, 2021a).

Climate change budget allocations and actual expenditures for the period 2015-2020, as reported in Eswatini's CPEIR, are provided in Figure 4-2. The climate change related expenditures for Eswatini reported for the financial period of 2015 to 2020 are summarised in Annex 4.2. Of the projects reported, government provided domestic funding for 35 of these projects, and the budget allocation of the government funded/co-funded projects totalled E2,823,049,000 over the 5-year period, and actual

expenditure for these projects was E2,540,069,00.

No additional data on climate change-related public expenditure were available, hence the analysis provided in the CPEIR was based on the data and values provided by the government. During this period, the Government of Eswatini approved funding for a total of 40 climate change-related projects, extending over the entire period of 2015–2020 (GoE- MTEA, 2021a). The majority of these projects have a lifespan of over five years, with very few projects added each year.

Adaptation measures have been the predominant focus and priority of the government, with very few projects (and associated budget allocations) focusing on mitigation. More than 95 per cent of total budget allocations have been in adaptation, whereas mitigation has attracted very low budget allocations and an even lower magnitude of actual expenditures (GoE-MTEA, 2021a) (Figure 4-2).

Mitigation and Adaptation Distribution

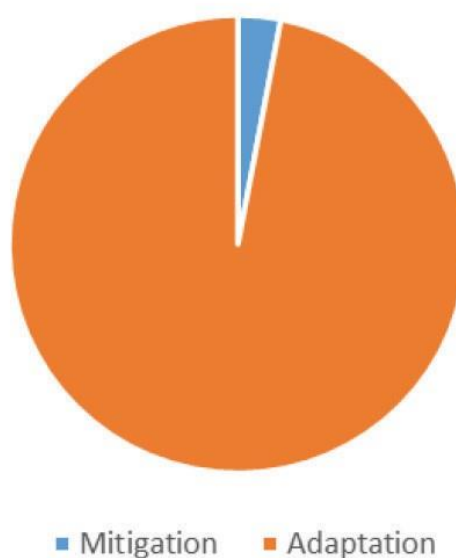


Figure 4-2: Distribution of mitigation and adaptation projects (GoE-MTEA, 2021a).

Table 4-2 provides the summarised climate change-related expenditures from the national public expenditures (national budgets) allocated to different ministries, based on their projects and programmes. Since ministries have defined sectors (for example, water, agriculture, public infrastructure), the allocated budget is directly related to the specific sectors of the economy.

More than 50 per cent of all climate change-related expenditures over the period of five years were distributed between the Ministry of Natural Resources and Energy

and Ministry of Agriculture. Many of the projects approved in these two ministries were related to the water and sanitation sectors, which are directly involved in adaptation measures for climate change impacts. The agriculture and water sectors are critically vulnerable sectors in the country as shown in the country's vulnerability assessments and sectoral studies.

Table 4-2: Climate change-related expenditures for different sectors (GoE-MTEA, 2021a) (Amounts are shown in Swazi lilangeni (E) and in thousands).

Climate change-related expenditures	2015-16	2016-17	2017-18	2018-19	2019-20
Agriculture	129 971	378 496	332 201	862 587	1 136 692
Water	274 950	508 848	137 074	185 200	408 300
Health	8 000	8 000	8 000	4 000	2 500
Infrastructure	90 000	95 850	205 000	93 000	58 500
Energy	47 150	59 500	58 338	47 508	27 000
Tourism	800	3 000	1 500	1 500	0
Education	32 950	28 000	230 000	5 000	5 000
Economic planning and development	80 000	100 000	180 000	192 500	120 000

4.2.3 Non-Monetised Support Received

The non-monetised support received by Eswatini is summarised in Table 4-3 e.g., technical support and capacity building support received from developed countries, it includes detail on the donor, type of support, period of support, focus, and a description of the objective of the support received.

Table 4-3: Non-monetised support received by Eswatini up to Dec 2020.

	DONOR	TYPE OF SUPPORT	TIME FRAME	FOCUS	ACTIVITY /OBJECTIVE
1	FANRPAN COMESA	Capacity building and technical support	12-17 November 2018	Policy and NDC	Training workshop on NDC project development and investment mobilisation held under the theme: Transforming Paris Agreement Aspirations into Action through the implementation of the Nationally Determined Contributions in COMESA Member States

	DONOR	TYPE OF SUPPORT	TIME FRAME	FOCUS	ACTIVITY /OBJECTIVE
2	GIZ	Capacity Building Technical Support	5-7 March 2019	Mitigation: Waste Sector	The training was aimed at improving Eswatini's climate data management system in the Waste Sector to ensure enhanced data gathering and to improve the quality of reporting in the waste sector for Eswatini's National Greenhouse Gas Inventory. It targeted stakeholders in data collection, data management and compilation of waste information. The stakeholders included various municipalities and town boards, the private sector, national authorities, government ministries tertiary and research institutions as well as waste management companies.
3	UNFCCC GHG MANAGEMENT INSTITUTE	Capacity Building	Yearly	Mitigation	Trainings of National Stakeholders on the BUR, National Communications, and overall UNFCCC processes for inclusion in the roster of experts. Certification of experts on the GHG inventory
4	UNFCCC and UNEP-GSP	Capacity Building and Technical Support	3 -6 September 2019	Mitigation: MRV	The first Southern Africa Regional MRV Network Training and Peer Review workshop as part of the provisions Southern Africa MRV Network, in partnership with UN Environment Global Support Programme (GSP), in collaboration with the United Nations Framework Convention on Climate Change (UNFCCC). The Southern Africa MRV Network, comprised of 13 countries, including Eswatini, Mozambique, Zambia, South Africa, Lesotho, Mauritius, Seychelles, Comoros, Zimbabwe, Malawi, Botswana, Angola, and Madagascar. The Main objectives of this workshop included. Provide specific training on use of 2006 IPCC GHG Guidelines software. Conduct peer review for national draft reports for selected countries. Share challenges and good lessons on experiences on national MRV institutional arrangements Identify priority areas for capacity building in the North and Central Africa region and develop a plan addressing the identified gaps in the region. Identify specific capacity needs and develop a schedule of in-country or bilateral training

	DONOR	TYPE OF SUPPORT	TIME FRAME	FOCUS	ACTIVITY /OBJECTIVE
5	NDC Partnership Climate Action Enhancement Package	Capacity Building	12-16 Oct 2020	Mitigation	<p>Training on the “Low Emissions Analysis Platform” (LEAP) model. The training primarily focused on how LEAP can be used to model energy systems, and estimate emissions of greenhouse gases (GHGs), short-lived climate pollutants (SLCPs) and air pollutants. Participants learnt how LEAP can model energy supply and demand, and greenhouse gas emissions associated with them. One session (15th Oct) focused on how LEAP can be used to model non-energy sector emission sources. This was attended by participants including Government officials and national consultants engaged by UNEP as well as participants from relevant sectors and the training was virtual.</p>
6	NDC Partnership Climate Action Enhancement Package	Technical support	Sept 2020 - June 2021	Mitigation	<p>Greenhouse Gas Mitigation Assessment capacity building virtual trainings on the Energy, Waste and Livestock Sector for National GHG Inventory Expects.</p> <p>An economy-wide GHG mitigation assessment has been conducted, quantifying GHG emissions and evaluating mitigation options in the energy, industrial processes (IPPU), agriculture, forestry, and land-use (AFOLU), and waste sectors.</p> <ul style="list-style-type: none"> • The GHG mitigation assessment has updated the estimate of historical GHG emissions, providing the most up-to-date basis for projecting emissions into the future. • The baseline, or reference projection of GHG emissions in Eswatini to 2030 has been revised, based on key national documents, and accounts for the impact of COVID-19 on Eswatini's economic outlook. • An extensive assessment of policies and measures has been undertaken. The GHG mitigation assessment evaluates the GHG emission reduction potential of key plans and policies that have been put in place since 2015 to assess how these plans could contribute to reducing GHG emissions in Eswatini. • The GHG mitigation assessment also evaluates emission reductions of short-lived climate pollutants (SLCPs), such as black carbon, and health-damaging air pollutants that are emitted alongside GHGs. The inclusion of these additional pollutants allows

	DONOR	TYPE OF SUPPORT	TIME FRAME	FOCUS	ACTIVITY /OBJECTIVE
					<p>for an evaluation of the local benefits that can be achieved in Eswatini from taking action to reduce GHGs to be evaluated, highlighting important local co-benefits from climate change mitigation. The Mitigation Assessment identified</p> <p>13 mitigation measures which were included in the NDC. The mitigation assessment work included data collection, stakeholder workshops, data analysis and capacity building through webinars.</p>
7	Commonwealth Secretariat	Technical support	July 2020 -current	Mitigation, Adaptation	Embedded Climate Finance Advisor at MTEA. Commonwealth Secretariat provided a Climate Finance Advisor since July 2020, and he will be undertaking the Climate Public Expenditure and Institutional Review (CPEIR) and assisting the country to develop proposals to access climate finance.
8	NDC Partnership Climate Action Enhancement Package	Technical support	Sept - Dec 2020	Mitigation, Adaptation	Gender assessment of Eswatini's climate policy and planning instruments.
9	CTCN	Technical support	2016-2018	Mitigation	<p>Development of a Regional Efficient Appliance and Equipment Strategy in Southern Africa. Provision of support in developing country and prioritization assessments, which will provide the financial, energy, and climate potential of accelerating a market transformation for each of the prioritized products.</p> <p>Overall Task and Objective of project: Review of potential for implementation of energy efficiency policies and strategies in Southern Africa for lighting, refrigerators, air-conditioning, motors, and transformers. The output was a report which reviewed the potential for increasing the energy efficiency of products in Swaziland by providing a technical market assessment of current conditions and policies. Five specific product categories were reviewed: lighting, air conditioning, refrigerators, motors, and transformers. The research provided context and insight in relation to the barriers and opportunities.</p>
10	CTCN	Technical support	Jan 2019 (18 months)	Mitigation	Leapfrogging Eswatini's market to energy-efficient refrigerators and distribution transformers. The CTCN previously developed detailed country assessments for 9 Southern Africa countries, including Eswatini, focusing on five priority products (i.e. lighting, refrigerators, air conditioners, electric

	DONOR	TYPE OF SUPPORT	TIME FRAME	FOCUS	ACTIVITY /OBJECTIVE
					<p>motors, and distribution transformers). This assistance sought to help to inform Eswatini's future objectives for climate-related policy actions.</p> <p>CTCN support included: Validation of data, detailed market assessments and feasibility of implementation studies, development of a technology roadmap and action plan for promoting and adoption of efficient appliance in the country, propose draft minimum energy performance standards (MEPS) and labelling for refrigerators and procurement specifications for distribution transformers, and develop a proposal for financial/market based mechanism on energy-efficient refrigerators and/or distribution transformers.</p>
11	CTCN	Capacity building	2016	Mitigation, Adaptation	Building capacity for climate change science. Expected impacts was improved awareness of climate change issues and Swaziland's NDC among civil society members, and availability of training materials for the country to continue creating awareness in future using those materials.
12	CTCN	Technical support	2020	Adaptation	Strengthening the National Disaster Management Agency's (NDMA) application of unmanned aerial vehicles (UAV) and Remote sensing technology for vulnerability assessments and response planning. The CTCN support is to strengthen Eswatini's vulnerability assessments including the agricultural sector by building scientific and technical capacities within the National Disaster Management Agency (NDMA) on the application of UAV technology and remotely sensed imagery for crop monitoring and early warning systems, as a climate change adaptation intervention. The expected impact is to improve the country's early warning capabilities through the integration of UAV technology.

4.3 Support Needs

4.3.1 Financial Support Needed

Domestic and international financial support is needed to undertake sectoral activities, including technical, capacity building and project management, for the

implementation of the NDC. The financing required for implementing the NDC was estimated between USD 950 million to USD 1.5 billion (Chiluwe, 2021). The total cost and breakdown per sector for financing requirements for adaptation and mitigation measures is provided in Table 4-4 and Table 4-5 (GoE-MTEA, 2021b; Chiluwe, 2021). The total cost of all adaptation measures was estimated at USD 350 833 455, and the total cost of all mitigation measures was estimated at USD 646 364 784.

Table 4-4: Financing requirements for adaptation measures (GoE-MTEA, 2021b)

ADAPTATION	
Sector	Finance needs (USD)
Agriculture	141 469 764
Water	34 739 608
Health	45 230 000
Ecosystems and biodiversity	67 608 522
Infrastructure	61 785 560
TOTAL Adaptation cost	350 833 454

Table 4-5: Financing requirements for mitigation measures (GoE-MTEA, 2021b).

MITIGATION	
Sector	Finance needs (USD)
Transport	41 561 404
Residential	55 579 200
Electricity Generation	501 212 417
Industry	4 437 000
Industrial Processes and Product Use	7 594 000
Agriculture, Forestry, Fisheries and Other Land Use	21 724 342
Solid Waste	14 156 419
TOTAL Mitigation Cost	646 264 782

4.3.2 Technical or Capacity Support Needs

Eswatini faces significant challenges in its efforts to address climate change, primarily due to the absence or unreliability of baseline data, which is often scattered and inaccessible. This lack of consistent data makes it difficult to perform accurate analyses and hinders evidence-based decision-making. The country struggles with limited resources and capacities to collect, manage, and utilize reliable climatic and project data effectively. Furthermore, the absence of a robust Monitoring, Reporting, and Verification (MRV) system complicates the ability to measure the impact of

climate interventions and track the use of climate finance. Financial constraints also limit the ability to provide co-financing for climate initiatives, and Eswatini's restricted fiscal space exacerbates these challenges. Climate finance remains poorly understood, often regarded as a secondary funding option, which diminishes its role in supporting climate action.

Eswatini's institutional and technical capacity challenges further complicate its climate resilience efforts. The country has a shortage of expertise in planning and managing climate-related projects across sectors, which undermines the execution of climate action. Additionally, there is limited know-how in crafting high-quality proposals that can attract competitive climate finance, restricting access to crucial funding opportunities. Weak institutional coordination and a lack of absorptive capacity prevent the country from delivering long-term impacts from climate projects. The absence of a nationally accredited entity that can directly access funds from mechanisms like the Green Climate Fund (GCF) adds another layer of difficulty, as it restricts the country's ability to independently secure climate finance. These challenges are compounded by outdated policies that require reform to better integrate climate considerations, alongside limited capacity to convert existing policies into tangible actions on the ground.

To address these gaps, Eswatini has conducted various assessments, such as the Technology Needs Assessment (TNA), the National Capacity Needs Self-Assessment, and the Third National Communication to the UNFCCC (2016). These assessments have identified feasible technology options for climate mitigation and adaptation, as well as the barriers that hinder progress. The Adaptation Communication to the UNFCCC has highlighted the importance of understanding the obstacles in implementing adaptation measures to better target support. Recommendations from these assessments, as outlined in the revised Nationally Determined Contribution (NDC) technical report (GoE-MTEA, 2021b), include the establishment of a comprehensive, costed capacity-building program for stakeholders, the development of a resource mobilization plan for climate-focused institutions, and the enhancement of technical skills in numerical weather prediction and modelling. Addressing these needs is crucial for Eswatini to transition effectively towards a low-carbon, climate-resilient development pathway and to ensure long-term sustainability in its climate action efforts.

Based on the findings and recommendations of these assessments, current challenges and capacity gaps in climate action can be summarized in the following categories:

- Technical Knowledge and skills;
- Data management and Management Information Systems;
- Technology transfer and diffusion;
- Institutional , technical, and human resource capacity;
- Effective Measurement, Reporting and Verification (MRV) System;

- Finance;
- Legal, policy, and institutional frameworks;
- Private sector engagement;
- Early warning systems.

The Technology Needs Assessment for Eswatini to identify technology priorities for adaptation and mitigation sectors included delineating capacity building requirements (Pullanikkatil, 2018). Based on this assessment, the following specific needs related to technology and capacity building for adaptation and mitigation were identified (Note: the needs listed in this chapter reflect needs of prioritised sectors only highlighted in the TNA and not needs across all sectors in the country). The technical and capacity building needs for Eswatini are summarised for adaptation and mitigation in Table 4-6 and Table 4-7, respectively.

Table 4-6: Technical and capacity building needs for adaptation.

ADAPTATION
Technology needs
Wetlands Restoration and Protection (WRP) – Undertake WRP for five chosen medium size wetlands thereby improving the country's preparedness for flood control, biodiversity management and enhancing micro-climatic conditions
Rainwater harvesting (RWH) – Providing subsidized RWH systems for 20,000 households and demonstration of systems in 100 institutions with the aim of improving access to water and creating awareness about the benefits of such practices
Conservation Agriculture (CA) – Providing access to mechanised planters that can be hired by farmers and creating demonstration CA sites to showcase improved / sustainable farming practices and thereby transform the sector to become climate resilient in the long run
Micro and Drip Irrigation – Provide access to subsidized irrigation technology to improve farm yield and water use efficiency
Agroforestry techniques to increase crop production, improving soil quality and thereby enhancing the economic gain for farmers and preparing the sector from flood and other disasters
Conservation of genetic resources – Building a National Botanical Garden and Field Gene Bank to preserve genetic plants of Eswatini and train officials in conservation techniques
Capacity building needs
Training of staff in plant genetic resources management, plant ecology, plant taxonomy and ethnobotany
Training of National Water Authority on water use efficiency and resource management
Training of staff and field officers for scaling up implementation of micro and drip irrigation technology across the country and designing of awareness programmes for farmers
Building capacity of government staff implementing policies and measures such as the National Water Act and Integrated River Basin Management
Build capacity of education system to include RWH in the curriculum and impart practical training for students on the technology implementation
Build capacity of officials to identify financing instruments for implementing NDC strategies, targets, and actions

Table 4-7: Technical and capacity building needs for mitigation.

MITIGATION
Technology needs
Access to state-of-the-art building insulation materials to improve energy efficiency across buildings
Access to state-of-the-art renewable energy generation technologies such as solar PV, wind, and biomass
Access to affordable clean transport technologies such as electric 2-wheelers and 4-wheelers
Access to waste sorting and composting technology for handling increasing solid waste load from the country
Capacity building needs
Build capacity of officers to develop energy efficiency standards, regulations, and policies
Build capacity of construction sector professional in improving energy efficiency performance of buildings through insulation and other technologies
Build skill of artisans and engineers of power production from combined heat and power using biomass, solar, wind and other emerging technologies
Build skill of energy sector officers on energy planning using globally practised energy models
Build capacity of officers to access renewable energy and climate change funds such as the GCF for implementation of projects
Develop capacity building programmes for training, testing and accreditation of solar PV installation officials
Build capacity of waste sector stakeholders on diversifying waste streams and conversion to useful products and creating a circular economy value chain

4.3.3 Technology Needs Assessment

Eswatini has undertaken several comprehensive assessments and technical studies to identify climate risks, adaptation needs, and gaps that inform decision-making which included the Technology Needs Assessment (2016-2018). Eswatini's TNA, completed in 2018, emphasized the importance of adaptation and mitigation and identified key sectors in adaptation (agriculture, water, and forestry & biodiversity) and mitigation (energy, waste, and Land Use, Land-Use Change and Forestry (LULUCF)). The technology assessment process included the identification of barriers hindering the acquisition, deployment, and diffusion of prioritized technologies (Barrier Analysis and Enabling Framework (BAEF) reports) and included accompanying Technology Action Plans (TAPs) for both adaptation and mitigation².

The TNA for adaptation prioritised the following technologies:

- Water sector - integrated river basin management, rooftop rainwater harvesting, and wetland restoration;
- Agriculture sector - livestock and poultry selective breeding, conservation agriculture, and micro and drip irrigation;
- Forestry and biodiversity sector - agroforestry, conservation of genetic resources, and alien invasive species management.

² Eswatini's TNA for adaptation and mitigation - <https://tech-action.unepccc.org/country/eswatini/>

The TNA for mitigation prioritized the following technologies:

- Energy (Power generation subsector) – Hydro power, biomass combined heat and power, solar PV, and energy efficient buildings;
- Waste – Separate/reuse/recycle, composting, and semi-aerobic landfill;
- LULUCF – agroforestry, urban forestry, and grazing land management.

The high impact of Eswatini's TNA on subsequent climate-related activities was highlighted in Gregersen, L. et al. (2019) and includes the following examples:

- Based on the recommendations of Eswatini's Technology Action Plans (TAPs) for mitigation and adaptation, technologies integrated into the Eco-Lubombo Biosphere project under the auspices of UNESCO include technologies related to wetland protection, conservation agriculture, agroforestry, and livestock selective breeding.
- As part of implementation of the TNA results, it has resulted in the development of the National Wetland Policy.
- Developing a Green Climate Fund Proposal for further implementation of actions which form part of different components of the Eco-Lubombo Biosphere project.
- The TNA results are included in the GCF country programming which contribute to the country mobilizing grants under the GCF Readiness Program.
- Prioritized technologies under the TNA served as an input to the country's Revised NDC.

4.4 Support Received for the Preparation of BUR 1

The United Nations Environment Programme (UNEP) has been the implementing entity responsible for the management of funds for the Global Environment Facility (GEF). The Kingdom of Eswatini, as a signatory to the UNFCCC, received financial support from the GEF to compile and publish its First Biennial Update Report (BUR-1), as well as its Fourth National Communication (NC4).

The preparation of the BUR was funded by the GEF project on the Preparation of National Communications and Biennial Update Reports to the UNFCCC with UNEP as the implementing agency; external funding received was USD 852 000. The national executing agency is the Ministry of Tourism and Environmental Affairs (MTEA). The project supported Eswatini to prepare and submit National Communications and Biennial Update Reports that comply with the UNFCCC reporting requirements while responding to national development goals.

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5 Institutional Arrangements Related to MRV

5.1 Introduction

This chapter reports on the existing institutional arrangements towards Monitoring, Reporting and Verification (MRV) for mitigation in the country. Updates in terms of the arrangements in place with respect to the country's greenhouse gas (GHG) emissions inventory, mitigation actions, and support needed are unpacked with respect to the current roles and responsibilities and processes in place. The steps envisaged towards the development of MRV tools and systems for continuous reporting that fulfils transparency requirements and allows the country to effectively track the implementation of its NDC commitments are also presented.

The MTEA is the UNFCCC National Focal Point and is responsible for the preparation of NCs, BURs, and NIRs through the Department of Meteorology. The MTEA thus coordinates the activities needed to ensure that inputs and outputs required for reporting to the UNFCCC are prepared, and are of sufficient quality to meet Eswatini's commitments. Ad-hoc structures are currently in place through a project steering committee and technical working groups that are supported by consultants, as shown in Figure 5-1.

A multi-stakeholder committee made up of representatives from government institutions, the private sector, and non-governmental organizations constitute the Project Steering Committee towards driving collaborative efforts around the GHG inventory and MRV needs.

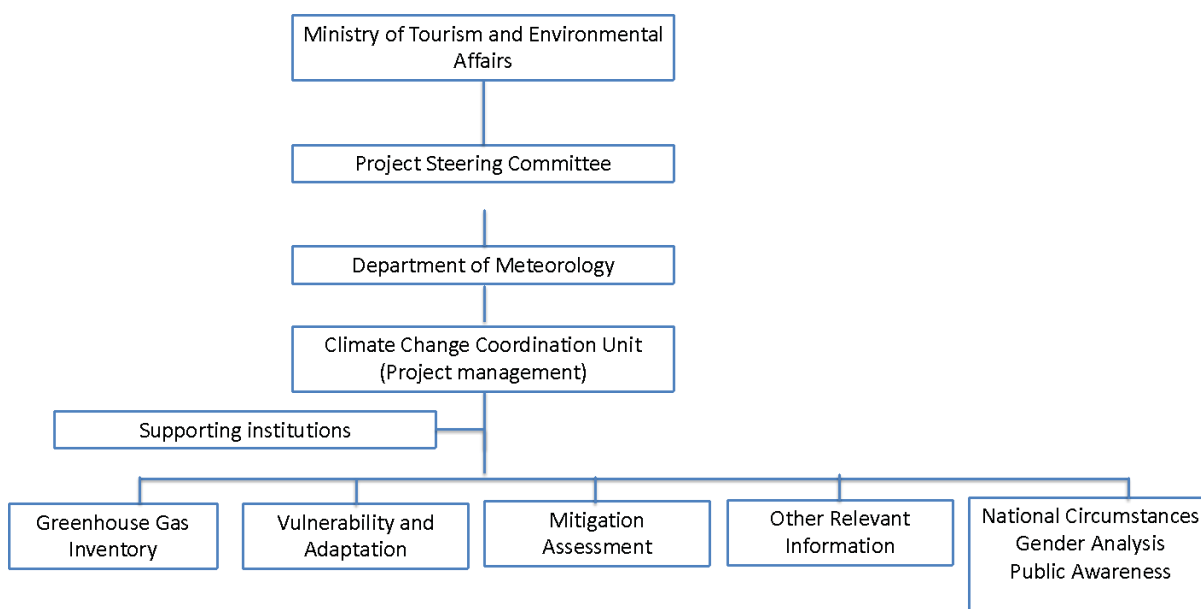


Figure 5-1: Institutional arrangements to support reporting to the UNFCCC.

The arrangements depicted in Figure 5-1 have successfully supported the implementation of the country's first BUR (BUR1) and its fourth NC (NC4). The country's Climate Change coordinator provides continuity to the MRV process using the arrangements described above.

5.2 MRV for the GHG Emissions Inventory

A national GHG emissions inventory was compiled for reporting in the BUR1/NC4. The responsibility for the compilation of the GHG Inventory resides in the MTEA. The Department of Meteorology (MET) played a key role in co-ordinating the data collection processes, the sectoral experts and the GHG inventory archiving system for the compilation of the inventory reported in the BUR1/NC4. National consultants who are familiar with the different emission sectors were involved, in collaboration with international consultants, for co-ordinating the data collection and compilation of GHG inventory, overseen by a project steering committee. Data were sourced from national, regional, and local governments as well as the Central Statistics Office and private sector organisations. Sector level experts completed standard templates for activity data and emission factors which served as inputs into the national GHG management system.

Whilst the process for data sharing for the compilation of the GHG inventory is not under-pinned by a formal legal framework, existing sectoral mandates assisted in the process. The Ministry of Natural Resources and Energy through the Department of Energy provided data and linked the project with key energy stakeholders in the country. The Ministry of Agriculture similarly is key to providing agriculture and land use data, and linking with key agriculture stakeholders. The Central Statistics Office has the national legal mandate to collect and archive all national data and is therefore also a key stakeholder for data collection and management.

A quality assurance and quality control (QA/QC) plan was developed at the start of the process for the compilation of the GHG inventory for the BUR1/NC4 project. The plan defines roles and responsibilities for the QA/QC and the objectives of the QA/QC system to maintain and improve the quality in all stages of the inventory work. It was stored on the GHG inventory archiving site developed during this process. The Department of Meteorology played a co-ordination role for QA/QC for the inventory reported in the BUR1, which was supported by national experts and external reviewers (e.g. UNEPGSD).

Various levels of verification occurred throughout the process of the GHG compilation that included verifying the data with data providers, cross checking data from the previous inventory, and the verification of the GHG emission inventory by

external consultants in line with IPCC guidelines. The overall arrangements for the compilation of the inventory are shown in Figure 5-2.

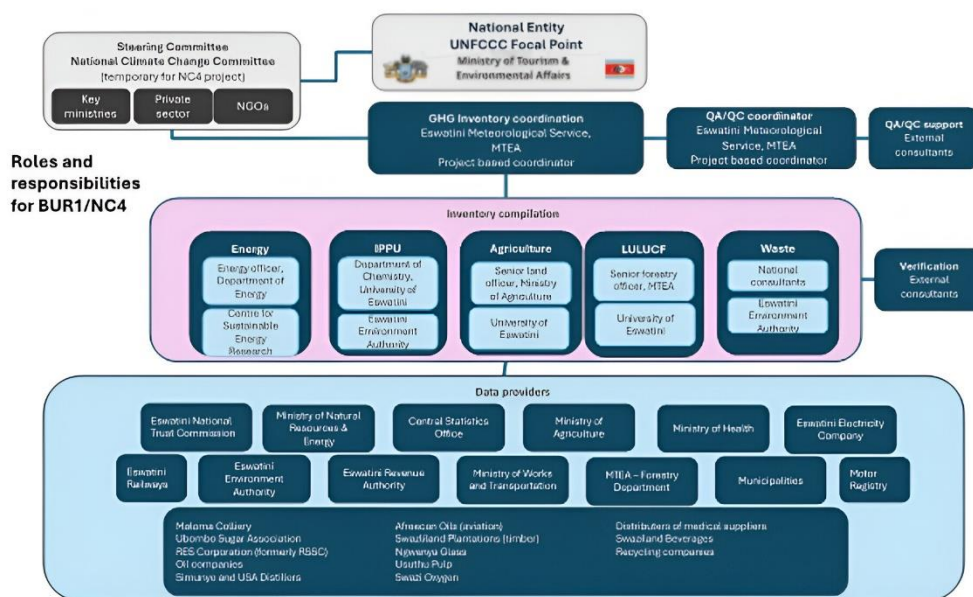


Figure 5-2: Institutional arrangements for the compilation of the GHG emissions inventory (MTEA, 2020).

There are improvements made in the current inventory that provide key steps towards improving continuity and supporting a continuous reporting system around data archiving, training, and current work to develop country specific emission factors and, thus, supporting this process.

In terms of continuity, for the previous inventory there was no archiving system in place, thus there was a lack of information and data available from that assessment. By having the process in place to ensure that the GHG estimates are transparent and accompanied by clear and up-to-date description of methodologies, data sources, assumptions, models, and underlying assumptions at sufficient category and subcategory detail, the basis for continually updating and improving the processes for the GHG inventory will be put in place. Through the current inventory process for the NC4/BUR1 a cloud-based GHG Inventory Archiving Site was put in place to store the data and information for all sectors covered in the GHG inventory. This site provided a secure platform for data sharing and use across government departments during the compilation process. The IPCC Inventory Software was used for the compilation and documentation of the AFOLU inventory datasets.

Additionally, steps have been taken to enhance the co-operation between institutions, with a memorandum of understanding with the MNRE and the MTEA

initiated to formalize the roles and responsibilities and procedures with respect to the collection of data and flow of information for the Energy sector. Similarly, such institutional arrangements are needed for the other sectors, preferably through a memorandum of understanding with the MTEA. These arrangements would also need to be initiated and guided by the key mitigation actions that are contained within the NDC and related sectoral policies.

The compilation of the current inventory also contributed to enhancing the technical capacity of national consultants, who were supported through a team of international and regional consultants, with the aim of building national capacity to compile the inventory independently. As part of this capacity building programme the tools, templates, and systems have also been updated for the compilation of the BUR1/NC4 GHG inventory. Through the process of the inventory compilation as well as the mitigation assessment undertaken for the NDC, opportunities to improve the GHG inventory have been documented, with the activity data for industrial processes and waste sectors further improved on.

The GHG emissions inventory developed for the BUR1/NC4 project and the inventory developed for the updating of the NDC has resulted in an improvement in the baseline emission estimates. Many of the challenges experienced during the initial NDC with respect to data collection and archiving, and quality assurance and control have been improved upon, resulting in a more representative inventory and improved baseline. Other key improvements noted for the country's GHG inventory include improving the time series consistency. This is an important step in establishing a baseline that can be effectively used to track GHG emission reductions and other non-GHG variables that result from those actions.

5.3 MRV for Mitigation Actions

The mitigation actions chapter presented in this report (BUR1) was developed under the co-ordination of the MTEA using a consultant - the Council for Scientific and Industrial Research (CSIR) - and with the involvement of key stakeholders involved in the development of the 2020 GHG inventory. The inventory and assessment were used as a baseline for the estimation of mitigation emission reductions from key policies, measures, and actions. The main data used to estimate emissions in all major source sectors covered in the GHG mitigation assessment were derived from the national sectoral GHG emission assessments and several different sources that included:

- Energy Master Plan 2034;
- National Energy Balance 2010-2018;
- Fuel consumption data;
- Census reports for population data;

- Various national departments that include Eswatini Electricity Company, Eswatini Sugar Association, National Ozone Unit, Ministry of Public Works, Transportation, Eswatini Revenue Authority, Ministry of National Resources;
- Large industrial sources.

The NDC covers the Energy, IPPU, Waste and AFOLU sectors. To be able to adequately report on the progress of implementing mitigation actions within these sectors, there is a need for a robust GHG inventory and reporting on the Sustainable Development Goals (SDGs). The Poverty Reduction Unit reports on the SDGs and the progress on the MRV of GHG emissions were described in the section above. Currently, these enabling systems are still fragmented. The National Climate Change Policy of 2016 includes policy statements for sectoral monitoring of GHG emissions, which must be enhanced based on appropriate methodologies and the setup of a nationally appropriate mitigation plan. The CBIT funding is meant to be used to fully integrate all existing components and those which must be set up. Thus, while a MRV system for mitigation actions currently does not exist for the country, efforts are underway to strengthen and improve existing reporting capabilities.

The existing data collection processes for the key sectors provide a basis for building up the MRV system for mitigation actions, and provide a foundation for data collection that can be strengthened once the Climate Change Bill, currently in draft, is in place. These existing processes and gaps therein are discussed in the section below.

In the Energy sector, the national energy balance is the primary source of data for energy generation and usage. International commitments ensure that energy data is up to date through the IRENA treaty ratified in 2011 and the Convention of the African Energy Commission ratified in 2012. For the compilation of the energy balance, the MNRE collects data from providers and ensures confidentiality without an MoU in place. MNRE also collaborates with the Central Statistics Office in terms of sampling methodologies and analysis used in energy surveys (Figure 5-3). MTEA receives the energy balance data from MNRE for GHG calculations for the energy sector and transport sub-sector.

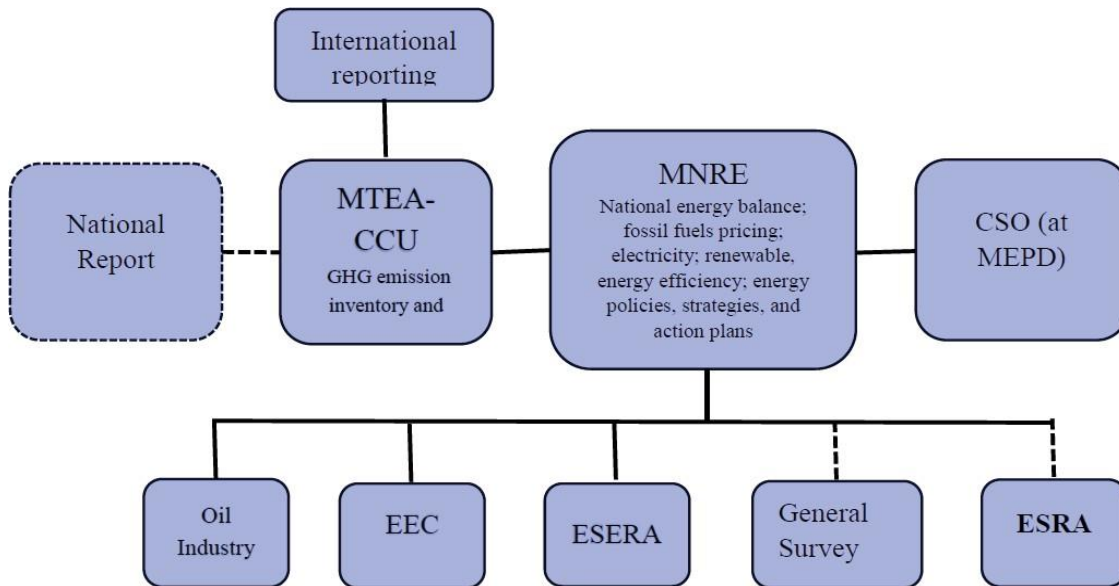


Figure 5-3: Current institutional arrangement for data collection for the energy balance.

For the IPPU sector, the context for tracking of mitigation is set against the GHG inventory, with much of the data (such as data on lubricants) collected through processes managed by the Department of Energy. The collection of data directly from industries is favoured to ensure accuracy, with such data requested formally for use in the inventory. Future work to improve the data in this sector will also look to improve the estimation of fuel use in sub-sectors, for example, in the forestry sector, as not all fuel consumed may be used for energy production.

Other existing structures include frameworks for reporting which supply data can be leveraged for the GHG inventory, such as that included under the Ozone Depleting Substances Regulation (Montreal Protocol), the planned Kigali Amendment through the National Ozone Unit, the Convention on Long Range Transboundary Air Pollutants (CLRTAP), the Meteorological Service Act and the Environmental Management Act. The roles and necessary capacities of institutions and individual organisation members for MRV as shown in Table 5-1.

Table 5-1: Roles and necessary capacities of institutions and individual organisation members.

Title	Responsibility	Necessary Capacities	Position (Organisation)
National entity	Overall responsibility for expected outputs such as NCs, BURs.	Administrative skills, government authority	Ministry of Tourism and Environmental Affairs (MTEA)
Steering Committee	Provide overall planning, coordination, management and technical facilitators of inputs and outputs.	Technical and administrative expertise, government authority	NC4/BUR1 project-based steering committee
Inventory coordinator	Management of the inventory program and timelines	Technical and administrative expertise, government authority, capacity to coordinate and lead process	Project based coordinator, Eswatini Meteorological Services, MTEA
QA/QC coordinator	Implementation of QA/QC Plan, oversees cross-cutting QA/QC	Quantitative skills, knowledge of the UNFCCC reporting requirements and IPCC methodologies	Project based coordinator Eswatini Meteorological Services, MTEA Supported by external consultants (Aether).
Inventory compilers (sector experts)	Day to day compilation of the GHG inventory and projections for the sector	Quantitative skills, knowledge of the UNFCCC reporting requirements and IPCC methodologies	Department of Chemistry, University of Eswatini Eswatini Environment Authority
Data providers	Reliable and regular provision of key datasets	Technical skills, legal authority to improve and enhance data collection	Ministry of Natural Resources and Energy (who collect data from industry), Eswatini Revenue Authority, Eswatini Environment Authority, Central Statistics Office, private sector organizations

In the Waste sector, tracking progress of mitigation is set against the GHG inventory. There is a legal mandate to collect data on waste management, monitoring compliance, and enforcement. The Waste Information System under this mandate is to be implemented. Whilst no existing arrangements to track emissions (e.g., MoU) are in place, institutions such as the MHUD, MTAD, MCIT, and EEA have legal mandates for waste management. The roles of these institutions as data providers are shown in Table 5-2.

Municipal Solid Waste data are still very limited, though most municipalities have started in the last three years to record data on waste collected. Progress on reporting on segregated waste data has also been made with some municipalities (as early as 2006) keeping records and information such as recyclable waste not going to the waste stream. The information is, however, not yet representative of the whole country. Through recent projects, such as the CBIT, improvements have been made in the Waste sector reports. For the Wastewater sector the activity data needed is collected from the SDG database, for which the country already has an MRV system in place

Table 5 2: Key stakeholders in the Waste sector.

Industry	Category	Stakeholders
4A – Solid Waste Disposal	Managed Waste Disposal Sites	<ul style="list-style-type: none"> • EEA • Municipalities • Company towns • MHUD
	Unmanaged Waste Disposal Sites	
	Uncategorized Waste Disposal Sites	
4B – Biological Treatment of Solid Waste	Biological Treatment of Solid Waste	<ul style="list-style-type: none"> • EWSC • Company Towns • EEA
4C – Incineration and Open Burning of Waste	4D1 – Waste Incineration	<ul style="list-style-type: none"> • Ministry of Health • Private hospitals • Company hospitals • EEA
	4D2 – Open Burning of waste	<ul style="list-style-type: none"> • EEA • Municipalities
4D – Wastewater Treatment and discharge	4D1 – Domestic Wastewater Treatment and Discharge	<ul style="list-style-type: none"> • EEC • ILLOVO • RES • Tongaat Hullets • Montigny

For the AFOLU sector, tracking progress of mitigation is set against the GHG inventory. Under the ICAT project, an updated LULUCF inventory baseline from 2001 to 2020 has been produced that will be used to update the 2020 GHG inventory. Further improvements in terms of livestock data have been made, specifically through initiatives such as the country's ICAT project in which templates for both livestock and non-livestock sectors were developed.

The Department of Forestry in MTEA, and the Departments of Agriculture and Extension Services, and Livestock and Veterinary Services in MoA have legal mandates to coordinate data collection processes otherwise no pre-existing formal data agreements exist. With the shift towards Tier 2 GHG inventory methodologies, data will also be collected from farmers. However, there are insufficient arrangements in place to enable the collection of activity data for sustainable land

management practices and small-scale forestry. There is a need for a MoU between the Ministry of Agriculture and MTEA to source spatial data. The key roles and responsibilities needed for the MRV of mitigation actions in this sector are shown in Table 5-3.

Table 5-2: Roles and necessary capacities of institutions and Individual team members.

Title	Responsibility	Necessary Capacities	Position (Org)
National entity	Overall responsibility for expected outputs such as NCs, BURs.	Administrative skills, government authority	Ministry of Tourism and Environmental Affairs
Steering Committee	Provide overall planning, coordination, management and technical facilitators of inputs and outputs.	Technical and administrative expertise, government authority	National Climate Change Committee (NC4)
Inventory coordinator	Management of the inventory program and timelines	Technical and administrative expertise, government authority, capacity to coordinate and lead process	Project based coordinator, Eswatini Meteorological Services
QA/QC coordinator	Implementation of QA/QC Plan, oversees cross-cutting QA/QC	Quantitative skills, knowledge of the UNFCCC reporting requirements and IPCC methodologies	Project based coordinator, Eswatini Meteorological Services, external consultants (Aether).
Inventory compilers (sector experts)	Day to day compilation of the GHG inventory and projections for the sector	Quantitative skills, knowledge of the UNFCCC reporting requirements and IPCC methodologies	Senior Land Use Officer. Department of Agriculture University of Eswatini
Data providers	Reliable and regular provision of key datasets	Technical skills, legal authority to improve and enhance data collection	Ministry of agriculture, Forestry Department, Eswatini Revenue Authority, Eswatini Sugar Association, Eswatini National Trust Commission, University of Eswatini

5.4 MRV for Support Received

The overall mandate of the MTEA is to manage and co-ordinate the national climate action programme including mitigation and adaptation policy development and implementation. This ministry also serves as the National Designated Authority for the financial mechanisms under the UNFCCC, with the responsibility to approve readiness proposals and climate change mitigation and adaptation projects, and to interact with climate finance institutions. The country is in the process of addressing the need for an effective system to monitor and manage finance flow into the country (this will be addressed as part of the development of the MRV tool under CBIT as discussed in Section 6.6 below).

Accessibility of data and information related to climate change expenditures is a challenge for Eswatini, as is the case in many developing countries, where clear and specific information on distribution of climate-related expenditure in national budgets is not recorded and/or accounted for. Furthermore, due to the cross-cutting nature of climate change, many development-related projects have mitigation and/or adaptation components, and extracting climate-change related expenditure is challenging.

International funding coming into the country is tracked by the Aid Coordination Management Section (ACMS) of the Ministry of Economic Planning and Development (MEPD) (GoE-MTEA, 2021b). Climate finance provided by some donors to government ministries, domestic public climate finance, and external and domestic social and private climate finance are not included. It also does not include climate finance received by public institutions other than ministries (i.e., parastatals and sub-national governments) and climate finance received by non-public institutions, including NGOs, academia, and the private sector (GoE-MTEA, 2021a). The External Assistance Report is published annually by the ACMS, and the monitoring and reporting considers 11 sectors, one which is environment, of which climate change is a sub-sector. The Ministry of Finance compiles climate change budget allocations and actual expenditures data and information which includes the yearly breakdown of projects and programmes approved through national budgets, implementing agency, total budget allocation, actual expenditures incurred, and whether the projects contain mitigation and/or adaptation components (GoE-MTEA, 2021b).

The Public Finance Management Act mandates ministries to report on the climate funding that is received; however, there are compliance challenges and confusion that exists around the budget cycle and reporting needs. As such, there are challenges in the coverage of information reported in the ACMS for reporting.

Progress is also needed in setting arrangements for monitoring, coding, and tracking climate change expenditures to enhance accountability and transparency in line with the Paris Agreement, as well as mechanisms to identify the sources of finance and track how the funds are used. The CPEIR of 2021, emphasised the need to account for climate change expenditures in a systematic manner and made the following recommendations, based on gaps identified in its review of climate expenditure, in order to strengthen the government's mechanisms to better manage its climate action programme in the country (GoE- MTEA, 2021b):

- Integration of climate change into national budgeting process through the establishment of a system for functional budget tagging of climate change expenditures classification. This includes a need for training all relevant national staff on the use and implementation of the system.
- Address cashflow situation for climate budget allocations, which has not allowed the government to allocate the approved funds for the projects and programmes.

- Develop and implement a climate finance tracking tool to include all recipients of climate finance. While public funds are well documented and to some extent tracked, climate finance is also being spent by non-government actors and by the private sector. Such contributions often remain off-budget, but should be tracked, accounted for, and acknowledged for a more comprehensive picture of climate finance expenditures.
- Sensitise policymakers and stakeholders on the importance and rationale for climate change expenditures accounting and budget tagging.
- Regularly update the CPEIR.

5.5 Planned Improvements

Gaps and opportunities for strengthening domestic MRV processes are viewed in the context of what already exists and what is needed to ensure that all the principles of transparency and accuracy are met, whilst ensuring the effectiveness and sustainability of the reporting processes. The country views its MRV needs within the context of local capacity and resources for MRV, and the key needs towards tracking the achievement of its national mitigation goals.

The country has taken steps towards enhancing its MRV capabilities towards improved reporting and tracking of mitigation actions, particularly through improvements in its GHG emissions inventory. The GHG inventory will, over time, play an important role in the country's MRV system as a key element in setting mitigation goals, through identifying the high-emitting sectors and sources therein, and understanding opportunities for mitigation. The country has also taken steps in terms of improving their MRV of financial support provided and received, and in terms of assessment of further support required to inform the global stocktake under Article 14 of the Paris Agreement.

Processes are already underway to address the data gaps and develop country-specific emission factors. Ongoing projects with support from the Initiative for Climate Action Transparency (ICAT) are aimed at improving the collection of activity data and institutional arrangements for all the sectors of the NDCs. The ICAT project is supporting the government to set-up sectoral MRV systems and enhance capabilities such that the GHG inventory for the agriculture sector can be compiled using Tier 2 data for future inventory compilation. Specifically, data collection templates for Tier 2 agriculture GHG inventory are being developed, and a roadmap for agricultural GHG emissions reporting with respect to enhancing the data collection and institutional arrangements. Similarly for the Energy sector, work is underway to produce more robust energy balances in the future, thereby improving the estimation of GHG emissions from the Energy sector. These steps will contribute towards ongoing efforts to improve the availability, collection, and quality of data

needed for estimating emissions in the Energy and AFOLU sectors, and enable Eswatini to meet its enhanced international reporting standard requirement.

The roles, responsibilities, and legal framework (organisation mandates) supporting the reporting of the GHG inventory will be further formalised through upcoming support programmes including the United National Development Programme (UNDP) Climate Promise Initiative, the NDC Partnership Climate Action Enhancement Package (CAEP), and the CBIT programmes of work (MTEA, 2020).

Capacity within the MTEA to coordinate inter-ministerial agreements and facilitate data sharing with the relevant departments, requires dedicated financial resources and staff. The process to establish a unit within the MTEA that is dedicated to the development of the national communications, including a sustainable GHG inventory system, is currently still underway. The country is currently implementing steps to establish an institutional framework that will be responsible for reporting under the UNFCCC. A transition from temporary or ad-hoc operations to more permanent institutional arrangements is being set up through the development of the Climate Transparency Unit, and will facilitate a sustained process involving permanent national teams. Through the CBIT project, the MTEA is coordinating all stakeholders and establishing an online MRV platform that will be complemented with the tools, templates, and guidelines for MRV. Country specific metrics, indicators, and methodologies will be used on the platform towards tracking and mainstreaming of the NDCs into the National Climate Change Policy. This process will also see a strengthening of the linkages between the organizations responsible for the preparation of the national inventories and other national organizations involved in the collection of activity data.

The enhancements in terms of effective institutional arrangements, a centralised platform for data collection, and an MRV system will strengthen the capacity of the country to plan, implement, and report on its NDCs.

5.6 References

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ANNEXES

ANNEX 4.1. International climate finance received between 1997 and 2020 (Amounts in USD)

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Loan	Ezulwini Sustainable Water and Sanitation Service Delivery	AfDB	AfDB	Eswatini Water Services Corporation (EWSC), Ezulwini Municipality	23 013 000	0	23 013 000	Ongoing	Apr 15	Dec 22
Grant	Energy Technical Assistance Programme	AfDB	AfDB	MNRE	1 006 041	0	1 006 041	Completed	Dec 15	Sep 18
Loan	Lower Usuthu Smallholder Irrigation Project II (LUSIP)	AfDB	AfD	Ministry of agriculture - Eswatini Agricultural Development Enterprise (ESWADE)	0	0	0	Ongoing	Oct 16	Dec 21
Grant	Mkondvo-Ngwavuma Water Augmentation Program (MNWAP)	AFDB	AFDB	Eswatini Water and Agricultural Development Enterprise	1 200 000	837 859	2 037 859	On-going	May 20	Dec 22
Loan	Mbabane Manzini Multipurpose Dam	AFDB	AFDB	MNRE	1 014 944	0	1 014 944	Completed	Feb 16	Dec 21
Grant	Enhancing Readiness for Investment in Low Carbon and Climate Resilient Development in Eswatini	AFDB	AfDB	Ministry of Tourism and Environmental Affairs (MTEA)	305 000	0	305 000	Completed	Oct 15	Dec 18

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Grant	Program for the Ecosystem Management of the Swaziland Lubombo	CEPF and COPSE	COSPE (Development Cooperation for Emerging Economies -Italy), Swaziland National Trust Commission (SNTC), GIZ, etc.		269 960	0	269 960	Completed	Jul 12	Oct 15
Grant	Increasing Farmer Resilience to Climate Change- Upscaling Market Oriented Climate Smart Agriculture Project	COMESA	UNDP	NAMBOARD	636 363	200 000	836 363	Ongoing	May 18	Dec 20
Grant	PRO-Swazi: Promotion of rural opportunities in Swaziland	COSPE	SNAU (Swaziland National Agriculture Union)		1 319 208	0	1 319 208	Completed	Feb 13	Jan 17
Grant	PREVENT AND RESPOND TO CLIMATE CHANGE: Resilient practices of mitigation of drought effects in Swaziland and Mozambique	COSPE		Ministry of agriculture	2 892 500	0	2 892 500	On-going	Jan 18	Feb 21

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Grant	High value Crop and Horticulture Project (HVCHP)	EDF (EU)	EDF (EU)	ESWADE, National Agriculture Marketing Board (NAMBOARD)	15 235 000	0	15 235 000	Ongoing	Jun 15	Jun 20
Grant	Support to Water & Sanitation in Swaziland (SWASS)	EU	EU	MNRE, EWSC	24 409 666	0	24 409 666	Completed	Jul 12	Sep 17
Grant	Water Harvesting, Small and Medium Earth Dams Project	EU	EU	MoA	16 481 261	0	16 481 261	Ongoing	Oct 16	Oct 21
Grant	Swaziland Agricultural Development Programme	EU, USAID, Government of Canada, Government of the Netherlands	FAO	MoA	20 811 844	0	20 811 844	Completed	Dec 07	Dec 17
Grant	Incorporation of Climate Smart Agriculture in Eswatini Schools and Agriculture Training Centres	Food and Agriculture Organization (FAO) TCP Funds	FAO	Ministry of Agriculture (MoA)	263 000	0	263 000	Ongoing	May 17	Apr 19
Grant	Green Climate Fund (GCF) Readiness Support Project for Eswatini	GCF	UN Environment	MTEA	299 032	0	299 032	Ongoing	Mar 18	Dec 20

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Grant	Building Capacity to Advance National Adaptation Planning in Eswatini	GCF	UN Environment	MTEA	2 796 400	0	2 796 400	Ongoing	Feb 19	Feb 22
Grant	National framework for leapfrogging to Energy Efficient Appliances and Equipment in Eswatini (Refrigerators and Distribution Transformers) through regulatory and financing mechanism	GCF	UN Environment - The Climate Technology Centre and Network (CTCN)	MTEA, MNRE, Eswatini Standards Authority (SWASA)	328 755	0	328 755	Approved but not yet started	Jun 20	Jul 20
Grant	SIP: Lower Usuthu Smallholder Irrigation Project (LUSIP)	GEF	International Fund for Agricultural Development (IFAD)	ESWADE	1 972 820	8 671 080	10 643 900	Completed	May 09	Mar 15
Grant	Adapting national and transboundary water resource management in Swaziland to manage expected climate change	GEF	UNDP	MNRE	1 670 000	3 720 000	5 390 000	Completed	Jan 12	Dec 16

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Grant	Strengthening National Protected Areas System (SNPAS)	GEF	UNDP	Eswatini National Trust Commission (ENTC)	5 390 000	25 000 000	30 390 000	Ongoing	Feb 14	Dec 20
Grant	Food-IAP: Climate-Smart Agriculture for Climate-Resilient Livelihoods (CSARL)	GEF	IFAD	MoA, ESWADE, Eswatini Environmental Authority (EEA)	7 211 009	48 000 000	55 211 009	Ongoing	Jul 16	Sep 23
Grant	Preparation of National Communications and Biennial Update Reports to the UNFCCC	GEF	UN Environment	MTEA	852 000	147 000	999 000	Ongoing	Jul 18	Jul 21
Grant	Enabling Activities for the Implementation of the UNFCCC	GEF	UNDP	Swaziland Meteorological Services	303 850	0	303 850	Completed	Mar 97	Jul 06
Grant	SolarChill development, testing and technology transfer outreach	GEF	UNEP	Ministry of Health	2 712 150	8 033 500	10 745 650	Completed	Jun 16	Sep 21

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Grant	Preparation of Nationally Determined Contribution (INDC) to the 2015 Agreement under the United Nations Framework Convention on Climate Change (UNFCCC)	GEF	UNEP	The Ministry of Tourism and Environmental Affairs, Department of Meteorology	200 000	0	200 000	Completed	Nov 14	No completion date on GEF website
Grant	Development of a Strategic Market Intervention Approach for Grid-Connected Solar Energy Technologies (EMPower)	GEF	UNEP	UNEP and KfW	975 000	800 000	1 775 000	Completed	Nov 03	May 05
Grant	Eswatini drought preparedness	GFDRR		NDMA	200 000	0	200 000	On-going	Jul 19	Aug 21
Grant	Capacity building for enhanced transparency in climate change MRV	Global Environment Facility (GEF)	UN Environment	MTEA	1 000 000	270 000	1 270 000	Ongoing	Dec 19	Dec 22
Grant (0.5M) and Loan (9.6M)	Smallholder Market led Project	IFAD	IFAD	ESWADE	10 100 000	14 410 000	24 510 000	Ongoing	Feb 16	Jan 22

Financial flows/ support	Project name	DONOR	Implementing Agency	National Executing Agency	External	Co-financing	Total	Status	Start date	Completion date
Loan	Water Supply and Sanitation Access Project	International Bank for Reconstruction And Development (IBRD)	World Bank	EWSC	45 000 000	0	45 000 000	Ongoing	Sep 19	Sep 25
Grant	Greening the Raleigh Fitkin Memorial Hospital demonstration project	Italian Government	UNDP	MNRE	2 727 234	202 016	2 929 250	Ongoing	Mar 20	Dec 20
Grant	Strengthen Eswatini's Early Warning System and Climate Services	Italian Government	UNDP	MTEA	1 088 681	0	1 088 681	Ongoing	Mar 20	Apr 21
Loan	Lower Usuthu Water Supply Project	Organization of the Petroleum Exporting Countries (OPEC) Fund for International Development (OFID)	OFID	Eswatini Water and Agricultural Development Enterprise (ESWADE)	14 160 000	1 000 000	15 910 000	Completed	2013	2016
Grant	Environment Sustainability and Climate Change	UNDP	UNDP	MTEA	137 143	0	137 143	Ongoing	Mar 12	Dec 20
Grant	NDC Review and Updating	UNDP, COMESA, UNEP, Commonwealth	NDC Partnership	MTEA, Ministry of Economic Planning and Development (MEPD)						

ANNEX 4.2. Climate change-related expenditures between 2015-2020 (all projects) (Amounts are shown in Swazi lilangeni (E) and in millions)

Project Code	Funder	Implementing Ministry	Total Budget allocation (5-year) E'000	Actual Expenditure (5-year) E'000	Project Name	Purpose of funding
A324	Government	Ministry of Agriculture	175 550	155 000	Lower Usuthu - Downstream Development (LUSIP (I))	Project was aimed at increasing agricultural production and household incomes in the Lower Usuthu Basin through the provision of water for irrigation schemes through the development of water infrastructure amongst others.
	Global Environment Fund		6992	0		
A337	Government	Ministry of Natural Resources & Energy	18 148	18 148	SISOMA	Improve Water Supply Service and sanitation facilities to 20,000 people in three targeted rural communities. The project also provided renewable energy for use by the project.
	European Development Fund Grant		195000	0		
A360	Government	Ministry of Agriculture	27 139	16 643	Purchase of Heavy Plant & Earth Dam Construction Equipment	Project purchased heavy plant equipment for the construction of water harvesting structures, water conveyance systems. Irrigation infrastructure and soil conservation structures.
A372	Government	Ministry of Agriculture	21 000	45 712	Water & Irrigation Development at Sigangeni, Mpuluzi, Gege, Ngcoseni & Nyamane	Project entailed installation of an irrigation infrastructure, construction of fishponds and soil conservation structures at Mayiwane Dam as well as the construction of medium sized dam and installation of irrigation infrastructure at Malanti community.
A380	Government	Ministry of Agriculture	65 962	40 962	Small-holder Market Led Production	The development objective of Smallholder Market-Led Project is that smallholder households in the Project Chiefdoms sustainably enhance food and nutrition security and incomes through diversified climate resilient agricultural production and market-linkages.
	IFAD Loan		184476	30142		

Project Code	Funder	Implementing Ministry	Total Budget allocation (5-year) E'000	Actual Expenditure (5-year) E'000	Project Name	Purpose of funding
A381	Government	Ministry of Agriculture	481 569	481 569	Lower Usuthu II Extension - Downstream Dev.	Project is an extension of LUSIP I and mainly involved construction of a conveyance system and water canals with the aim of increasing agricultural production and household incomes in the targeted rural area through irrigation schemes. The project also aims at effective management of biophysical environment to promote conservation and minimize negative impacts of project construction and operation.
	AfDB Loan		1807548	201113		
E343	Government	Ministry of Education & Training	9 000	7 196	Water Supply to Schools VII	Project entails purchasing of water tanks and accessories for distribution in selected primary & secondary schools to increase access to clean water.
E344	Government	Ministry of Education & Training	14 000	10 000	Schools Toilets VII	Project constructs VIP (Ventilated Improved pit latrines) and flush toilets in selected rural & urban schools across the country.
E397	Government	Ministry of Education & Training	114 000	110 997	Emergency Response and Rehabilitation of Government Schools Phase I	Project funds emergency response and rehabilitation of storm damaged schools.
E447	Taiwan Grant	Ministry of Education & Training	4950	0	Provision of Water to Rural Schools	Project was funded through donor funds and involved the provision of water in selected rural schools.
F017	Government	Ministry of Natural Resources & Energy	6 000	1 000	Energy Efficiency in Public Buildings	The Project involves installation of energy efficient technologies in public institutions.
F019	Government	Ministry of Natural Resources and Energy	1 900	1 082	Fuel Marking and Quality Assurance	This project entails establishment of long-term monitoring of fuel volumes, revenue and quality assurance and capacity building.
F020	Government	Ministry of Natural Resources & Energy	6 120	592	Ethanol Blending	Ethanol blending programme at government depots, capacity building and study tours on the biofuels industry.

Project Code	Funder	Implementing Ministry	Total Budget allocation (5-year) E'000	Actual Expenditure (5-year) E'000	Project Name	Purpose of funding
F030	Government	Ministry of Natural Resources & Energy	17 738	17 576	Rural Electrification VI	Projects extend electricity grid in rural communities.
	Taiwan Grant		198788	172035		
G609	Government	Ministry of Economic Planning & Dev.	660 000	621 000	Microprojects - Infrastructure Development VI	Fund to develop rural communities through provision of water supply, sanitation, rural electrification schemes, construction of bridges and dip tanks and other community development needs.
H339	Government	Ministry of Health	10 000	9 435	Water & Sanitation Project II	Project constitutes providing portable water and construction of pit latrines in several health facility locations in the country.
H345	Government	Ministry of Health	20 500	18 497	Provision of Water in Health Facilities	Project funds provision of water in health facilities.
P306	Government	Fire & Emergency Services	32 000	23 935	Replacement of Firefighting Equipment and Specialized Vehicles	This involves the purchase of firefighting vehicles and specialized equipment to meet current and future fire service needs.
P338	Government	Correctional Services	17 173	16 405	Irrigation Infrastructure for Correctional Farms	Project entails installation of irrigation infrastructure from local rivers and/ construction of a dam for increased agricultural production to enhance food security for inmates.
P347	Government	Fire & Emergency Services	13 200	10 959	Mobile Satellite Fire Stations	Project entails the construction of Fire Stations across the country to increase national coverage.
P349	Taiwan Grant	Fire & Emergency Services	26000	14417	Procurement of Three Water Tankers (Bush Tenders Phase II)	Project was for the purchasing of three water tankers to meet current and future fire services needs.
T359	Government	Ministry of Public Works and Transport	23 500	63 480	Rehabilitation and Upgrading of Link Roads	Project constructs, upgrades, and rehabilitates feeder roads, low level bridges in rural areas.

Project Code	Funder	Implementing Ministry	Total Budget allocation (5-year) E'000	Actual Expenditure (5-year) E'000	Project Name	Purpose of funding
T363	Government	Ministry of Public Works & Transport	172 000	120 137	Rehabilitation & Maintenance of the Feeder Roads Network & Rehabilitation of Armcos and Calverts	Project constructs, upgrades and rehabilitates feeder roads, low level bridges in rural areas.
T512	Government	Ministry of Public Works & Transport	105 850	5 849	Chemical Soil Stabilizers (Probase)	Project upgrades gravel roads in rural areas using chemical soil stabilizers.
W361	Government	Ministry of Tourism	6 800	800	Augmentation of Met. Observation Stations and Installation of Thunderstorm Detection Equipment	Project entails upgrading of weather station and implementation of Quality Management systems in compliance to ICAO resolution 75.
W370	Government	Ministry of Natural Resources & Energy	47 000	68 138	Feasibility Study-Mkhondvo & Nondvo Dams	Project was accessing the feasibility for the construction of multipurpose dams, whose main objective was to store water to provide potable water to the two growing cities of Mbabane and Manzini. With the aim to reduce poverty and increase economic growth, the project seeks to improve availability of water resources for the local population livelihood as well as their productive activities.
	AfDB Loan		83000	0		
W375	Taiwan	Ministry of Economic Planning and Development	12500	23895	Water and Sanitation Phase 2	Project constitutes providing portable water and construction of pit latrines in several health facility locations in the country.
W377	Government	Ministry of Natural Resources and Energy	30 000	30 000	Manzini Region Water and Sanitation	The objective of the Project is to meet the potable water requirements of Manzini and surrounding areas and reduce the risk of environmental pollution of the groundwater through provision of appropriate sanitation services.
	AfDB Loan		180000	0		

Project Code	Funder	Implementing Ministry	Total Budget allocation (5-year) E'000	Actual Expenditure (5-year) E'000	Project Name	Purpose of funding
W465	Government	Ministry of Natural Resources & Energy	153 200	153 200	Ezulwini Water Supply & Sewer	The project is designed to augment water supply to Ezulwini Town to meet its water demand and that of surrounding areas up to 2030. The project also has a sanitation component which involves construction of a sewerage network system for the town.
	AfDB Loan		519000	77589		
X202	Government	Ministry of Housing & Urban Development	36 000	13 525	Urban Development Project	Project centres on the resettlement of homesteads in densely populated peri-urban areas and provision of bulk infrastructure, roads and drainage systems, sanitation infrastructure and other community amenities.
X461	Government	Ministry of Natural Resources and Energy	4 200	1 646	Replacement of Water Testing Equipment and Rehab. Of DWA Laboratory	This project entails replacement of water quality testing equipment and rehabilitation of laboratory.
X465	Government	Ministry of Natural Resources and Energy	20 000	40 000	Ezulwini Water Supply and Sewer	The project is designed to augment water supply to Ezulwini Town to meet its water demand and that of surrounding areas up to 2030. The project also has a sanitation component which involves construction of a sewerage network system for the town.
X480	Government	Ministry of Housing & Urban Development	180 000	140 000	Intergovernmental Capital Development Fund	Project funds are for financing infrastructure development in Urban Local Governments such as the construction of roads and drainage systems, solid waste management equipment etc.
X482	Government	Ministry of Housing and Urban Development	8 000	0	Relocation of Solid Waste Disposal Site at Matsapha	Completion of access road.

Project Code	Funder	Implementing Ministry	Total Budget allocation (5-year) E'000	Actual Expenditure (5-year) E'000	Project Name	Purpose of funding
X485	Government	Ministry of Natural Resources & Energy	200 000	200 000	Nhlangano Water Supply & Sewerage	Project focussed on increasing capacity to supply water to Nhlangano Town through constructing a water treatment plant in a nearby area. This project initially catered for a population of 16,500 residents.
X486	Government the principal national agent for supervising household and commercial waste under the auspices of urban local government bodies such as city councils, town councils, and town boards. Waste sector action: avoiding, minimizing, and recycling solid waste actions to mitigate climate change. <i>Table 3-6: Overview of avoiding, minimizing, and recycling solid waste actions to mitigate climate change.</i>	Ministry of Natural Resources & Energy	27 000	27 000	New Sewer Treatment Plant for Matsapha Industrial Town	Project constructed a sewerage treatment plant for Matsapha Industrial Town to augment water Supply for the town to meet economic development needs.
X498	Government	Ministry of Natural Resources & Energy	1 500	576	Procurement of Tools and Equipment for Portable Water Schemes	Project procured tools and equipment for portable water schemes.
X501	Government	Ministry of Natural Resources & Energy	97 000	69 010	Rural Water Supply XIII	Project resuscitates rural water supply schemes and develops new water schemes in various communities across the country.