Scoping and gap analysis for the energy sector in Eswatini

ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency - ICAT

Scoping and gap analysis report for the energy sector in Eswatini

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Executive Summary

Background

This report present a scoping and gap analysis report for measurement, reporting, and verification of the energy and transport sector greenhouse gas (GHG) inventory. It is a component of the "Technical support to increase the overall transparency capacity and set-up of sectoral MRV systems in the Kingdom of Eswatini,"[i] funded by the Initiative for Climate Action Transparency (ICAT) and the United Nations Office for Project Services (UNOPS), managed by the Government of Eswatini through the Ministry of Tourism and Environmental Affairs (MTEA). The report is prepared by the Centre for Sustainable Energy Research (CSER) at the University of Eswatini supported technically by the Greenhouse Gas Management Institute (GHGMI). The specific objective of this report is to Identify data sources, data suppliers and data gaps through consultation with Ministry of MNRE and other energy stakeholders, in particular, the MPWT to obtain Eswatini fleet data to enable Tier 2 GHG emissions reporting and also to Identify data requirements for a sustainable energy balance.

The work started with the engagement of high-level officers in the MNRE responsible for the preparation of Eswatini's annual energy balance. The Ministry granted the CSER permission to engage with all relevant officers in MNRE's Department of Energy. Two contact officers were assigned to the ICAT Eswatini energy sector project to assist the CSER Team to make engagements within the MNRE and other Government and non-Government entities, as necessary. A questionnaire was prepared by the Team and sent to the officers. This was followed up by a face-to-face meeting that included the Principal Energy Officer in the Department. During the course of the ICAT Eswatini Project, these Department of Energy personnel worked closely with the Activity 2 Energy Team to support the Team with information provided by the MNRE, with contacts and meeting arrangements with key Government and non-Government agencies ranging from the Eswatini Energy Regulatory Authority (ESERA), to the Eswatini Electricity Corporation (EEC), Central Statistics Office (CSO), Ministry of Economic Development and Planning (MEDP), among others.

Results

The officers provided information on their data providers, the kind of data they collect, matters of data reliability, and challenges they face and have faced. They also shared the data collection templates that are used by the Department of Energy to collect information from the industrial, commercial and institutional economic sectors. They pointed to the existence of data gaps on historical data that they have found difficult to close. The summary findings of the preliminary engagement with MNRE are given in the table below. The results indicate the institutional arrangements required. These will be incorporated in the Energy Sector Data Collection Roadmap which will comprise the final report for this Activity.

Sector	Identified gaps and constraints	Measures to address
Transport subsector gaps and needs	1. GHG emission estimates are currently calculated using fuel consumption data provided by the MNRE, (Tier 1)	1. Improve the data scope to include relevant data for Tier 2 GHG emissions determination.
	2. Unavailability of Data for Tier 2 and uncoordinated data sharing with the Climate Change Unit. Unavailable data include the following: a. Annual distances travelled b. Occupancy rates of passenger vehicles c. Tonnes of freight transported and d. Vehicle fuel type does not appear in registration certificate.	1. Develop institutional arrangements between MTEA, MNRE, MoF (Ministry of Finance), and MPWT to improve data collection and sharing. 2. Develop sector specific online data collection templates for road license renewal in an App format. 3. Develop software for data sharing between the relevant ministries. 4. Include fuel type in the database for motor vehicle registration.
	3. Climate change has not been mainstreamed within the transport sector. There are no climate change personnel responsible for such. There is a poor understanding of the GHG inventory process, reporting and accounting methodologies within MWPT.	1 MTEA must sensitise road transport staff at MWPT and the Ministry of Finance (which collects fleet data for MPWT) on climate change matters. 2 Assign staff within MNRE, MoF, MWPT and MTEA to coordinate and oversee MRV in the transport sector. 3 Need to update the online repositories and archive for data
Energy sector gaps and needs	1. MNRE is interested in total energy consumption per sector without regard to the end-use technology required for calculating GHG emissions.	1. Develop an institutional arrangement where MNRE is responsible for energy sector GHG inventory estimates so that they conduct their data collection in consideration of the subsequent GHG inventory determinations.
	2. Estimates of residential wood fuel (biomass) use are based on a model that is based the results of a very old study (1993).	1. Fast track the proposed biomass study. 2. Use computational modelling expertise from the University of Eswatini to develop a local model for residential biomass usage based on the results of the study.
	3. Improve industrial biomass data collection.	1. Also collect biomass data usage for self-consumption in industry, for example in the timber industry; and include the end-use technology for fuels.

	4. Insufficient data for non-energy use of petroleum fuel in industry.	1. Data collection templates must provide for the entry of non-energy use for fuels.
	5. Missing regulatory mechanism that assigns responsibility for data capture and sharing between MNRE and all entities – current data is shared under common understanding.	1. Formal instruments must be put in place to compel all entities to share data of national importance. 2. Some industries, particularly those brought into the country by the Eswatini Industrial Promotion Authority (EIPA), tend to have stronger ties with that entity, which can engage to assist in getting more cooperation from them. 3. Several entities like the MEPD and the Eswatini Environment Authority requires some data on regular basis from the same data providers surveyed by MNRE. Collaborations amongst these entities is essential so that the needed data are collected once a year at the same time to reduce fatigue on the data providers. 4. Municipalities also have bylaws that organisations within their jurisdiction must abide by. Collaboration with municipalities can also be an enabler for data collection.
	6. No MRV mechanism for energy balance	1. Climate action must be mainstreamed in the energy sector with transparent data capture and sharing of GHG energy data between MNRE units (bottom-up approach). 2. A dashboard archive system for energy balance must be developed.
	7. Minimum mainstreaming of Climate Change issues, i.e. Energy balance does not include climate and SDG indicators.	1. MTEA must coordinate collaboration between MNRE, Ministry of Economic Planning and Development (MEPD) and development partners such as UNDP to include climate and SDG indicators as part of an annual energy balance report.
	8. No robust system of data verification, audits, quality checks with stakeholders	1. Develop internal quality control protocols for data collection and put in place quality assurance systems. 2. Identify external entities to conduct quality assurance of collected data and to assess internal quality systems.
	9. Inadequate finance, personnel, skills, equipment and materials	1. Mobilise all necessary resources to upskill, increase personnel and provide tools and finance to build capacity to mainstream climate

	to mainstream climate change at MNRE.	change at MNRE.

Recommendations

The engagement with MNRE and data providers revealed some gaps and constraints in the data collection process required for MRV system and design. In this section, recommendations to enable MNRE to get technical support, capacity building and access to climate change funds to improve the data collection process for the sustainable robust energy balance are being made. Such can include studies by MNRE, training of staff, and even increasing human capacity and tools within the Ministry to strengthen its climate change aspect of the energy sector. Training MNRE staff on the determination of GHG emission inventories in the energy sector could enable the staff to appreciate the need to disaggregate data to end-use technology level.

The collection and compilation of energy statistics needed to generate a complete energy balance requires collaborative effort with a number of stakeholders. Amongst others, these include MPWT, MEPD, MOF, CSO, ESERA, EEC, ERS, EEA, EIPA, municipalities, energy research institutions (e.g. the CSER), business federations, and others. MNRE is currently not backed up with strong institutional arrangements and adequate funding to fully incorporate climate change matters in their daily work. The following recommendations are further proposed which will create a coordinated and sustainable energy collection system leading to improved transparency and quality of energy data.

1. Establishing appropriate institutional arrangements among all relevant governmental ministries, e.g., MNRE and MTEA, MPWT, MOF, CSO, ERS, EIPA, EEA, and other government agencies, that defines a clear mandate for involvement in transparency related work is of paramount importance. This will ensure the collection and compilation of high-quality energy statistics and periodically and review their effectiveness. The responsibilities of each of the stakeholders involved in data collection and compilation, energy data processing and ensuring data quality should be clearly defined.
2. 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.
3. There is a need for stakeholder awareness in data sharing, especially in the private sector. Quarterly and annual workshops among MNRE, CSO and data providers should be organized to harmonize, reconcile data collected share best practices, fine tune data collection practices and strengthen data quality control procedures.
4. The sectoral breakdown of final energy consumption is not thoroughly compiled in the energy balance. This needs to be improved for a compilation of a full energy balance. There is a need to establish breakdown keys for final energy consumption by sector and further by main energy uses. The level of data disaggregation need to be increased for more detailed input data at end-use technology level. For the transport sub-sector, calculations based on distance travelled i.e. bottom-up approach need to be introduced to be more accurate and closer to quantifying actual emissions. More detailed data on disaggregation of final energy consumption in transport should be split between passenger and freight transport. Also, MNRE and MPWT to work together on disaggregation of data for transport sector technologies.
5. Data collection process should be reinforced to include establishment of a database a fundamental step towards filling data gaps in terms of ensuring time series consistency and completeness, data-sharing system and web-based knowledge management platform. A robust data information system work on energy statistics and balances requires additional technical, financial and human resources. All this is only possible when the long-term budget for energy statistics is ensured.
6. Data collecting templates customised for the different data providers to feed information into the energy balance need to be improved. Adding questions to the existing questionnaire to allow the collection of data with by classifying the energy consumers into the categories will result in a complete energy balance. It is also recommended that questions on energy end-use (cooling, cooking, lighting, etc.) be introduced into the survey.

7. It is recommended that the energy balances are disseminated through the MNRE website and sent directly to key stakeholders in easy-to-read formats.

Establish a unit dedicated to energy statistics and appoint a focal point responsible for data provision and management. There is further a need for capacity building in a sustainable manner through training and workshops and increasing the number of professionals in the transparency field to create a sustainable reporting system. This unit should be also responsible for calculating the energy sector GHG inventories to appreciate the need for for detailed data when preparing the national energy balance.

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Abbreviations

CSO	Central Statistics Office
CBIT	Capacity Building Initiative for Transparency
CSER	Centre for Sustainable Energy Research
EEC	Eswatini Electricity Company
ESERA	Eswatini Energy Regulatory Authority
ERS	Eswatini Revenue Service
EIPA	Eswatini Investment Promotion Authority
GHG	Greenhouse Gas
GHGMI	Greenhouse Gas Management Institute
GoE	Government of Eswatini
ICAT	Initiative for Climate Action Transparency
IPCC	Intergovernmental Panel on Climate Change
MEPD	Ministry of Economic Planning and Development
MNRE	Ministry of Natural Resources and Energy
MF	Ministry of Finance
MoU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
MTEA	Ministry of Tourism and Environmental Affairs
MPWT	Ministry of Public Works and Transport
NDC	Nationally Determined Contributions
QA	Quality Assurance
QC	Quality Control
UNESWA	University of Eswatini
UNFCCC	United Nations Framework Convention on Climate Change
UNOPS	United Nations Office for Project Services

1 Introduction

This project is on Energy sector greenhouse gas (GHG) inventory institutional arrangements and data collection roadmap with recommendations for monitoring reporting and verification (MRV) system and design. It is a component of the "**Technical support to increase the overall transparency capacity and set-up of sectoral MRV systems in the Kingdom of Eswatini**,"[2] funded by the Initiative for Climate Action Transparency (ICAT) through the United Nations Office for Project Services (UNOPS). The Project was managed by the Government of Eswatini through the Ministry of Tourism and Environmental Affairs (MTEA). Technical support was provided by the Greenhouse Gas Management Institute (GHGMI) under contract with ICAT. The executing agency is the Centre for Sustainable Energy Research (CSER) at the University of Eswatini (UNESWA), through an Energy Sector Activity Team.

The project is to contribute to the preparation of Eswatini to measure and assess the effects of climate actions of the country, as part of its commitments under the Paris Agreement to which it is party to. It is meant to improve data gathering, identify gaps and means to fill them, and to develop structures for producing sustainable energy balances in the future.

At present, a national energy balance, produced by the MNRE, provides information on energy flow in Eswatini's economy. It gives an account of total energy sourced from various local sources including the environment, imported, exported, and how it is transformed, traded and its end consumption. It also provides information on the contribution of each source and consumption by specific economic sectors. An energy balance also exposes the national energy market and helps in monitoring the effectiveness of policies through reviewing and verifying information on how close targets are met.

The information availed by energy balances can be used for future assessment of energy supply and demand and national energy security. Energy balances can also be used to compare energy statistics to those of previous periods, and those of other countries and regions. They can be used for the future through feeding into new policies, modelling and forecasting systems, and baseline GHG emissions and climate change mitigation scenario development. Since the energy balance is important for decision making, it is important that due diligence is accorded to its preparation.

This scoping and gap analysis report was developed through several engagements with the officers responsible for preparing the National Energy Balance (NEB) at MNRE, and stakeholders such as the Ministry of Public Works and Transport (MWPT), Central Motor Registry (CMR), Ministry of Finance, Central Statistics Office (CSO), Eswatini Environment Authority (EEA) and data providers. The MNRE officers provided information on their data providers, the kind of data they collect, matters of data reliability, and challenges they faced. They also shared the data collection templates that they use to collect information from the industrial sector. They pointed to data gaps on historical data that are near impossible to close save for by interpolation.

2 Methodology

The Needs and Gap Analysis outcome is the primary step towards the improvement of the MRV system within the energy and transport sector. It determines whether the current system of preparing the NEB requires interventions or not, and the action plan required to support a transparent climate action reporting in the sector. The following steps were taken to conduct the scoping and gap analysis exercise:

Step 1: A desktop review of published national reports and climate action plans was conducted. Officers at MNRE responsible for producing the national energy balance were also interviewed and consulted on the

methodologies used to collect the national energy consumption data feeding into the preparation of national GHG emissions from energy sources.

Step 2: Analysis of the energy sector in the country was carried out to identify all possible emission source categories, and these were listed in a table categorised according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Step 3: Analysis of the feasibility of Tier 2 transport calculations in the country was conducted. The team first noted that data collected from petroleum fuel sales from petrol stations may not a give an accurate picture of the GHG emission within Eswatini given that on a daily basis there are a number of vehicles from South Africa and Mozambique that fuel and transit over the country. Petrol and diesel is cheaper in Eswatini than in the two countries because Eswatini fuels tax levies are lower. To avoid the impact of fuel tourism on GHG emissions, the team decided to investigate improving data collected by the Eswatini Revenue Service (ERS) under the Ministry of Finance (MOF) on the annual car licence tax renewals. It should be possible that MPWT to require that annual car licence renewal form could also require car owners to record their odometer readings (annual kilometres travelled per vehicle, occupancy and tonnage rates and other information). Given that revenue office has all the details about vehicle types and engine capacity and consumption level, this data should enable Tier 2 transport calculations. These calculations should give more accurate fuel consumption by on-road transportation.

Step 4: Stakeholder mapping process depending upon their level of involvement in the data collection process including quality assurance to lead to the identification of institutional arrangements.

Step 5: Determinations of how the needs and gaps should be carried out through further consultations and interviews of the key role players and stakeholders. The goal of this step is to gain a consensus on the prioritization of the needs of the stakeholders to achieve the desired goal of producing sustainable robust energy balances for the country.

3 Eswatini Energy Sector Overview

The Ministry of Natural Resources and Energy is responsible for the collection of energy statistics in the country. It compiles and disseminates the annual energy balance through the Energy Data, Planning and Economy Section under the Department of Energy. A sample energy supply for the country is illustrated in Figure 1 for 2019.[3] In 2019 Eswatini's total primary energy supply was approximately 1 132 kilotonnes of oil equivalent (ktoe) which is supplied mainly from biomass (fuelwood, bagasse and woodchips), petroleum products, imported electricity, bituminous coal, local hydro and small amounts of solar power. Of the total primary energy supply, Eswatini produces about 60% mainly in the form of biomass and hydroelectricity, and the rest is supplied through imports from the Republic of South Africa, Republic of Mozambique and the Southern African Power Pool (SAPP).[4]

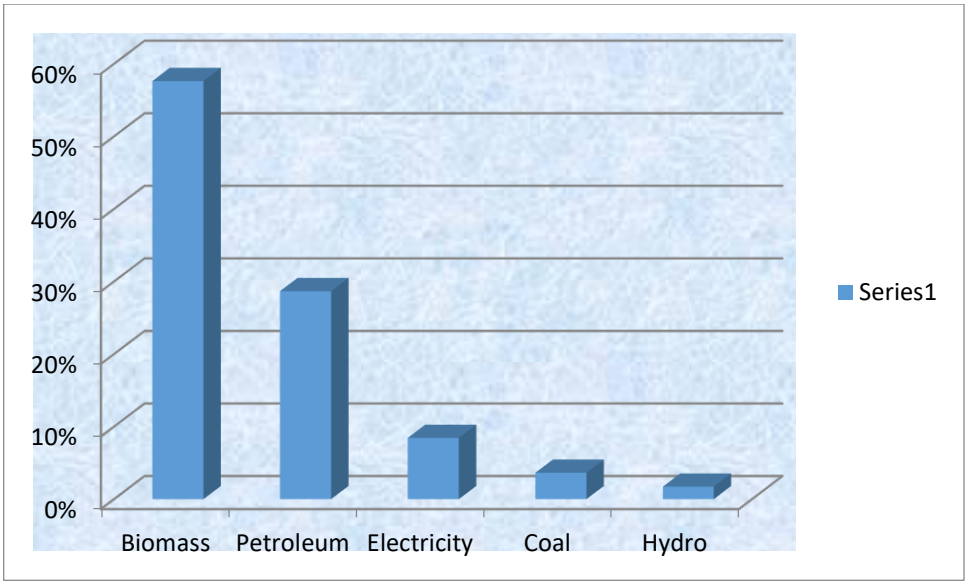

Figure-1 Energy Consumption for Eswatini in the Year 2018 (Sourced from 2018 Energy Balance)

3.1 Biomass

Biomass in the form of fuelwood is mainly used in rural households where it is mostly harvested from the indigenous forest in areas where it exists, which are most parts of the country. There is also harvesting of fuel wood from indigenous forests for use in the commercial sector where butcheries use it to cook maize meal and roast meat, and in the informal sector where people put-up road-side fresh maize and meat roasters. This harvesting together with uncontrolled settlements is reducing the indigenous forest cover, thus reducing the carbon sink and impacting biodiversity. In the north-western high grasslands of the country, the source of firewood is mostly exotic planted species such as wattle, pine and eucalyptus, which are not under any threat since they are somewhat invasive, in the sense that they gradually spread beyond the areas of original plantation. Biomass used in the sugar industry for heat and power generation is bagasse and wood chips which are sustainable. Bagasse is a direct byproduct of the sugar production from sugar cane. Wood chips are sourced directly from the timber industry or produced from logs purchased from plantation forests. Both the bagasse and woodchips are sourced from sustainable sources as there is always replanting after harvesting.

3.2 Coal

Eswatini imports all the bituminous coal that is used in the country for process heat, mainly in the Food and Beverages industry for products that include sugar, alcoholic and nonalcoholic beverages, soft drink concentrate, candy, canned fruit and others. Some bituminous coal is also used to generate electricity in one of the ethanol producing plants in the country. Eswatini has a coal mine that mines anthracitic coal that is exported primarily to the steel and metallurgical industries.[5] The reason for the use of bituminous coal in the local industry is that the equipment used is imported from South Africa where such coal is abundant. In addition, the anthracite coal is a good foreign exchange earner.

3.3 Petroleum products

All petroleum products that are used in the country are imported primarily from South Africa and some from Mozambique. These include petroleum diesel oil (diesel), motor gasoline (petrol), paraffin (kerosene), heavy furnace oil (HFO), liquefied petroleum gas (LPG), aviation gasoline (avgas) and jet kerosene (usually Jet A-1). About 89% of petrol and diesel are consumed in the transport sector.

3.4 Electricity

The country imports over 75% of its electricity from South Africa through a Power Purchase Agreement (PPA – agreed upon price over a period of time) with the South African Electricity Supply Commission (ESKOM), and the Southern Africa Power Pool (SAPP) through the Day-Ahead-Market (electricity purchased for the following day at a very high price) which is often availed at a premium to the Eswatini Electricity Company (EEC). Local electricity production is from hydropower with an installed capacity of 60.4 Megawatt and biomass (bagasse and woodchips) from the local sugar industries (three sugar mills operated by two companies, RESC and Ubombo/Illovo). The installed capacity in the sugar sector is about 105 MW from combined heat and power or co-generation processes. The biomass power plants in the sugar industry are also used during the cane harvesting and crushing season when bagasse is readily available. The electricity that is generated in the sugar industry is mainly for self-use with one of the companies (Ubombo/Illovo) exporting excess electricity to the grid through a private PPA with EEC. The hydropower plants are mainly used during peak demand periods except in the rainy season when rivers and dams are full thus enabling continuous generation.

The Eswatini Electricity Company (EEC) also has at its disposal a 9 MW diesel plant which was installed for use during peak power demand. However, it was actively used up to 2003 and in 2013 just to use up the fuel in the tanks, and thereafter it has not been used because of the high cost of diesel fuel . EEC has recently commissioned a 10 MW solar PV power plant feeding to the grid. In addition, there is a 100kW pilot independent solar PV power producer installation feeding to the grid.[6] There is also an ethanol distillery that has an installed capacity of 2.2 MW for self-consumption using bituminous coal.[4]

In recent years there has been an increase in the number of companies that have installed solar PV plants, some up to 1 MW for self-use, most without storage. This embedded generation is not reflected in the energy balance.

3.5 Renewables

From the discussion above, renewable energy is sourced in Eswatini from biomass, hydro and solar. This section highlights the significant role of renewable energy in the country. The CHP plants in the sugar industry predominantly use renewable biomass resources in the form bagasse and woodchips as feedstock. Some of the electricity reflected in the energy balances comes from a sugar company (Ubombo Sugar Limited) that produces electricity through cogeneration using bagasse and wood chips. The hydropower that appears in the energy budget of the country is produced by the national utility company (EEC). As mentioned above, there is also an independent power producer that supplies the national grid from a 100kW solar PV plant, while EEC has also installed its own 10 MW solar PV system. EEC is also piloting off-grid solar PV solutions of standalone power systems and in addition a community mini-grid at a location where they do not consider expanding their grid in the near future.[7] There is also a growing adoption of solar PV by both small- and large-scale farmers, pack houses and small businesses. All this is against an estimated national maximum electricity demand of about 245 MW[8]. This demand however is expected to grow due to an increase in household connections and economic growth.

3.6 National Energy Balance

Every year the Ministry of Natural Resources and Energy (MNRE) conducts an energy survey to track energy supply and the national energy consumption patterns to inform Government economic and development planning. The data collected is incorporated into the national energy balance that is an important indicator for energy demand and supply.

The anonymised data is also used for secondary applications that include the calculation of greenhouse gas emission from energy sources. The accuracy of these calculations relies on the collaborations between MNRE and data providers.

Figure 2 shows the 2019 energy balance. It is produced using the collected data and software from the International Energy Agency (IEA). The personnel at the Ministry were trained by IEA on how to use it.

Eswatini											**2019**
Thousand tonnes of oil equivalent (ktoe)											
SUPPLY AND CONSUMPTION	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geo-therm./ Solar/ etc.	Biofuels/ Waste	Electri-city	Heat	Total
Production	76	-	-	-	-	23	3	612	51	-	762
Imports	47	-	318	-	-	-	-	-	88	-	446
Exports	-75	-	-	-	-	-	-	-	-	-	-75
Intl. Marine bunkers	-	-	-	-	-	-	-	-	-	-	-
Intl. aviation bunkers	-	-	-2	-	-	-	-	-	-	-	-2
Stock changes	-	-	-	-	-	-	-	-	-	-	-
TPES	**47**	**-**	**317**	**-**	**-**	**23**	**3**	**612**	**131**	**-**	**1132**
Transfers	-	-	0	-	-	-	-	-	-	-	-0
Statistical differences	-	-	3	-	-	0	-2	0	0	-	1
Electricity plants	15	-	-	-	-	-18	-0	-	-	-	-9
CHP plants	6	-	-	-	-	-	-	63	-	-	69
Blast furnace	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	-	-	-	-	-	-	-	-	-
Coke/pat..fuel/BKB plants	-	-	-	-	-	-	-	-	-	-	-
Oil refineries	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-
Other transformation	-	-	-	-	-	-	-	-	-	-	-
Energy industry own use	-	-	-	-	-	-	-	-	-	-	-
Losses	-	-	-	-	-	-	-	-	-16	-	-16
TFC	**26**	**-**	**320**	**-**	**-**	**-**	**-**	**549**	**115**	**--**	**1010**
INDUSTRY	**26**	**-**	**59**	**-**	**-**	**-**	**-**	**299**	**34**	**-**	**418**
Iron and steel	-	-	-	-	-	-	-	-	-	-	-
Chemical and petrochemical	-	-	-	-	-	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-	-	-	-	-	-
Non-metallic minerals	-	-	-	-	-	-	-	-	-	-	-
Transport equipment	-	-	-	-	-	-	-	-	-	-	-
Machinery	-	-	-	-	-	-	-	-	-	-	-
Mining and quarrying	-	-	0	-	-	-	-	-	1	-	1

Food and tobacco	26	-	11	-	-	-	-	289	23	-	348
Paper, pulp and printing	-	-	-	-	-	-	-	-	-	-	-
Wood and wood products	-	-	-	-	-	-	-	11	2	-	13
Construction	-	-	8	-	-	-	-	-	0	-	9
Textile and leather	-	-	-	-	-	-	-	-	2.	-	2
Non-specified	-	-	39	-	-	-	-	0	6	-	45
TRANSPORT	**-**	**-**	**225**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**225**
Domestic aviation	-	-	-	-	-	-	-	-	-	-	-
Road	-	-	225	-	-	-	-	-	-	-	225
Rail	-	-	-	-	-	-	-	-	-	-	-
Pipeline transport	-	-	-	-	-	-	-	-	-	-	-
Domestic navigation	-	-	-	-	-	-	-	-	-	-	-
Non-specified	-	-	-	-	-	-	-	-	-	-	-
OTHER	**-**	**-**	**36**	**-**	**-**	**-**	**-**	**249**	**81**	**-**	**366**
Residential	-	-	1	-	-	-	-	249	37	-	285
Comm. and public services	-	-	16	-	-	-	-	-	16	-	32
Agriculture/forestry	-	-	19	-	-	-	-	-	29	-	48
Fishing	-	-	-	-	-	-	-	-	-	-	-
Non-specified	-	-	-	-	-	-	-	-	-	-	-
NON-ENERGY USE	-	-	-	-	-	-	-	-	-	-	-
In industry/transp/energy	-	-	-	-	-	-	-	-	-	-	-
of which chem/petroleum	-	-	-	-	-	-	-	-	-	-	-
in transport	-	-	-	-	-	-	-	-	-	-	-
in other	-	-	-	-	-	-	-	-	-	-	-
Electricity and heat output											
Electr. Generated - GWh	**11**	**-**	**-**	**-**	**-**	**269**	**2**	**306**	**-**	**-**	**587**
Electricity plants	*11*	-	-	-	-	*269*	*2*	-	-	-	*281*
CHP plants	-	-	-	-	-	-	-	*306*	-	-	*306*
Heat generated - TJ	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CHP plants	-	-	-	-	-	-	-	-	-	-	-
Heat plants	-	-	-	-	-	-	-	-	-	-	-

Figure 2. Eswatini energy balance2019 created with IEA balance builder tool based on data provided by the user 14/12/21 14:59 (Version: February 2018.1).

4 GHG Source Categories for the Energy Sector

During the compilation of the Eswatini Energy Sector Greenhouse Gas Inventory, 1990-2018, the greenhouse gas emissions were classified according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[9] The energy sector emissions were found to come from the main source categories 1A (Fuel Combustion Activities) and 1B (Fugitive emissions from fuels). The possible sources of emissions have been broken down as shown in Table 1. Some of these sources are not included in the energy balances, but the team observed that they need to be interrogated further before being omitted as negligible. Not all the listed sources were considered in the abovementioned study.

Table 1: GHG Emission source categories for the energy sector

Source Category	Activity	Fuel
1A1	**Energy Industries**	
1A1ai	Electricity Generation	Coal
1A1aii	Combined Heat and Power	Coal and biomass
1A1ci	Manufacture of solid fuels	Charcoal
1A2	**Manufacturing and Construction Industries**	
1A2c	Chemicals	Any fuels used?
1A2d	Pulp, paper and print	Any fuels used?
1A2e	Food processing, beverage and tobacco	Coal
1A2j	Wood and wood products	Any fuels used?
1A2k	Non-metallic Mineral	Any use of HFO?
1A2k	Construction	Is there LPG use?
1A2l	Textile	Is there kerosene use?
1A2l	Textile	Is there coal use?
1A3a	**Civil Aviation**	
1A3aii	Domestic Aviation	Why not reported?
1A3b	**Road Transportation**	
1A3bi1	Passenger cars with 3-way catalyst	Gasoline
1A3b2	Passenger cars without 3-way catalyst	Gasoline
1A3bi1	Mini public buses with 3-way catalytic converter	Gasoline
1A3b2	Mini public buses without 3-way catalytic converter	Gasoline
NC	Mini public buses	Diesel
1A3bii1	Light-duty goods vehicles with 3-way catalyst converter	Gasoline
1A3bii2	Light-duty goods vehicles without 3-way catalyst converter	Gasoline
1A3biii	Heavy-duty trucks and Buses	Diesel
1A3biv	Motorcycles	Gasoline
1A3c	Railways	Why not reported?
1A4	**Other**	
1A4a	Commercial/Institutional	Is there LPG use?
1A4a	Commercial/Institutional	Is there kerosene use?

1A4b	Residential	Biomass data accuracy?
1A4b	Residential	LPG
1A4b	Residential	Kerosene
1A4c	Agriculture/Forestry	Coal
1A4ci	Stationary	No fuels reported
1A4cii	Off-road vehicles and other machinery	Not separated.
1B	**Fugitive Emission**	
1B1ai1	Underground mining	Fugitive emissions
1B1ai3	Abandoned underground mines	Fugitive emissions

5 Matters of Data Collection

In this chapter, matters of appropriate data sources, data suppliers, gaps and challenges are outlined. Some the information outlined here was obtained from the MNRE. The information was obtained from an initial questionnaire that was sent by the team to the Ministry. This was followed by a physical meeting with the Ministry officials held in January 2022 with the MNRE designated officers and their colleagues. In addition there were other physical consultations in March and April that were used to update the original information that was obtained.

5.1 Existing Institutional arrangements

For the compilation of the NEB, the Ministry has established a rapport and trust with the data providers, as confidentiality of the data collected is very critical. These relationships have been forged over the years without any instrument such as memoranda of understanding. MNRE also collaborates with the Central Statistics Office in terms of sampling methodologies and analysis used in energy surveys. The CSO is a government entity under the Ministry of Economic Planning and Development and is mandated by the Act of 1967 to conduct all surveys including sectoral data on population, households, economy and others upon request by the relevant Ministries.

The Climate Change Unit (CCU) at MTEA, within the MTEA's Meteorological Department, uses the information in the NEB for the reference approach to obtain the energy sector GHG emissions. For sectoral approach MTEA must source the information directly from data providers which pose challenges for the team as they do not have the benefit of the relationships that MNRE has. For confidentiality, the published NEB is not detailed enough for energy sectoral GHG emissions estimates. The flow chart below shows the compilation of GHG emissions from energy sources and reveals the current working relationship arrangements. MTEA is only involved in receiving energy balance data from MTEA for GHG calculations for the energy sector and transport subsector.

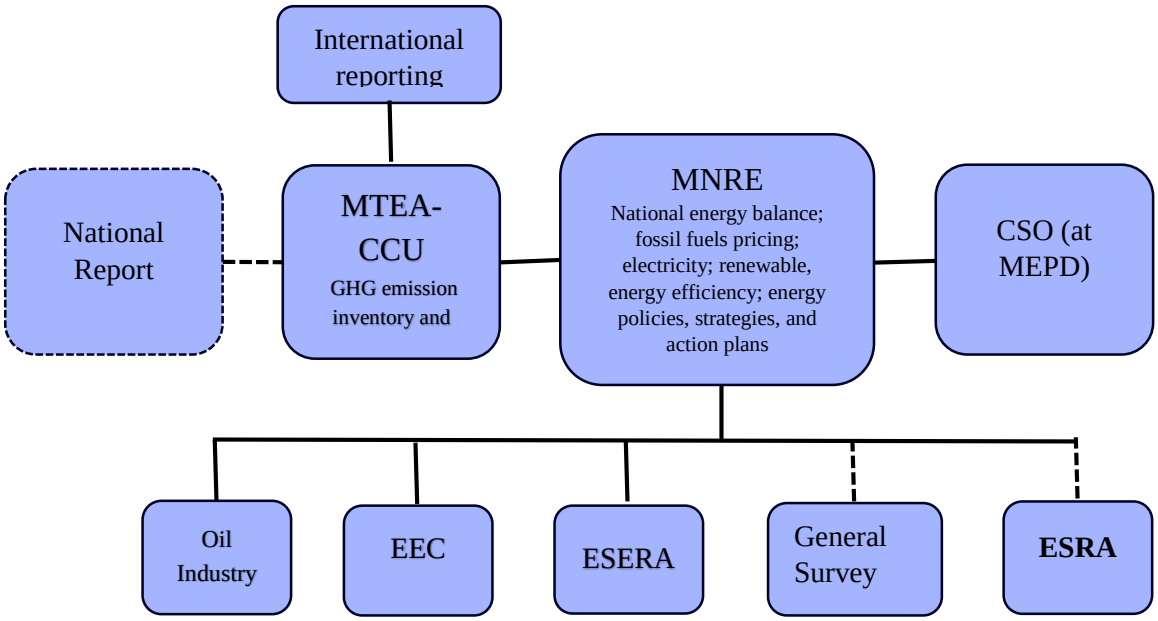

Figure 3. Current institutional arrangement for data collection for the energy balance.

MNRE compiles the NEB from data collected from EEC, petroleum companies, major industries (include the sugar and timber companies) and import data from ESRA. Currently, the energy industry does not report on their carbon footprint. The flowchart also shows that the government ministry responsible for public transport licencing and road infrastructure, MPWT is kept out of the climate action arrangements. The data available from MNRE on petroleum fuel for on-road transport is aggregated (based on fuels sales by petroleum companies) and thus only Tier 1 calculations are possible. For Tier 2 GHG emission calculations MPWT needs to be included in the data arrangements to introduce data gathering during car licence renewals. MNRE has a working relationship with Revenue Authority (which collects vehicle fleet data for MPWT), but for other energy interests and not to address climate change.

5.2 Data Providers

MNRE obtains data from various data providers. Table 2 shows the data sourced and providers used by the Ministry in the compilation of the energy balances.

Table 2: Data sourced and data providers for MNRE

Data item	Data providers
Financial data	Central bank and Central Statistics Office (CSO)
Coal data	Mining company, ESRA and major industries
Traditional biomass	Olade biomass estimation tool
Industrial biomass data	Timber companies; sugar industry & food & tobacco Industry
Electricity data	National electricity utility company (EEC); energy regulatory entity (ESERA); and independent power producers
Petroleum data	Petroleum companies
Consumption data	Industries the commercial sector and institutions
Domestic data	CSO surveys

5.3 Data collection method

MNRE requests data on the consumption of various energy carriers using a standard questionnaire. This questionnaire is sent to data providers for filling the requested data. MNRE then follows up with phone calls, emails and make site visits. For household data administered surveys are used, with the assistance of the CSO. It also requests for information on the different usages of fuels to produce heat and steam for electricity production and for non-energy use. In some cases data are obtained from records and reports.

5.4 Data quality

The available data for the energy balance is of variable reliability. Some of the data are considered reasonably accurate, while some may not be. There are also some historical data gaps that have proved to be elusive to close.

5.4.1 Reliable data

Some of the data collected is accurate to a high confidence level. Such data include electricity and petroleum data. Proper records of such data have been collected and recorded for decades by the electricity utility company (EEC) and the petroleum companies, respectively.

For data where MNRE depends on questionnaires, they make every effort to ensure the completeness of the responses through persistent follow-ups.

5.4.2 Unreliable data

Data that is doubtful is the residential biomass, which is classified as traditional biomass. Traditional biomass fuel resources are not a formerly traded commodity and therefore not quantified. This calls for periodic studies to determine the extraction of this resource from the forests particularly those with indigenous trees. The calorific values of the firewood are also not known and needs to be determined.

For the energy balance, residential biomass data is estimated using the Olade Biomass Estimation tool. It calculates total wood consumption in kilotonnes. The input data used is based upon household surveys and is as follows:

1. Total number of households using firewood,
2. Number of meals cooked using wood per day,
3. Number of persons per household using wood,
4. Specific food consumption per meal

5.5 Data gaps

Data gaps exist for historical data. Interpolation and extrapolation is used to fill these gaps if required. Examples of data gaps are as follows:

a. There are no vehicle scrappage curves for Eswatini. Instead those from South Africa are used.

b. Annual fuel sales (petrol, diesel, illuminating paraffin) are available from 1995 and the 1990-1994 gap is filled using International Energy Statistics

c. Vehicle renewal data does not contain adequate information to disaggregate fuel usage by technology end use for reliable GHG emissions estimations.

d. Consumption of industrial biofuels is available for 1995 and from 2010 to present in the national energy balances. Missing years must be completed by interpolation.

e. Imported bituminous coal has a variety of uses in the country that includes industrial boilers, electricity generation[4], and agricultural uses such as heating of chicken coops and piggeries. Available data is not readily disaggregated for such uses.

5.6 Gaps identified in the energy balance and their explanations

Looking at the energy balance in Figure 2, there are some subsectors that required some further investigation. These are outlined in Table 3.

Table 3. Gaps identified in the energy balance

Identified gap	MNRE explanation	Recommendation
Coal use in textile	Data difficult to obtain, some level of understanding is developing.	Use the powers of EEA and municipalities and the relationship of these companies with the Eswatini Industrial Promotion Authority to obtain the needed information.
Paraffin use in textile, dry cleaning and bakeries.	These subsectors stopped using paraffin boilers, instead they are using electricity.	No action needed.
Fuel use in asphalt laying	The only company that lays asphalt is not normally surveyed.	It has been found that the asphalt laying company uses paraffin to heat the asphalt for application, and these quantities need to be determined.
Diesel use for other applications besides transport	Data for big stationary diesel combustion systems is available but lumped into transport.	There is need to disaggregate the data for stationary combustion plants.
Petrol use besides for transport	The assumption is that 89% of petrol is used for transportation, while the balance is used for petrol generators, brush cutters, chain saws and other small equipment.	The assumption may be considered reasonable as these other uses are small units, some are of seasonal use and all in total are much less that petrol cars in numbers.
Industrial use of paraffin.	There is information to the effect that paraffin is used in for some factory purposes	Information should be gathered on the quantities involved.
Avgas consumption in domestic aviation	Lumped up in total gasoline consumption.	There is need to disaggregate this information. Only one company is licensed to supply this fuel.
Diesel usage in rail transport	Information available but lumped up in total transport diesel consumption.	The information must be reported separately for GHG emissions estimates.
Fuel use in pulp and paper industry	No information available.	There is craft paper company in operation in the country and needs to be surveyed.
Charcoal production and use	The Eswatini Environment Authority is against charcoal production in the country, and as a result there is no charcoal production	To complete the energy balance, there is need to account for charcoal consumption as it is imported from Namibia and South Africa. ESRA can be engaged on this matter.
Coal use in the sugar industry.	The sugar industry still uses coal. The sugar industry supplies this	Establish an institutional arrangement between MNRE and

	information to MNRE without any legal instrument.	the sugar industry for data provision.
Data for abandoned mines	This is of no interest to MNRE.	MTEA must assist MNRE to conduct a study on the methane emissions from abandoned underground mines.
Non-metallic minerals	Heavy fuel oil (HFO) usage is aggregated under petroleum products.	The HFO data must be reported separately. (The use of HFO must be reported separately. In previous years it was used by the pulp company a concrete products company. The pulp company closed while the other company still operates under a different name.)
Improvement of biomass data.	The industrial biomass data is provided by the sugar companies and is considered reliable. There will be a study to be conducted on domestic biomass.	1. Biomass use in the timber industry must be investigated. 2. While planning the study, MNRE must solicit the support of the Department of Statistics for sampling and the Faculty of Science and Engineering to develop a local biomass estimating tool for the future.

5.7 Other challenges faced by the Ministry in data collection

The MNRE like any other government ministry faces some challenges as follows:

1. There are sometimes challenges with responses where data sources cite confidentiality for the refusal of data provision.
2. There are sometimes limitations of follow-ups on data collection due to inadequacy of vehicles
3. The government fiscal problems result in an inadequate budget to improve the data collection and conduct needed surveys like for biomass consumption statistics
4. There is staff turnover resulting in unfilled vacancies because of inadequate budget

6 Meeting Tier 2 Transport Emissions Calculations

6.1 Requirements for Tier 2 Transport Emissions

To estimate GHG emissions using the Tier 2 level for the transport sector requires more disaggregated data

than for Tier 1. The requirements according to the 2006 IPCC guidelines are as follows:

1. The main gas from the energy sector CO_2 emissions are determined by the fuel type and country specific emission factors.
2. The other main GHG gases from the energy sector are methane (CH_4) and nitrous oxide (N_2O) are determined by
    a. vehicle fuel type
    b. vehicle type
    c. emission control technology type
    d. emission factor (kg/km) and
    e. distance travelled.

For Eswatini, currently it is not possible to use the Tier 2 method for calculating GHG emissions for the transport sector due to a lack of data. The current limitations are outlined in next two sections and the means to overcome them are also provided so that Eswatini can start making advances towards a Tier 2 approach for the Transport sector.

6.2 Available data from Motor Vehicle Registration Certificates

The data available from MNRE consists of the total fuels supplied by the petroleum industry in the form of unleaded petrol and 50 ppm diesel in total amounts for the transport sector each year. The end-use according to vehicle technology is not known. There is some information that is collected during the registration of automobiles in the country and is as listed below:

1. Registration Number
2. Vehicle Identification Number
3. Engine number
4. Vehicle Make
5. Vehicle Model
6. Vehicle Type
7. Tare weight
8. Year of manufacture
9. Horsepower
10. New/Second hand
11. Vehicle usage

Information on fuel type used by vehicles is collected during vehicle registration but does not appear in the registration certificate. MWPT will have to provide access to such information for GHG calculations.

Some of the information that appears in the registration certificate is of great use for Tier 2 GHG emissions calculations. However, no other information is required during the annual renewal of the road license. Therefore the available information in the registration certificate is not adequate for Tier 2 level determinations in the transport sector.

This information is collected by the Central Motor Registry (CMR) in the Ministry of Finance on behalf of the Ministry of Public Works and Transport, who in turn use it for road planning purposes. The Ministry of Finance collects the data for collecting revenue based on vehicle type and use in both registration and annual license renewals. There is the opportunity for MNRE to develop understanding with the other two ministries to assist it in obtaining additional information during the annual license renewal to allocate the fuel consumption according to vehicle technology for better estimating GHG emissions from the transport sector.

6.3 Tier 2 transport GHG data collection

To improve the data collection for Tier 2 determinations would require additional data collection during vehicle road license renewal. To renew the license, vehicle users would have to enter the information as shown in Table 4. With the information as in the table for road licenses renewals Tier 2 GHG emissions estimations can be achieved.

Table 4. Data to be collected during vehicle license renewal

Data required	Comment
Registration number	Entering the registration number will pull up the file for the vehicle
Odometer reading (km)	Enter the reading on the odometer from which the previous year mileage will be deducted, to obtain the distance travelled in the past year.
Current usage	There could be a change of use of a vehicle where one that was owned for business is change to private use or vice versa.
Local or cross-border	This is to determine whether the vehicle is mainly used for cr0ss-border travel or local.
Public road or off-road use	To determine whether the vehicle is used in a public road or is mainly used off-road
Does it have a catalyst?	The vehicle may have originally come with a catalytic converter, but it may have been stolen or a replacement exhaust was installed without it.
Average passenger load (No.)	Number of passengers per trip (for private vehicles and buses).
Average truck load (Tonnes)	Average load per trip (for goods trucks).
Amount paid (E)	Amount paid for road license renewal.
License disc collection place	This is the convenient revenue office or post office for the vehicle user. It could also be delivered through mail or physically for a fee.

7 Mapping Institutional Arrangements for Transparent Data Collection

MTEA is the Ministry responsible for national Climate Action, for preparing national GHG inventory reports, and their use in BURs and National Communications, and for reporting on the National Determined Contributions (NDC). The data for GHG emissions within the Energy and Transport sector relies on the energy balance calculations from MNRE and well as from transport statistics from the MPWT as mentioned earlier. A mapping of institutional arrangements is necessary for more robust energy balance and better estimates of the national GHG emissions.

The Department of Energy within MNRE collects, analyses and disseminates energy statistics working in close collaboration with the CSO that is unit under the Ministry of Economic Planning and Development as said before. The CSO collects national data through national census and household and income surveys. The CSO is empowered legally for collecting and analysing national data through the Statistics Act of 1967.

To support a world class gathering of data for GHG emissions inventory Government Units, public enterprises, companies, academia and NGOs would need to develop clear institutional arrangements for data collections. Table 5 gives the roles of the different organisation in the development of a robust and sustainable energy balance for transparency. These are further elaborated in the Energy Sector Data Collection Roadmap which is the final document of this component of the project.

Table 5: Role players and their proposed contribution to the national inventory of GHG emissions from energy sector

Main Organization	Role in GHG Energy & Transport Sector inventories
Ministry of Tourism and Environmental Affairs through the Climate Change Unit (Meteorological Department)	1. Support GHG emissions data collection and management 2. Support mainstreaming of Climate Action reporting within the Energy sector and Transport subsectors 3. Assist the development of reporting templates. 4. Work with MNRE to develop a tool to determine emissions from abandoned coal mines.
Ministry of Natural Resources and Energy through the Department of Energy (DoE)	1. Collect, analyse and disseminate energy sector data 2. Create a section focusing on mainstreaming of climate change action in the energy sector, that would facilitate the easy flow of data 3. Prepare annual energy sector GHG emission inventories
Ministry of Public Works and Transport	1. Provide vehicle statistics to ensure Tier 2 calculations 2. Mainstreaming of climate change action in the transport subsector and construction sector. Sector.
Ministry of Economic Planning and Development	1. Increase the capacity of the CSO that is legally empowered to collect and analyse data of national importance.
ESERA	1. Ensure that energy suppliers provide accurate data to the Department of Energy at MNRE.
Eswatini Revenue Authority	1. Expand the working agreement with the Department of Energy at MNRE on providing trade statistics from national companies that import fuels and increase the mandate for transport sector data collection for the determination of GHG inventories.
Eswatini Fuel Retailers Association	1. Maintain the strong collaboration with MNRE on data sharing on fuel importation and distribution.
Eswatini Electricity Company	1. Provide data on power sources and electricity supplies.
Income tax collection department	1. Provide statistics of vehicle registration
Eswatini Railways	1. Provide data on rail transport activities 2. Mainstreaming of climate change action in the railway sector.
ESWACA	1. Provide fuel data on air transport activities 2. Mainstreaming of climate change action in the railway sector.
Federation of the Swaziland Chamber of Commerce and Employers Federation	1. Support data collection within the business sector through surveys, etc. 2. Mainstreaming of climate change action in the commercial sector.
Federation of Swazi Business Community	1. Support data collection within the business sector through surveys, etc.

	2. Mainstreaming of climate change action in the commercial sector.
Sugar industry	1. Energy data provider 2. Energy supplier
Mining Company	1. Coal data provider
Eswatini Environment Authority	1. Assist with their legal power to obtain environmental data
Municipalities	1. Use their bylaws to assist in obtaining environmental data from organisations within their jurisdiction
Academia	1. Assist in developing quality control protocols and quality assurance programme, and offer training services on climate change
	2.
	3.

8 Quality Control and Quality Assurance

For the energy balance preparation, *Quality Control* (QC) is a process of regular technical activities to assess and maintain data quality during its compilation. The personnel compiling the data are responsible for performing this task. QC ensures that the data collection is complete and that data capture is accurate and stored properly. According to the IPCC 2006[10] the purpose of the QC programme is to:

1. provide routine and consistent checks to ensure data integrity, correctness, and completeness;
2. identify and address errors and omissions;
3. document and archive inventory material and record all QC activities.

The data collection protocols are to cover the following (responsibilities and timelines)

1. Check that assumptions and criteria for the selection of activity data are documented.
2. Check for transcription errors in data input and reference
3. Check that parameter units are correctly recorded and that appropriate conversion factors are used where necessary
4. Check the integrity of database and /or spreadsheet files.
5. Undertake completeness checks.
6. Compare estimates to previous estimates.

The *Quality Assurance* (QA) the energy balance should be done by personnel not directly involved in its preparation. It could even be done by a third party outside government, such as an academic institution. Its purpose is to review the systems in place to conduct the data collection. It will involve the review of documentation to ensure that QC personnel adhered to quality control procedures. It could also make recommendations to the QC personnel if need be.

9 Summary Findings

The first output of the Activity 2 is the Scoping and Gap Analysis Report of the MRV system of GHG emissions within the energy sector. This report results from reviewing the status of the energy sector including the issues of data quality, data sharing, and data gaps. The analysis is informed by continuous consultations with high-level officers from energy stakeholders.

The assessment shows that the MNRE is not well-resourced in terms of human resources and technical experience to offer a robust MRV for the NDC for climate action. To clear the ground for a robust and transparent MRV system in the Ministry, the following issues must be addressed

1. Financing issues:- staffing, equipment (including transport resources), training (capacity building), and building of IT system for inputting, sharing and archiving data.
2. Regulatory issues:- regulatory framework for recording, reporting, and sharing of data in both public and private sources.
3. National ownership:- coordination of climate actions in the private and public sectors.

Identified gaps in the energy balance and recommendations on how they can be closed and the preliminary results are summarised in Table 6.

Table 6. Results of the scoping and gap analysis exercise

Sector	Identified gaps	Measures to address
Transport subsector gaps and needs	1. GHG emission estimates are currently calculated using fuel consumption data provided by the MNRE, (Tier 1)	1. Improve the data scope to include relevant data for Tier 2 GHG emissions determination.
	2. Unavailability of Data for Tier 2 and uncoordinated data sharing with the Climate Change Unit. Unavailable data include the following: a. annual distances travelled b. occupancy rates of passenger vehicles c. tonnes of freight transported and d. vehicle fuel type does not appear in registration certificate.	2. Develop institutional arrangements between MTEA, MNRE, MoF, and MPWT to improve data collection and sharing. 3. Develop sector specific online data collection templates for road license renewal in an App format. 4. Develop software for data sharing between the relevant ministries. 5. Include fuel type in the database for motor vehicle registration.
	3. Climate change has not been mainstreamed within the transport sector, and there are no climate change personnel responsible for such. There is a poor understanding of the GHG inventory process, reporting and accounting methodologies within MWPT.	1. MTEA must sensitise road transport staff at MWPT and the Ministry of Finance (which collects fleet data for MPWT) on climate change matters. 2. Assign staff within MNRE, MoF, MWPT and MTEA to coordinate and oversee MRV in the transport sector. 3. Need to update the online repositories and archive for data
Energy sector gaps and needs	4. MNRE is interested in total energy consumption per sector without regard for the end-use technology required for calculating GHG emissions.	1. Develop an institutional arrangement where MNRE is responsible for energy sector GHG inventory estimates so that they conduct their data collection in consideration of the subsequent GHG inventory determinations.
	5. Estimates of residential wood fuel (biomass) use are based on a model that is based the results of a very old study (1993).	1. Fast track the proposed biomass study. 2. Use computational modelling expertise from the University of Eswatini to develop a local model for residential biomass usage based on the results of the study.
	6. Improve industrial biomass data collection.	1. Also collect biomass data usage for self-consumption in industry, for example in the timber industry; and include the end-use technology for fuels.
	7. Insufficient data for non-energy use of petroleum fuel in industry.	1. Data collection templates must provide for the entry of non-energy use for fuels.

8.	Missing regulatory mechanism that assigns responsibility for data capture and sharing between MNRE and all entities – current data is shared under common understanding.	1. Formal instruments must be put in place to compel all entities to share data of national importance. 2. Some industries, particularly those brought into the country by the Eswatini Industrial Promotion Authority, tend to have stronger ties with that entity, which can engage to assist in getting more cooperation from them. 3. Several entities like the MEPD and the Eswatini Environment Authority requires some data on regular basis from the same data providers surveyed by MNRE. Collaborations amongst these entities is essential so that the needed data are collected once a year at the same time to reduce fatigue on the data providers. 4. Municipalities also have bylaws that organisations within their jurisdiction must abide by. Collaboration with municipalities can also be an enabler for data collection.
9.	No MRV mechanism for energy balance	1. Climate action must be mainstreamed in the energy sector with transparent data capture and sharing of GHG energy data between MNRE units (bottom-up approach). 2. A dashboard archive system for energy balance must be developed.
10.	Minimum mainstreaming of Climate Change issues, i.e. Energy balance does not include climate and SDG indicators.	1. MTEA must coordinate collaboration between MNRE, Ministry of Economic Planning and Development (MEPD) and development partners such as UNDP to include climate and SDG indicators as part of an annual energy balance report.
11.	No robust system of data verification, audits, quality checks with stakeholders	1. Develop internal quality control protocols for data collection and put in place quality assurance systems. 2. Identify external entities to conduct quality assurance of collected data and to assess internal quality systems.
12.	Inadequate finance, personnel, skills, equipment and materials to mainstream climate change at MNRE.	1. Mobilise all necessary resources to upskill, increase personnel and provide tools and finance to build capacity to mainstream climate change at MNRE.

10 Recommendations

The engagement with MNRE and data providers has revealed some gaps and constraints in the data collection process required for a robust MRV system and design. In this section, recommendations to enable MNRE to get technical support, capacity building and access to climate change funds to improve the data collection process for the sustainable robust energy balance are made. Such can include studies by MNRE, training of staff, and even increasing human capacity and tools within the Ministry to strengthen its climate change aspect of the energy sector. GHGMI is already offering training to MNRE staff on developing GHG emission inventories in the energy sector. Such training can enable the staff to appreciate the need to disaggregate data to end-use technology level.

The collection and compilation of energy statistics needed to generate a complete energy balance requires collaborative effort with MNRE from many energy data stakeholders including MTEA, MPWT, MEPD, MOF, CSO, ESERA, EEC, ERS, EEA, EIPA, municipalities, energy research institutions (e.g. the CSER), business federations, and others. MNRE is responsible for energy data collection, compilation, production and dissemination of energy balances, however, is currently not backed up with strong institutional arrangements and adequate funding to fully incorporate climate change matters in their daily work. The following recommendations are further proposed which will create a coordinated and sustainable energy collection system leading to improved transparency and quality of energy data.

1. Establishing appropriate institutional arrangements among all relevant governmental ministries e.g. MNRE and MTEA, MPWT, MOF, CSO, ERS, EIPA, EEA, and other government agencies, that defines a clear mandate for involvement in transparency related work is of paramount importance. This will ensure the collection and compilation of high-quality energy statistics and periodically and review their effectiveness. The responsibilities of each of the stakeholders involved in data collection and compilation, energy data processing and ensuring data quality should be clearly defined.
2. 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.
3. There is a need for stakeholder awareness in data sharing, especially in the private sector. Quarterly and annual workshops among MNRE, CSO and data providers should be organized to harmonize, reconcile data collected share best practices, fine tune data collection practices and strengthen data quality control procedures.
4. The sectoral breakdown of final energy consumption is not thoroughly compiled in the energy balance. This needs to be improved for a compilation of a full energy balance. There is a need to establish breakdown keys for final energy consumption by sector and further by main energy uses. The level of data disaggregation need to be increased for more detailed input data at end-use technology level. For the transport sub-sector, calculations based on distance travelled i.e. bottom-up approach need to be introduced to be more accurate and closer to quantifying actual emissions. More detailed data on disaggregation of final energy consumption in transport should be split between passenger and freight transport. Also, MNRE and MPWT need to work together on disaggregation of data for transport sector technologies.
5. Data collection processes should be reinforced to include establishment of a database as a fundamental step towards filling data gaps in terms of ensuring time series consistency and completeness, data-sharing system and web-based knowledge management platform. A robust data information system work on energy statistics and balances requires additional technical, financial and human resources. All this is only possible when the long-term budget for energy statistics is ensured.
6. Data collecting templates customised for the different data providers to feed information into the energy balance need to be improved. Adding questions to the existing questionnaire to allow the collection of data with by classifying the energy consumers into the categories will result in a complete energy balance. It is also recommended that questions on energy end-use (cooling, cooking, lighting, etc.) be introduced into the survey.

7. It is recommended that the energy balances are disseminated through the MNRE website and sent directly to key stakeholders in easy-to-read formats.
8. Establish a unit dedicated to energy statistics and appoint a focal point responsible for data provision and management. There is further a need for capacity building in a sustainable manner through training and workshops and increasing the number of professionals in the transparency field to create a sustainable reporting system. This unit should be also responsible for calculating the energy sector GHG inventories to appreciate the need for detailed data requirements when preparing the energy balance.

References

[i] ICAT (March 2021), Technical support to increase the overall transparency capacity and set-up of sectoral MRV systems in the Kingdom of Eswatini

[2] ICAT (March 2021), Technical support to increase the overall transparency capacity and set-up of sectoral MRV systems in the Kingdom of Eswatini

[3] GoE, (2019), Internal energy balance document. MNRE

[4] GoE (March 2017), Energy Master Plan 2034. MNRE

[5] MCL, https://www.maloma.org/markets.html

[6]Swazi Observer (16 March 2016), E5M Wundersight Solar Power Launched. https://www.wundersight.co.uk/news/

[7] EEC, http://www.eec.co.sz/projects/

[8] EEC (2020) Eswatini Electricity Company Annual Report 2019/20

[9] Garg A, Kazunari K, and Pulles T (2006), IPCC guidelines for National Greenhouse Gas Inventories

[10] Winiwarter, W. et. al (2006), IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1: General Guidance and Reporting