FINAL REPORT

ESKOM CARBON FOOTPRINT STUDY 2019

A Report for Eskom Holdings SOC Ltd

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CONFIDENTIAL
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EcoMetrix Africa

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EXECUTIVE SUMMARY

EcoMetrix Africa (Pty) Ltd. was contracted by Eskom Holdings SOC Ltd. to provide an updated carbon footprint for the year 2019 and an Excel-based greenhouse gas (GHG) calculation tool to calculate its GHG emissions. The latter will enable Eskom to internally and independently calculate and report its GHG emissions going forward. While Eskom's financial year runs from April to March, the carbon footprint is based on the calendar year. This is in part to align with the requirements of the National GHG Emission Reporting Regulations (NGER).

A carbon footprint estimates the total GHG emissions caused by an organisation's activities. It is expressed in tonnes of carbon dioxide equivalent (tCO_2e). This provides insights into the sources and magnitude of the GHG emissions and allows for better management of GHG emissions. The last carbon footprint study for Eskom was conducted in 2011. Going forward, Eskom's Climate Change and Sustainable Development Department (CCSD) will calculate the carbon footprint every year, using the newly developed GHG calculation tool.

Eskom's footprint is calculated in line with the Corporate Accounting and Reporting Standard of the globally recognised Greenhouse Gas Protocol. To determine the organisational boundaries of the carbon footprint in terms of what activities are included, the operational control approach was chosen. Under this approach, 100 percent of emissions are accounted for from all operations over which there is operational control (i.e. the ability to introduce and implement operating policies).

In terms of GHG accounting and reporting, the standard identifies three different scopes of GHG emissions to differentiate between direct and indirect emissions: Scope 1 direct emissions (i.e. from on-site activities controlled by the organisation), Scope 2 indirect emissions (i.e. from purchased electricity or heat consumed by and organisation) and Scope 3 indirect emissions (i.e. from activities not controlled by an organisation that occur up- and downstream in the supply chain). As electricity generation is Eskom's main activity, Scope 2 emissions are in principle accounted for as Scope 1 emissions in accordance with the GHG Protocol. For this reason, Scope 2 emissions are excluded from the current carbon footprint study in order to avoid double counting.

The results of the carbon footprint study are presented in the Table 1. Total GHG emissions for 2019 stood at 212,601,425 tCO_2e.[1] The majority of these emissions were caused within the Stationary Combustion category by the burning of fossil fuels at power stations for the generation of electricity. Coal, heavy fuel oil, diesel and kerosene consumption contributed to over 99.8% of GHG emissions.

[1] Please note that the reported carbon footprint is specific to the GHG Protocol and assumptions applied as described in this report.

A second significant source of GHG emissions was Mobile Combustion by Eskom Fleet and Coal Delivery to Site. These emissions mainly relate to the use of Eskom-owned vehicles and the road transportation of coal to power stations by the contracted third-party trucks. Combined, the two categories led to 351,760 tCO_2e in GHG emissions (approximately 0.17%). The remaining categories contributed a total of 57,588 tCO_2e to the carbon footprint (approximately 0.03%).

TABLE 1 – ESKOM CARBON FOOTPRINT SUMMARY BY SCOPE AND CATEGORY

	GHG Emissions (tCO_2e)	GHG Emissions (%)
Scope 1 - Categories		
Stationary Combustion	212,192,077	99.81%
Mobile Combustion by Eskom Fleet	81,797	0.04%
Fugitive Emissions – SF6	36,212	0.02%
Waste Disposal	3,468	0.00%
Non-Combustion Product Use	9	0.00%
Scope 2 - Categories		
Electricity and Heat Purchased [1]	Excluded	Excluded
Scope 3 - Categories		
Coal Delivery to Site	269,963	0.13%
Official Mileage	12,627	0.01%
Air Travel	3,368	0.00%
Vehicle Rental	1,903	0.00%
Total	**212,601,425**	**100%**

[1] As electricity generation is Eskom's main activity, Scope 2 indirect emissions are in principle accounted for as Scope 1 direct emissions as per the GHG Protocol.

The carbon footprint study mainly relies on default emission factors (EFs) and net calorific values (NCVs) from the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and global warming potentials (GWP) from the Third Assessment Report (AR3) of the IPCC. In circumstances where country-specific values were available and appropriate, for example, from the National GHG Reporting Regulations, these were applied. For coal, an Eskom-specific annual weighted average NCV was used based on actual measurements.

While this study makes considerable progress in terms of data collection from additional GHG emitting activities compared to the previous carbon footprint study, areas for improvement have been identified. Among others, this relates to the categories mobile combustion by Eskom fleet, coal

delivery to site and fugitive emissions, which is described in more detail in the last section of this report. Addressing these issues will lead to further improvements in the Eskom carbon footprint in terms of the coverage and accuracy going forward.

1 INTRODUCTION

A carbon footprint is an important tool for measuring and monitoring greenhouse gas (GHG) emissions emanating from an organisation's activities. GHG emissions can result from a wide variety of activities, including electricity generation, transport, industry, agriculture and waste processing. As such, a comprehensive carbon footprint that is periodically updated provides valuable insights not only into the sources and magnitude of GHG emissions, but also as a basis for possible mitigation action and GHG offsetting measures.

For the information to be reliable and consistent, a carbon footprint needs to be based on high-quality data, which is collected and converted according to a recognised international GHG standard. Moreover, the information should be kept in a well-structured database that can provide graphical outputs useful for emissions monitoring and reporting purposes.

In an effort to measure its GHG emissions, Eskom Holdings SOC Ltd. has commissioned a study by EcoMetrix Africa (Pty) Ltd. to calculate its carbon footprint for the calendar year 2019 (i.e. the 'carbon footprint study'). The main objective is to provide an update of the Eskom's carbon footprint from the previous study (ERM, 2011), and to develop a customised Excel-based tool for calculating and reporting its GHG emissions on an annual basis going forward.

This report describes the main findings of the study by key emission scope and categories. The study has been conducted in line with the Corporate Accounting and Reporting Standard of the globally recognised Greenhouse Gas Protocol (WRI, 2004) and is structured as follow:

1. Scope and Methodology
2. Carbon Footprint Results and Assessment
3. Risks in Data Collection and Areas for Improvement

The first section deals with the further clarification of the scope of the study. It also sets out the proposed processes / approach followed in calculating Eskom's carbon footprint. The second section presents the actual footprint results, a high-level analysis of the outcomes and assumptions made regarding data collection and entry. The third and last section elaborates on potential risks in the data collection process and data gaps identified. On this basis, it also identifies areas for future improvement. The report is accompanied by the Excel-based version of the Enterprise Performance and Carbon Management (EPCAM) tool, which has been specifically tailored to calculate Eskom's carbon footprint on an annual basis going forward.

2 SCOPE AND METHODOLOGY

This section elaborates on the scope and methodology of the carbon footprint study. First, it discusses the GHG reporting standard used as well as the choice of organisational and operation boundaries in relation to the footprint calculation. It then briefly talks to the choice of emission factors and global warming potentials used. This is followed by two subsections with a description of the approach taken as well as the Excel-based Enterprise Performance and Carbon Management (EPCAM) calculator tool used to determine the Eskom footprint for 2019.

2.1 GHG REPORTING STANDARD

While there are various internationally recognised GHG standards, Eskom's carbon footprint has been calculated in line with the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (WRI, 2004). The GHG Protocol Corporate Standard was jointly developed by World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI). It is a leading international standard for companies, businesses and other types of organisations to prepare their GHG inventory / carbon footprint in a manner that provides a true and fair representation of their emissions in a manner consistent over time and between covered entities.

The standard covers the six main Kyoto Protocol GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFOs), perfluorocarbons (PFOs) and sulphur hexafluoride (SF_6). To calculate the emissions of these gases, the GHG Protocol first requires the determination of the organisational and operational boundaries of the carbon footprint.

2.2 SCOPE OF EMISSIONS

2.2.1 Organisational Boundaries

Larger organisations in particular often have complex legal and organisational structures with varying degrees of ownership and control (e.g. wholly or partially owned subsidiaries, incorporated and non-incorporated joint ventures and so forth). This has implications for the consolidation of GHG emissions for the entity as a whole. As such, the organisational boundaries of a carbon footprint determine the method according to which the GHG emissions of different business operations within the overall company are included in the carbon footprint.

The GHG Protocol Corporate Standard identifies two approaches to consolidate GHG emissions for corporate accounting and reporting purposes:

1. **Equity share approach**, whereby GHG emissions from a certain activity are accounted for according to the share of equity in the operation conducting the activity
2. **Control approach**, whereby GHG emissions from a certain activity are 100 percent accounted for by the organisation that has control over the operation conducting the activity. The operational control approach can be divided into two main subcategories:
    a. **Financial control** – occurs when a company has the ability to direct the policies of an operation so as to obtain (i.e. have a right to) all or the majority of economic / financial benefits from the activities
    b. **Operational control** – exists when a company has the full authority to implement operating policies at the operation of the GHG emitting activities

For the purpose of conducting Eskom's carbon footprint, it was decided to follow the operational control approach to consolidate GHG emissions across operations. Selection of the operational control method comes with advantages in data collection and GHG mitigation. Data collected from entities under direct control is, generally speaking, more robust as one has direct access to the relevant entities and GHG mitigation actions can be more easily implemented. For the same reasons, it is currently the method according to which many other companies consolidate and report their GHG emissions. The resulting carbon footprint organisational boundary based on Eskom's organogram is presented in Figure 1 below.

FIGURE 1 – ESKOM CARBON FOOTPRINT ORGANISATIONAL BOUNDARY

2.2.2 Operational Boundaries

The carbon footprint is calculated using the guidance of the GHG Protocol, which distinguishes between Scope 1 direct emissions as well as Scope 2 and 3 indirect emissions. Figure 2 provides a summary overview of the definition of these different scopes.

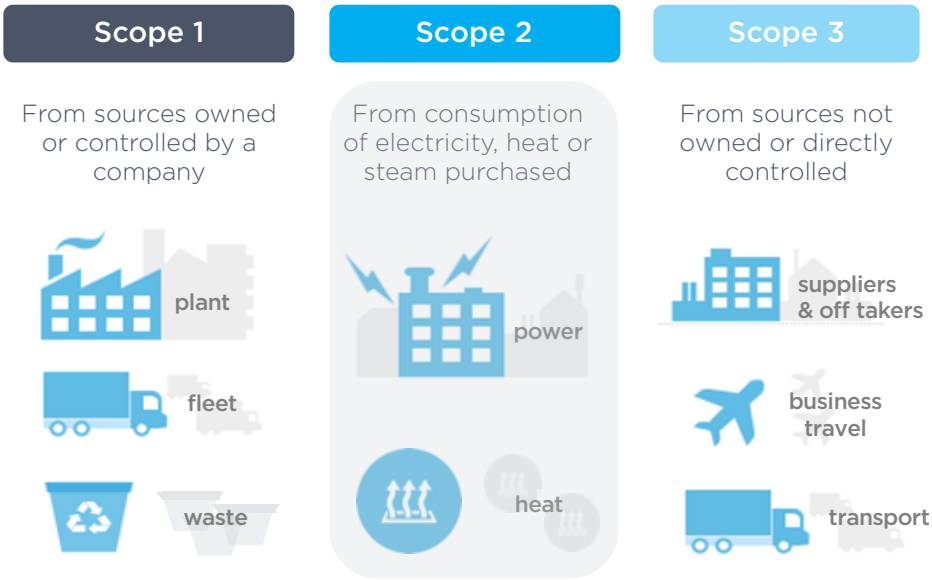

FIGURE 2 – THE GHG PROTOCOL CONCEPT OF SCOPES

Scope 1 emissions generally concern GHG emissions on site, where raw materials and fuel inputs arrive, processing takes place and waste products such as solid waste and wastewater are processed and/or stored. It also includes emissions from mobile equipment which is owned or controlled by the organisation. Scope 2 emissions concern indirect off-site emissions related to the generation of purchased electricity or heat. Scope 3 emissions concern emissions from a range of activities up- and downstream in the supply chain, including business travel and transport operated by third parties. These activities are outside the direct control of the organisation and the resulting GHG emissions are harder to manage. Generally speaking, scope 3 activities are therefore only partially taken into account in a GHG Inventory.

2.3 EMISSION FACTORS AND GLOBAL WARMING POTENTIALS

The internationally leading party regarding the development of globally accepted methodologies, emission factors and tools for GHG monitoring and reporting is the Intergovernmental Panel on Climate Change (IPCC), which is part of the United Nations Framework Convention on Climate

Change (UNFCCC). Many GHG monitoring, reporting and verification protocols including the GHG Protocol allow for the use of IPCC guidance in this regard.

When it comes to emission factors, the IPCC applies a so-called three-tiered approach, where Tier 1 offers high-level default emission factors (EFs) and or net calorific values (NCVs) to be applied and as one moves to Tier 2 and 3 the level of uncertainty of GHG estimates reduces and accuracy improves. However, moving towards Tier 3 will also increase the complexity of measurement processes and analysis.

The Eskom carbon footprint has been calculated using default EFs and NCVs from the 2006 Guidelines for National GHG Inventories from the IPCC for each emission category / source (IPCC, 2006a; IPCC, 2006b). This is in line with the recommendations of the GHG Protocol. Where possible and appropriate, country-specific EF and/or NCV values have been applied from the National Greenhouse Gas Emission Reporting Regulations (NGER) (DEA, 2017a; DEA 2017b). For the largest source of emissions in the electricity generation process, that is, stationary combustion of coal, an Eskom-specific NCV has been applied based on a weighted-average of actual measurements during 2019 (Eskom, 2020).

To convert this into one unit of measurement, the IPCC defines conversion factors which allow the climate change impact of different GHGs to be converted into tonnes of carbon dioxide equivalent (tCO_2e). These conversion factors are referred to as the global warming potential (GWP) of the different GHGs.

The GHG Protocol recommends using the GWPs contained in the latest assessment report of the IPCC. At the time of writing this report, this was the IPCC's Fifth Assessment Report (AR5) (IPCC, 2014). Nevertheless, in order to align with the South African national climate change regulatory framework in the form of the NGER and accompanying technical guidelines, the carbon footprint calculation was based on the GWPs in the IPCC's Third Assessment Report (TAR) (IPCC, 2001). It is important to note that although the values do not differ much between the two publications, there are slight differences, with the AR5 containing the latest scientific insights and thus most up to date figures.

Table 2 below provides an overview of the six most common GHGs and their GWPs as identified by the Kyoto Protocol and reported in the third assessment report of the IPCC. Based on an analysis of Eskom's activities, only carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and sulphur hexafluoride (SF_6) were considered relevant GHGs for the Eskom Carbon Footprint study.

TABLE 2 – GLOBAL WARMING POTENTIALS BASED ON IPCC'S AR3

Specific GHG	GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	23
Nitrous Oxide (N_2O)	296
Perfluorocarbons (PFCs)	5,700 – 11,900
Hydrofluorocarbon (HFCs)	12 – 12,000
Sulphur Hexafluoride (SF_6)	22,200

2.4 A FIVE-STEPPED APPROACH

To successfully perform a carbon footprinting study and estimate an organisation's GHG emissions, a five-stepped approach is recommended based on standard practices, including the following key activities (see Figure 3). This is further detailed for each step below, including the main outcomes of the Eskom carbon footprint study.

FIGURE 3 – STEPS FOLLOWED IN DEVELOPING ESKOM'S CARBON FOOTPRINT STUDY

2.4.1 Categorisation

The first step of the development of a carbon footprint involves the categorisation of main GHG emission sources within the organisational and operational boundaries set. Only a good understanding of an organisation's main operational activities and processes that lead to GHG emissions will lead to an accurate and reliable carbon footprint.

Outcome – The project team conducted an organisational mapping of activities and agreed on the following main source categories of GHG emissions in terms of applicability and materiality per scope. Scope 2 emissions from the consumption of purchased electricity and/or heat is excluded to avoid double counting, as the generation of electricity is Eskom's main activity and therefore the associated emissions are accounted for under Scope 1.

TABLE 3 – SUMMARY OF GHG EMISSION CATEGORIES INCLUDED IN THE ESKOM CARBON FOOTPRINT 2019

Scope	GHG Emission Categories
Scope 1 – Direct emissions	– Stationary Combustion (i.e. coal and other fuels consumed in power stations) – Mobile Combustion by Eskom Fleet (i.e. fuel consumption by corporate fleet and heavy trucks owned by Eskom) – Non-Combustion Product Use (i.e. lubricant and oil use) – Waste Disposal (i.e. solid waste and wastewater treatment) – Fugitive Emissions (i.e. SF_6 from gas insulated switchgear or CH_4 from coal stockpile)
Scope 2 – Indirect emissions	Excluded (i.e. consumption of electricity or heat purchased) as electricity generation is Eskom main activity
Scope 3 – Indirect emissions	– Air Travel (i.e. kilometres flown in economy or business class) – Official Mileage (i.e. kilometres travelled with third-party owned petrol or diesel cars) – Vehicle Rental (i.e. kilometres travelled with rented petrol or diesel cars) – Coal Delivery to Site (i.e. kilometres driven by third-party owned heavy coal trucks)

2.4.2 Data collection

On the basis of the categorisation in the previous step, the process of collecting the necessary consumption and/or activity data is initiated per GHG emission category. This involves contacting all relevant data providers within the organisation to ascertain what types of data are available and at what granularity (i.e. monthly, quarterly, annually) and to collect the relevant data identified within the availability constraints.

In general, it was possible to obtain monthly data which allowed for an analysis of trends, data ranges and the frequency of data inputs and underlying activities. In this way, data quality and completeness could be assessed.

Outcome – Scope 1 emission data inputs were available and collected on the basis of actual consumption data, such as fuels used. Scope 3 data inputs were based on activity data such as kilometres travelled on which basis GHG emissions were derived. A data quality check was performed and, in some cases, a further check with the data providers was initiated.

2.4.3 Quantification

Quantification of a GHG emissions is typically done by using a suitable GHG calculation tool. This can for example be an Excel-based tool or a web-based tool tailored for this purpose. Generally speaking, the process involves applying the various net calorific values and emissions factors to fuel consumption data in line with the standard practice of the IPCC and GHG Protocol. When it comes to Scope 3 emissions, carbon footprinting often relies on second-order activity data and applies emission factors on this basis (e.g. tCO_2e / kilometre).

Outcome – The Eskom carbon footprint was conducted using the EPCAM Excel-based system. The tool was configured in line with Eskom-specific requirements to calculate its footprint by converting all the gathered consumption and activity data into GHG emissions. For this, Tier 1, 2 and 3 emission factors were applied to the consumption and activity data as deemed applicable and appropriate by expert opinion.

2.4.4 Assessment

The assessment step of a carbon footprinting exercise generally involves two main activities. First, a further quality check of data inputs is conducted on the basis of the results of the carbon footprint quantification. Any anomalies are traced back to the data and/or parameter inputs and corrected where necessary. Second, the outcome of the footprint is analysed in terms of significant GHG emission sources and scope. This allows for the identification of the activities within an organisation that cause material GHG emissions and can serve as a basis to identify meaningful future GHG mitigation measures (e.g. based on cost vs. GHG reduction potential).

Outcome – No major deviations in the GHG inventory outcome from what could be expected on the basis of desk research and a top down and bottom up analysis of similar activities elsewhere were detected. This provides reasonable confidence in the data inputs supplied by the Eskom data suppliers. Moreover, the Eskom GHG emission profile as calculated was largely comparable to assessments of Eskom's carbon footprint in previous years.

2.4.5 Reporting

GHG monitoring and reporting should be geared towards providing relevant and reliable information regarding a company's GHG emissions. To achieve this, it is important that the results of the carbon footprint are presented in a comprehensive and transparent manner in alignment with the requirements of a recognised standard, in this case the GHG Protocol. Target groups for this information include both internal and external corporate stakeholders and the public more generally.

Outcome – The Eskom carbon footprint as calculated in the previous steps for the year 2019 is reported both in this report as well as through the ECPAM system dashboard. The next subsection elaborates further on the design and main functionalities of the EPCAM platform, including the dashboard used for reporting.

2.5 Enterprise Performance and Carbon Management (EPCAM) System

To calculate the carbon footprint and enable Eskom to do this on an annual basis from now on, the Excel-based version of the EPCAM platform has been configured to specifically fit the requirements of the organisation.

The EPCAM platform consists of two separate components:

- Data input modules per main emission source category, which are used by the data providers within the organisation to input the pertinent GHG emissions related data. Once captured, the data can then be loaded into the central data repository by the administrator. The data capture templates have been pre-defined so that only the relevant parameters are shown. It also flags entries that are outside expected, historic or set, boundaries as an extra data integrity and quality control. The data can be entered on a monthly basis.
- A central data repository, data processing unit and dashboard, which is kept and managed by the administrator of the system. The dashboard provides graphical outputs of the various components of the Eskom GHG emission profile that can be used for periodic monitoring and annual reporting purposes. It also allows for the comparison between power plants in terms of greenhouse gas performance.

The system provides flexibility to add additional GHG emission categories, sites and items as well as add or change emission factors and global warming potentials which are set for a calendar year.

3 ESKOM CARBON FOOTPRINT RESULTS AND ASSESSMENT

This section of the report presents the Eskom carbon footprint results and in conjunction an analysis of these results. It first reports the overall carbon footprint per main GHG emission source category. After this, the study focuses on stationary combustion by providing an overview of emissions per power plant. This is followed by two subsections concerning mobile combustion and non-combustion activities, as well as a sub-section providing an overview of the distribution of GHG emission by scope. The section is concluded with a discussion around assumptions made regarding data collection and processing.

3.1 SUMMARY OF ESKOM'S OVERALL CARBON FOOTPRINT IN 2019

The overall Eskom GHG inventory for the year 2019 is presented in Table 4 below. In total, the organisation was responsible for 212,601,425 tCO_2e emitted into the atmosphere.[2] The footprint is dominated by the category of Stationary Combustion, which accounted for 212,192,077 tCO_2e in 2019 and represents a share of over 99.8 percent of the total carbon footprint. The second two largest categories of GHG emissions sources are Coal Delivery to Site (which comprises only of road transportation and not rail) and Mobile Combustion by Eskom Fleet, which amount to 269,963 and 81,797 tCO_2e emitted, respectively. Together with the remaining emissions categories, these accounted for less than 0.2 percent of Eskom's total GHG emissions.

TABLE 4 – ESKOM CARBON FOOTPRINT SUMMARY BY SCOPE AND CATEGORY

Scope and Categories	GHG Emissions (tCO_2e)	GHG Emissions (%)
Scope 1 – Categories		
Stationary Combustion	212,192,077	99.81%
Mobile Combustion by Eskom Fleet	81,797	0.04%
Fugitive Emissions – SF6	36,212	0.02%
Waste Disposal	3,468	0.00%
Non-Combustion Product Use	9	0.00%
Scope 2 – Categories		
Electricity and Heat Purchased [1]	Excluded	Excluded
Scope 3 – Categories		

[2] Please note that the reported carbon footprint is specific to the GHG Protocol and assumptions applied as described in this report.

Coal Delivery to Site	269,963	0.13%
Official Mileage	12,627	0.01%
Air Travel	3,368	0.00%
Vehicle Rental	1,903	0.00%
Total	**212,601,425**	**100%**

[1] As electricity generation is Eskom's main activity, Scope 2 indirect emissions are in principle accounted for as Scope 1 direct emissions as per the definitions of the GHG Protocol.

For analysis purposes, the emission categories have been regrouped in three main types of activities irrespective of whether pertaining a Scope 1 or Scope 3 emission:

- Stationary combustion
- Mobile combustion
- Non-combustion

Grouping the emission categories per similar type of activity enables a comparison between the different categories and can initiate discussion about potential mitigation efforts applicable for similar type of activities both inside and outside the direct control of the organisation.

3.1.1 Stationary Combustion

Stationary combustion mainly includes the burning of coal at Eskom power stations to generate base load electricity, which is by far the largest source of GHG emissions from the organisation. To a lesser extent it includes the consumption of diesel and kerosene used in peaking stations. Heavy fuel oil and diesel are also used for start-up and back-up/auxiliary processes.

Figure 4 provides an overview the GHG emissions disaggregated by power station. It shows that, as can be expected, the power plants running on coal (the most carbon intense fuel) have the largest absolute emissions, with Komati representing the lower end of the range and Matimba the upper end. Peaking stations including Acacia, Ankerlig, Gourikwa and Port Rex, have relatively low emissions as these are smaller plants, in principal only used during peaking times, and produce relatively few gigawatt hours as a result.

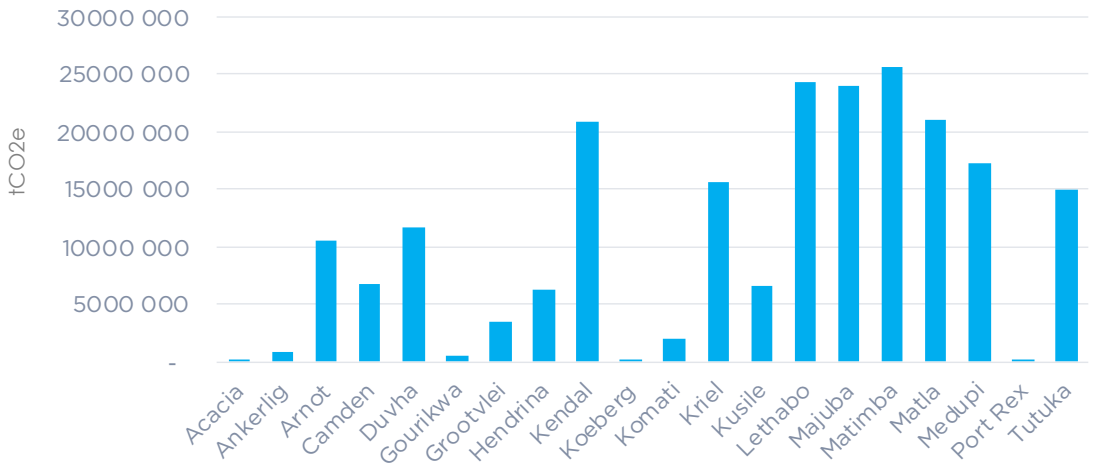

FIGURE 4 – GREENHOUSE GAS EMISSIONS BY POWERSTATION IN 2019 (tCO_2e)

Koeberg is the only nuclear-fuelled power plant in the Eskom portfolio, which uses some fossil fuels for auxiliary and backup processes with GHG emissions associated with it. The Kusile and Medupi power stations are currently only partially operational and their GHG emissions are expected to rise in the coming years as the plants are being completed and all units come online.

3.1.2 Mobile Combustion

Scope 1 Mobile Combustion emissions concern Eskom fleet including Eskom-owned vehicles (e.g. passenger cars and heavy-duty trucks) and Eskom-owned helicopters used for the inspection of power cables. Scope 3 Mobile Combustion emissions concern third-party coal delivery to site, official mileage (business travel by staff in their own vehicles), air travel and vehicle rental. Figure 5 below provides an overview of their respective contributions in tCO_2e and their percentage share. It shows that transportation of coal to Eskom power stations contributes almost three quarters within Mobile Combustion, with the remaining sources contributing a little over a quarter.

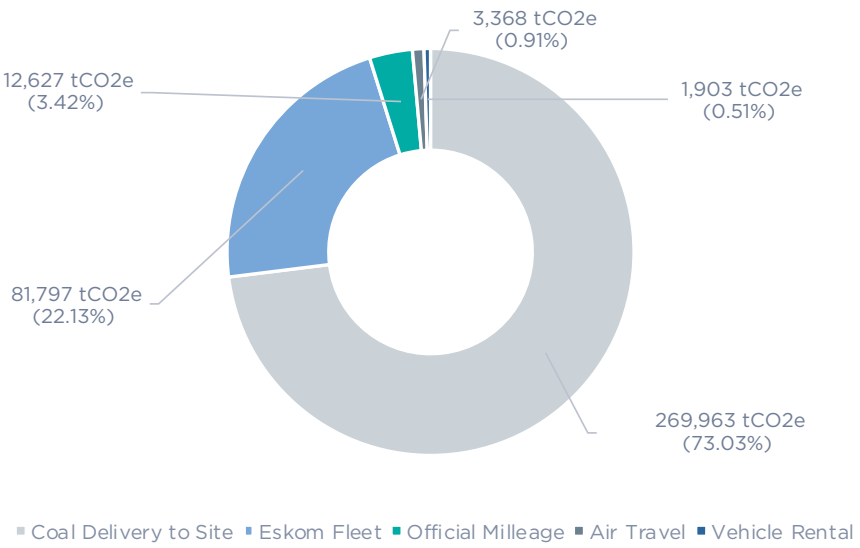

FIGURE 5 – MOBILE COMBUSTION GHG EMISSIONS IN 2019

3.1.3 Non-Combustion GHG Emissions

Non-combustion emissions arise in the form of fugitive emissions including the release of SF_6 from gas insulated switch gear, methane emissions from solid waste disposal and wastewater treatment as well as non-combustion product use pertaining the unintended oxidation of lubricants used in engines. Included in the footprint are only the emissions from activities under control of Eskom and therefore these emissions qualify as Scope 1 emissions.

The absolute emissions in tCO_2e and their percentage contribution within Non-Combustion activities are provided in Figure 6 below. This figure shows that fugitive emissions related to the use of SF6 in switchgear are by far the largest contributor with a share of over 90 percent, with the remaining sources accounting for less than 10 percent.

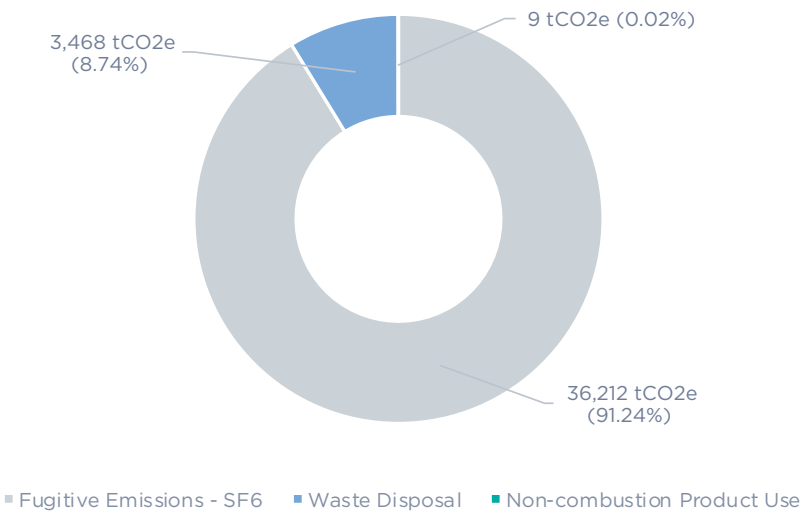

FIGURE 6 – NON-COMBUSTION GHG EMISSIONS IN 2019

3.1.4 Distribution by GHG Emission Scope

Lastly, to align with the GHG Protocol, the results of the Eskom carbon footprint are presented per main scope of emissions. Because stationary combustion emissions dwarf all other GHG emissions combined, an overview is provided both including and excluding stationary combustion emissions to create more meaningful graphs (see Figures 7 and 8, respectively). For reasons explained above, Scope 2 emissions are excluded from the footprint.

Scope 1 emissions including stationary combustion make up 99.86 percent of the carbon footprint. This is mainly the result of fossil fuel burn in power plants and some mobile emissions from Eskom fleet. Scope 3 emissions account for the remaining 0.14 percent.

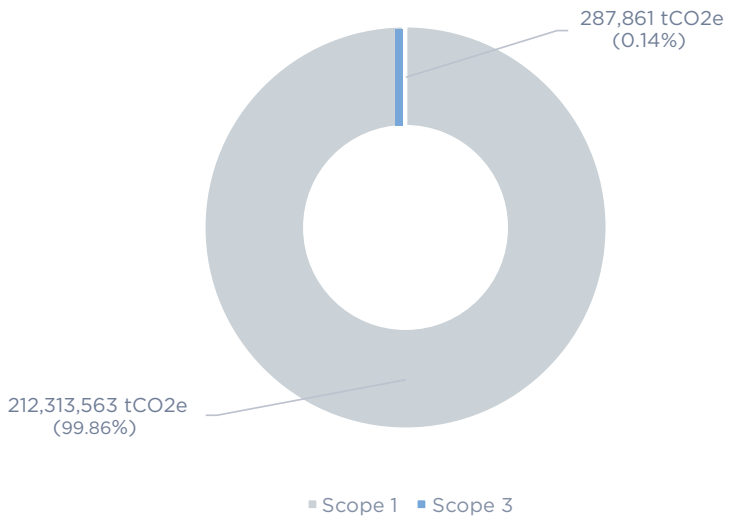

FIGURE 7 – GHG EMISSIONS BY SCOPE INCLUDING STATIONARY COMBUSTION

When stationary combustion is excluded from the overview, Scope 3 emissions become the largest relative contributor with 70.32 percent. Scope 1 emissions account for the remaining 29.68 percent.

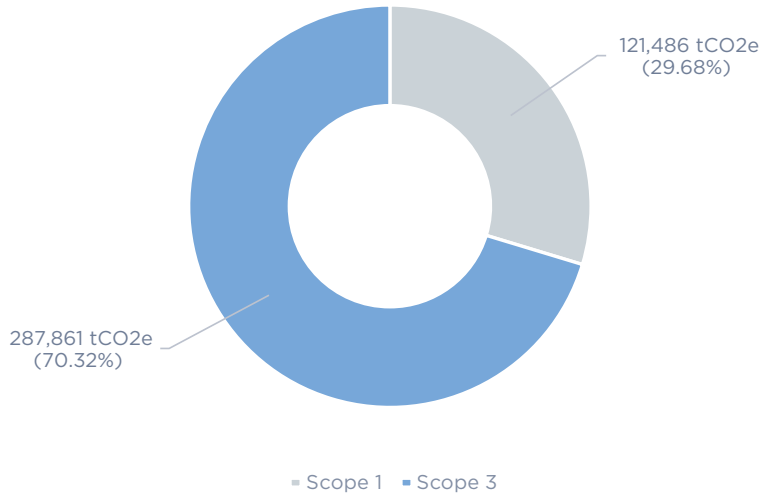

FIGURE 8 – GHG EMISSIONS BY SCOPE EXCLUDING STATIONARY COMBUSTION

3.2 Data Collection Process and Assumptions Regarding Data Processing

This subsection describes issues identified during data collection and assumptions made during data processing. It does this on a high-level per main GHG emission category as identified above and only where relevant.

3.2.1 Stationary Combustion

Coal, diesel, kerosene and fuel oil are combusted at Eskom power stations to generate electricity. This data was obtained per power station on a monthly basis. Within this fuel mix, coal represents by far the largest energy source. The coal consumption data is internally audited by Eskom to ensure that the figures are reliable and accurate. In addition to stationary combustion for electricity generation at power stations, annual consumption of diesel by backup generators at Eskom offices are accounted for as stationary combustion as well.

3.2.2 Mobile Combustion by Eskom Fleet

Mobile combustion concerns the use of petrol and diesel by Eskom-owned vehicles (e.g. passenger cars and heavy-duty trucks), as well as jet fuel consumed by Eskom-owned helicopters used for the inspection of power cables and other activities such as coal stockpile surveys or business travel. The total litres fuel used were provided on a monthly basis, where a split of 70 percent diesel and 30 percent petrol was assumed based on the input of Eskom staff. In addition, monthly numbers on jet fuel consumption were obtained to calculate GHG emissions from Eskom-owned helicopters used in its operations.

3.2.3 Non-Combustion Product Use

The non-combustion product use category relates to the use of lubricants and greases in engines of which a certain fraction slips into the combustion chamber and is co-combusted with the primary fuel inputs unintendedly. To calculate the resulting GHG emissions, the study relies on the methodology provided in IPCC (2006d) as well as monthly data on engine oil consumption, which provides default values on the total fraction of lubricants used and an *oxidised during use* (ODU) factor.

3.2.4 Waste Disposal

Waste disposal concerns both the landfilling of solid waste and the treatment of wastewater. The study identified two landfilling sites and four wastewater treatment plants operated / controlled by Eskom at its power stations (the others are managed by the municipalities or third-party contractors and therefore excluded from the scope). The data for landfilled solid waste was provided in two

units of measurement (UoM), being tonnes and cubic meters. As a result, a conversion factor was applied in line with EPA (2016) to arrive at the total tonnage of waste landfilled on which basis an emission factor was applied. For wastewater, the annual volumes treated and the average chemical oxygen demand (COD) were used to calculate GHG emissions in line with the methodology provided in IPCC (2006e).

3.2.5 Fugitive Emissions

Some industrial processes / activities lead to unintended release of GHGs. In the case of Eskom's operations, this includes the release of sulphur hexafluoride (SF_6) in the form of leakage from gas insulated switchgear (GIS) in transmission and distribution systems. It can also include the release of methane (CH_4) from coal stockpiled on site.

In GIS systems, monthly data on the top-ups of SF_6 was obtained for the transmission part of Eskom's electricity delivery network and converted in to tCO_2e using the applicable global warming potential. Methane emissions from coal stockpile were deemed immaterial and/or non-existent and are thus excluded from the footprint. This is in line with the NGER 2017, which sets the emission factor for surface coal mining to zero and the same emission factor has been assumed for stockpiling as stockpiling is inherent to mining of any kind.

3.2.6 Air Travel

This Scope 3 emissions category accounts for GHG emissions from flights undertaken by Eskom employees. The data on business kilometres flown was obtained from the travel agency contracted by Eskom for the booking of flights. The data was provided disaggregating between economy and business class flights as these have different emission values associated with them.

3.2.7 Official Mileage

Official mileage comprises of business travel with vehicles owned by employees for which a fixed reimbursement per kilometre is provided by the company. The data on kilometres driven was obtained from the Eskom SAP system on a monthly basis. As it was not possible to differentiate between diesel and petrol vehicles, the study relies on an emission factor relating to petrol vehicles (which is the higher emission factor of the two) to be conservative in its estimation of the resulting GHG emissions.

3.2.8 Vehicle Rental

Kilometres driven by Eskom employees in rented vehicles were obtained from the travel agency to which this has been outsourced by Eskom. As with official mileage, an emission factor relating to petrol vehicles was applied to be conservative in the estimation of GHG emissions.

3.2.9 Coal Delivery to Site

The final road coal delivery to site category relates to emissions from third-party owned heavy trucks for transporting coal to Eskom power stations. The kilometre travelled data was supplied in two separate categories:

1. Free Carrier Agreement (FCA) – Trucks contracted and managed by an Eskom representative (approximately 650 trucks)
2. Delivered at Terminal (DAT) – Trucks contracted and managed by the mines (approximately 2500 trucks)

Consideration was taken of the fact that generally speaking trucks will drive fully loaded from the mine to the relevant power station site and empty back to the mine. Data on rail transportation of coal to mines was not obtained and hence not included in the study.

4 RISKS IN DATA COLLECTION AND AREAS FOR IMPROVEMENT

This last section before the conclusion, provides a number of suggestions on what can be done to further improve the accuracy and quality of the carbon footprint. This relates to data gaps identified during the current study as well as the improvement of existing data to more precisely report GHG emissions. Both will contribute to a more comprehensive and precise footprint in the future.

4.1 DATA GAPS

While the current study makes considerable progress in collecting consumption / activity data for the relevant GHG categories compared to the previous carbon footprint study, it was not possible to obtain data on:

- Diesel consumption by backup generators at Megawatt Park and the Eskom Academy of Learning.
- Coal-delivery-to-site by means of rail transportation as opposed to road transportation.
- Regarding SF_6 top-ups for the distribution part of Eskom's electricity supply network. Only data on the transmission part of Eskom's electricity supply network was included.

Especially the latter is a significant source of emissions as the global warming potential is very high so that only small releases of the gas contribute materially to the footprint. Going forward it would be beneficial to also cover the aforementioned data gaps.

4.2 CARBON FOOTPRINT QUALITY IMPROVEMENT

In addition to the identification of data gaps, a number of improvements are recommended when it comes to existing data collection. These include the following:

- Mobile combustion of Eskom fleet data can be better disaggregated in terms of petrol and diesel usage, which is currently based on a realistic but assumed percentage split.
- Coal-delivery-to-site is a material source of GHG emissions and could be further improved by basing emissions factors on more exact truck specifications.
- All Scope 3 emission categories would benefit from using data of the actual consumption of fuels, instead of being based on kilometres driven.
- Frequent data entry on a quarterly or even monthly basis to avoid last minute data entry, avoiding errors and enable learning / capacity building could be applied.

More generally, distinguishing between the generation, transmission, distribution and corporate business units in data collection for certain emission categories, would improve detail in the reporting of GHG emissions and thus as a basis for management decisions.

By taking these measures forward, the footprint results can be further enhanced and confidence in the data improved. This can be done within the existing structure of the EPCAM, Excel-based, calculator tool.

5 CONCLUSION

The Eskom carbon footprint study established Eskom's GHG emissions for the year 2019 for the main GHG emission categories: stationary combustion, mobile combustion of Eskom fleet, non-combustion product use, waste disposal, fugitive emissions, air travel, official mileage, vehicle rental and coal delivery to site. This is done using the guidance of the international GHG Protocol Corporate Accounting and Reporting Standard. The carbon footprint relies on consumption / activity data provided by Eskom, recognised calculation methodologies from the IPCC and international standards as well as local (default) emissions factors as deemed appropriate to each specific situation.

The carbon footprint has been calculated using the specifically configured Enterprise Performance and Carbon Management (EPCAM) calculator tool, which will be used to determine the footprint on an annual basis going forward. Total GHG emissions from Eskom's operations amounted to 212,601,425 tCO_2e in 2019, with each individual emission categories contributing as follows:

Scope 1 emissions

- Stationary Combustion – 212,192,077 tCO_2e
- Mobile Combustion by Eskom Fleet – 81,797 tCO_2e
- Fugitive Emissions, SF6 – 36,212 tCO_2e
- Waste Disposal – 3,468 tCO_2e
- Non-Combustion Product Use – 9 tCO_2e

Scope 3 emissions

- Coal Delivery to Site – 269,963 tCO_2e
- Official Mileage – 12,627 tCO_2e
- Air Travel – 3,368 tCO_2e
- Vehicle Rental – 1,903 tCO_2e

The results are in the same order of magnitude as earlier reported GHG emissions in the previous Eskom carbon footprint study and Eskom published data on stationary combustion GHG emissions.

Going forward, it is recommended to address gaps in data collection for diesel consumption of office backup generators and SF_6 releases in distribution. Moreover, the capture of actual petrol and diesel consumption data for mobile combustion will improve the footprint: Scope 1 data should distinguish between petrol and diesel instead of assuming a split on total litres consumed of both fuels, while Scope 3 data pertaining to Air Travel, Official Millage, Vehicle Rental and Coal Delivery to Site should concern actual consumption data instead of activity data in the form of kilometres driven. In addition, it is recommended to increase the data collection frequency from annual to quarterly or even monthly. This will assist in improving the accuracy and quality of the carbon footprint in coming years, thereby establishing the footprint by means of repetitive periodic data capture exercises accumulating into an annual footprint rather than a once-off annual exercise.

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