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Final Summary Document: eThekwini Greenhouse Gas Emissions Inventory 2024

1 Synopsis

A Greenhouse Gas Emissions Inventory (GHGEI) for the eThekwini Municipality has been compiled for the 2024 calendar year. The inventory identifies the sources of Greenhouse Gas (GHG) emissions from both the local government and community sectors within the eThekwini Municipal Area.

The eThekwini Municipality compiles and reviews its GHGEI as a data-driven tool to quantify emissions, identify major sources such as transport and industry, track trends over time, and support evidence-based development and evaluation of climate change mitigation strategies.

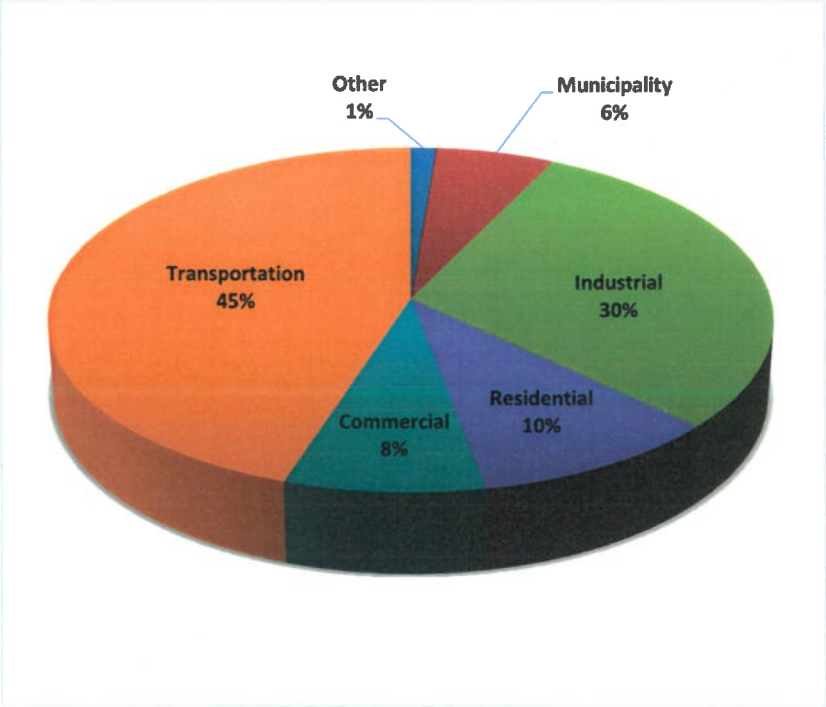

Figure 1: GHG emissions by sector

The GHGEI is structured into two sub-inventories:(i) a local government inventory, which captures greenhouse gas emissions arising from activities and operations directly controlled or managed by the eThekwini Municipality, and (ii) a community-wide inventory, which accounts for emissions generated by all major sectors operating within the geographical boundary of the eThekwini Municipal Area.

The total GHG emissions recorded for the entire eThekwini Municipal Area in this current review are estimated at 27,585,873 tCO_2e[1] for the 2024 calendar year. The emissions profile remains consistent with historical inventory trends, with the transportation sector representing the largest contributor at approximately 45% of total

[1] Includes scope 1, 2 and selected scope 3 emissions

emissions, followed by the industrial sector at 30%. These findings highlight the continued dominance of energy-intensive and mobility-related activities in the city's emissions profile. A detailed sectoral breakdown of emissions is presented in Figure 1.

2 Background

In 2010, the eThekwini Municipality, together with a cohort of global cities, became a signatory to The Global Cities Covenant on Climate (the "Mexico City Pact"). Through this covenant, the Municipality committed to the systematic monitoring, reporting and disclosure of annual GHG emissions, as well as the implementation and tracking of climate change commitments, climate mitigation and adaptation measures, and actions. To support this commitment, a baseline GHGEI excel sheet was developed for the 2010 reporting year using a structured and updatable emissions accounting framework, enabling the consistent compilation and annual reporting of GHG emissions data. The GHGEI has since been institutionalised as a core monitoring and reporting tool within the Municipality

The eThekwini GHGEI serves to fulfil the Municipality's international reporting commitments to The Global Cities Covenant on Climate. Furthermore, the GHGEI, is meant to aid the Municipality in forecasting emission trends and setting emission reduction targets and goals and informing climate change mitigation strategies and broader strategic planning processes.

3 Methodology Used

The eThekwini 2024 GHGEI was developed in accordance with the Local Government GHG Emissions Analysis Protocols, established by ICLEI – Local Governments for Sustainability, were used to guide the development of the eThekwini 2024 GHG Inventory:

- International Local Government GHG Emissions Analysis Protocol Version 1.0[2]; and
- Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories Version 1.1[3].

These protocols provide a standardized methodological guidelines to assist local governments in quantifying and reporting GHG emissions associated with both municipal operations and community-wide activities. Both protocols are based upon the Corporate GHG Protocol[4] developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) as well as technical guidance provided by the Intergovernmental Panel on Climate Change (IPCC) a scientific body affiliated to the United Nations Framework Convention on Climate Change (UNFCCC). Emission-generating activities are categorised and reported according to defined emission scopes, enabling consistent and transparent accounting:

- Scope 1: are any direct emissions produced by the organisation or area, such as combustion of fuel.
- Scope 2: activities are indirect emissions produced by electricity that is purchased by the organisation or area.
- Scope 3: emissions are those that occur from the organisation or area's activities, but the sources of the emissions are owned or controlled by another entity, such as emissions from flights where planes are not owned by the organisation/area in question.

[2]Available at http://www.icleiusa.org/tools/ghg-protocol
[3]Available at http://www.icleiusa.org/tools/ghg-protocol
[4]Available at http://www.ghgprotocol.org/standards/corporate-standard

The figure below is a summary of the different types of scopes for GHG emissions.

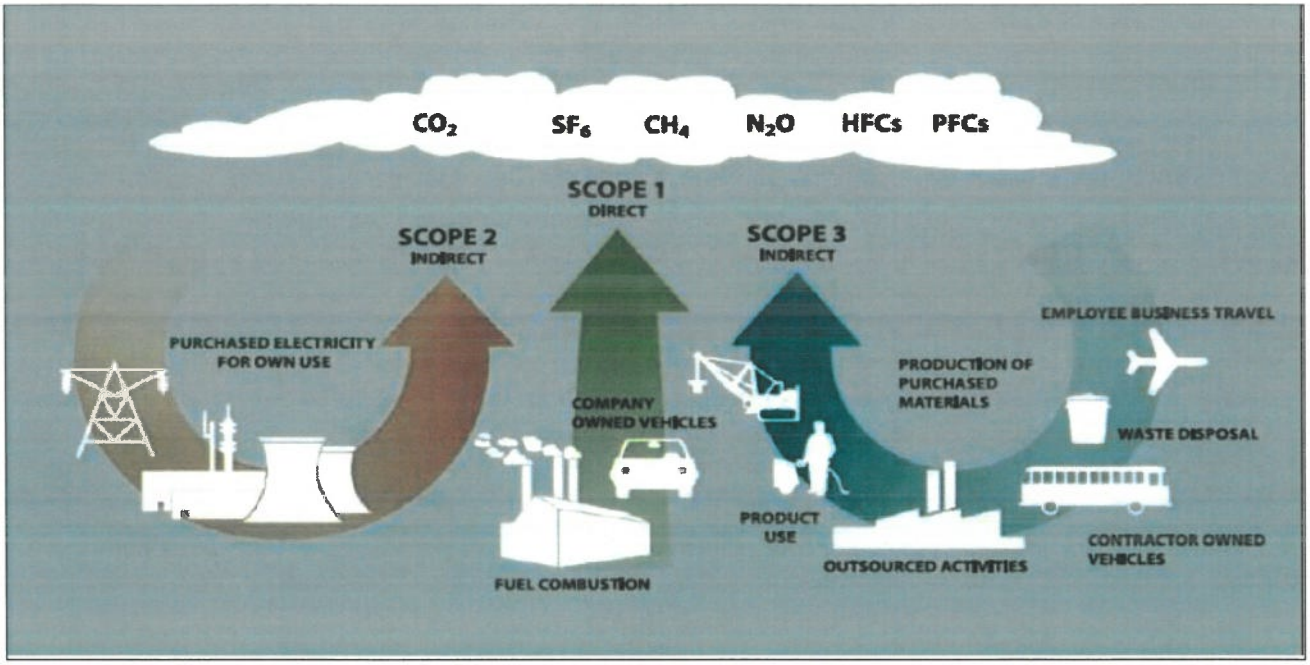

Figure 2: Total Government Emissions by Sector (Image Source: www.ghgprotocol.org)

The differentiation of emission scopes is fundamental to ensuring accurate GHG accounting, as it minimizes the risk of double counting emissions and enhances the integrity and transparency of reported emissions. In accordance with WRIs GHG Protocol, reporting of Scope 1 (direct emissions and Scope 2 (indirect emissions) is mandatory, forming the core for consistent emission reporting.

The eThekwini 2024 GHGEI is structured into two distinct but complementary sub-inventories: (i) a local government inventory and (ii) a community-wide inventory. The local government inventory quantifies emissions from direct (Scope 1) and indirect (Scope 2 and selected Scope 3) activities under the operational and financial control of the eThekwini Municipality, including municipal infrastructure, facilities, and services. In parallel, the community-wide inventory captures emissions associated with socio-economic activities occurring within the municipal boundary, including key sectors such as industry, commercial and residential energy use, transport systems, waste management, and agricultural activities. The emission sources and scope classifications included in each sub-inventory are detailed in Table 1 and Table 2, respectively

Table 1: Government Emission Sources collected according to Scope

Scope 1	Scope 2	Scope 3
Stationary Fuel Combustion	Electricity Consumption	Employee Air Travel
Mobile Fuel Combustion	Electricity Transmission & Distribution (Technical and Non-technical losses)	Transit vehicles operated by contractor
Wastewater Treatment		Electricity consumption by Eskom owned streetlights
Solid Waste Disposal		
Power Generation Facilities		

Table 2: Community Emission Sources collected according to Scope

Scope 1	Scope 2	Scope 3
Stationary Fuel Combustion	Electricity Consumption	Air Transport Systems
Mobile Fuel Combustion		Marine Transport Systems
Solid Waste Disposal		
Enteric Fermentation		
Pre-harvest Cane Burning		
Industrial Processes and Product Use		

To ensure standardised and comparable reporting, activity data (such as fuel consumption) is multiplied by appropriate emissions factors to convert all data into a common unit of tonnes carbon dioxide equivalent (tCO_2e). Emission factors represent internationally recognised coefficient that quantify the emissions associated with a unit of activity and are typically published by authoritative bodies. To date South Africa has not published a comprehensive list of emission factors for use in South Africa, except for an emission factor for electricity provided by ESKOM[5]. Therefore, the United Kingdom Government Department of Environment, Food and Rural Affairs (DEFRA) and the International Panel for the Climate Change (IPCC) published emission factors have been used in this report.

4 Results

For the 2024 calendar year, the total GHG emissions recorded for the entire eThekwini Municipal Area were quantified at 27,585,873 tCO_2e. The following section provides more detailed analysis on this figure but disaggregates this total into two principal components: emissions attributable to Municipality (local government) operations and emissions arising from the broader community. The branching into local government and community sub-sectors is consistent with established international reporting practices recognising that emissions from local government operations are typically more readily measurable due to direct control over data, while community emissions reflect wider socio-economic activities within the municipal boundary.

4.1 Local Government Emissions

Total GHG emissions attributed to local government operations for the 2024 period were quantified at 1,641,233 tCO_2e. The local government sub-inventory encompasses emissions arising from activities under the operational and financial control of the eThekwini Municipality, including those associated with the use of key municipal assets, infrastructure, and service delivery functions during the reporting year. A summary of municipal emissions disaggregated by GHG emission scope is presented in Table 3.

Table 3: Municipal Emissions by Scope

Emissions Scope	GHG Sources	Municipal Emissions (tCO2e)
Scope 1	Stationary Fuel Combustion, Mobile Fuel Combustion, Wastewater Treatment, Solid Waste Disposal	254,659 (15.52%)
Scope 2	Electricity Consumption, Electricity Transmission & Distribution (Technical and Non-technical losses)	1,357,462 (82.71%)

[5] 1kWh = 1.03kg CO_2

Scope 3	Employee Air Travel, Transit vehicles operated by contractor, Electricity consumption by Eskom owned streetlights	29,112 (1.77%)

Figure 3 illustrates the sectoral distribution of local government GHG emissions for the 2024 reporting year. The municipal emissions profile is dominated by Scope 2 emissions associated with electricity transmission and distribution losses, which account for approximately 65% of total emissions. Secondary contributions arise from electricity consumption in public lighting infrastructure (10%), followed by wastewater and solid waste treatment processes (7% each). Direct emissions from municipal fleet operations and buildings represent a comparatively smaller share, indicating a predominantly electricity-driven emissions structure.

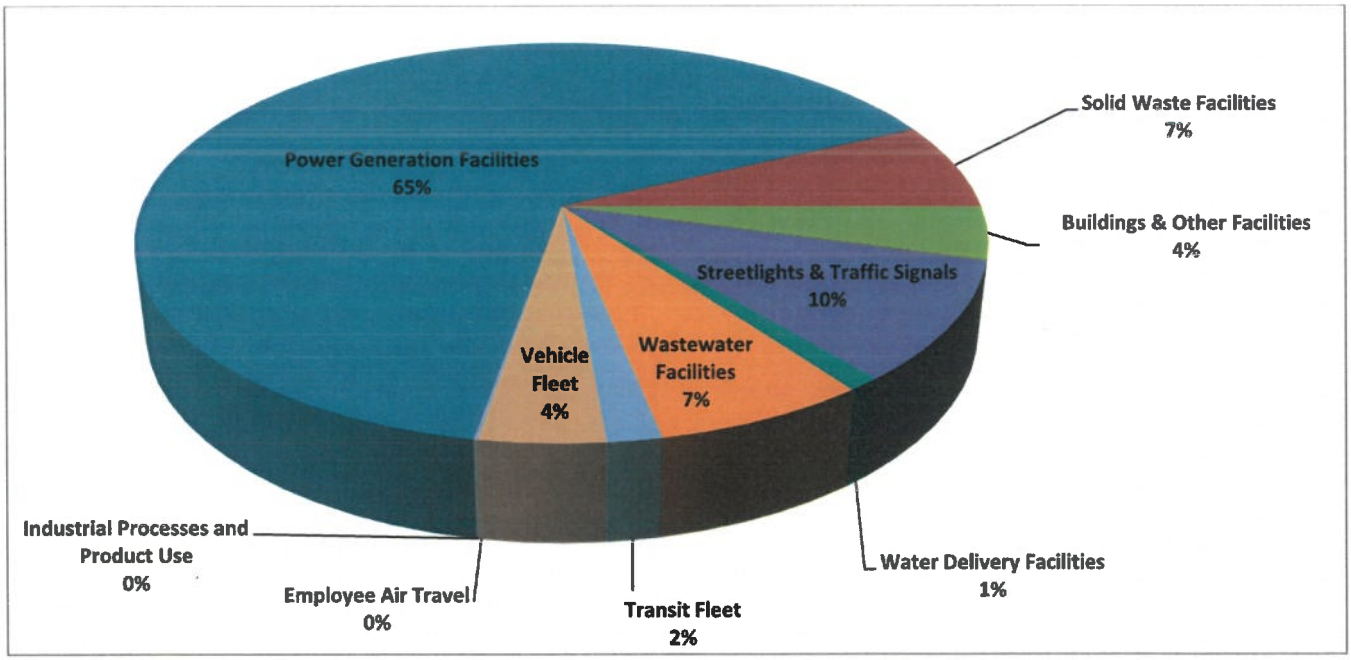

Figure 3: Total Government Emissions by Sector

Table 4: Municipal Operation Emissions by Sector and Source

Sector	Scope	Emission Sources	Emissions (tonnes CO_2e)
Buildings & Other Facilities	1 2	Stationary Fuel Combustion Purchased Electricity	517 69,564
Streetlights & Traffic Signals	2	Electricity consumption by municipal owned	157,401
	3	Streetlights	0
Water Delivery Facilities	2	Purchased electricity	17,699
Wastewater Facilities	1 2	Stationary and process emissions Purchased electricity	70,510 42,215
Vehicle Fleet	1	Mobile fuel combustion	65,106

Sector	Scope	Emission Sources	Emissions (tonnes CO_2e)
Transit Fleet	3	Mobile fuel combustion	28,746
Power Generation Facilities	2	Electrical distribution losses	1,070,373
Solid Waste Facilities	1 2	Fugitive emissions Purchased electricity	115,944 210
Industrial Process and Product Use	1	Bitumen	2,582
Employee Air Travel	3	Mobile fuel combustion	366
Total Municipal Emissions			1,641,233

4.2 Community Emissions

Total GHG emissions attributed to community-wide activities within the eThekwini Municipal Area were estimated at 26,507,755 tCO_2e for the 2024 reporting year. The community emissions inventory encompasses emissions arising from a range of socio-economic activities occurring within the municipality's geographical boundary. These include key sectors such as industry, commercial and residential energy use, transport systems, waste management, and agriculture. A detailed breakdown of community emissions by reporting scope is presented in the table below.

Table 5: Community Emissions by Scope

Emissions Scope	GHG Sources	Community Emissions (tCO2e)
Scope 1	Stationary Fuel Combustion, Mobile Fuel Combustion, Solid Waste Disposal, Enteric Fermentation, Pre-harvest Cane Burning	13,450,471 (51.84%)
Scope 2	Electricity Consumption	7,790,571 (30.03%)
Scope 3	Air Transport Systems, Marine Transport Systems	4,703,598 (18.13%)

Figure 4, illustrates that the community-wide emissions profile is dominated by transport and industrial sectors, contributing approximately 48% and 32% of total emissions respectively. Transport emissions are primarily driven by on-road and off-road vehicle activity, while industrial emissions reflect energy-intensive production processes. Secondary contributions arise from residential (11%) and commercial (8%) energy use, with negligible contributions from IPPU, waste, and AFOLU sectors. This profile indicates a predominantly energy- and mobility-driven emissions structure, with mitigation efforts needing to prioritise low-carbon transport systems and industrial decarbonisation.

A more in-depth breakdown of the sectors according to emission source can be found in Table 6.

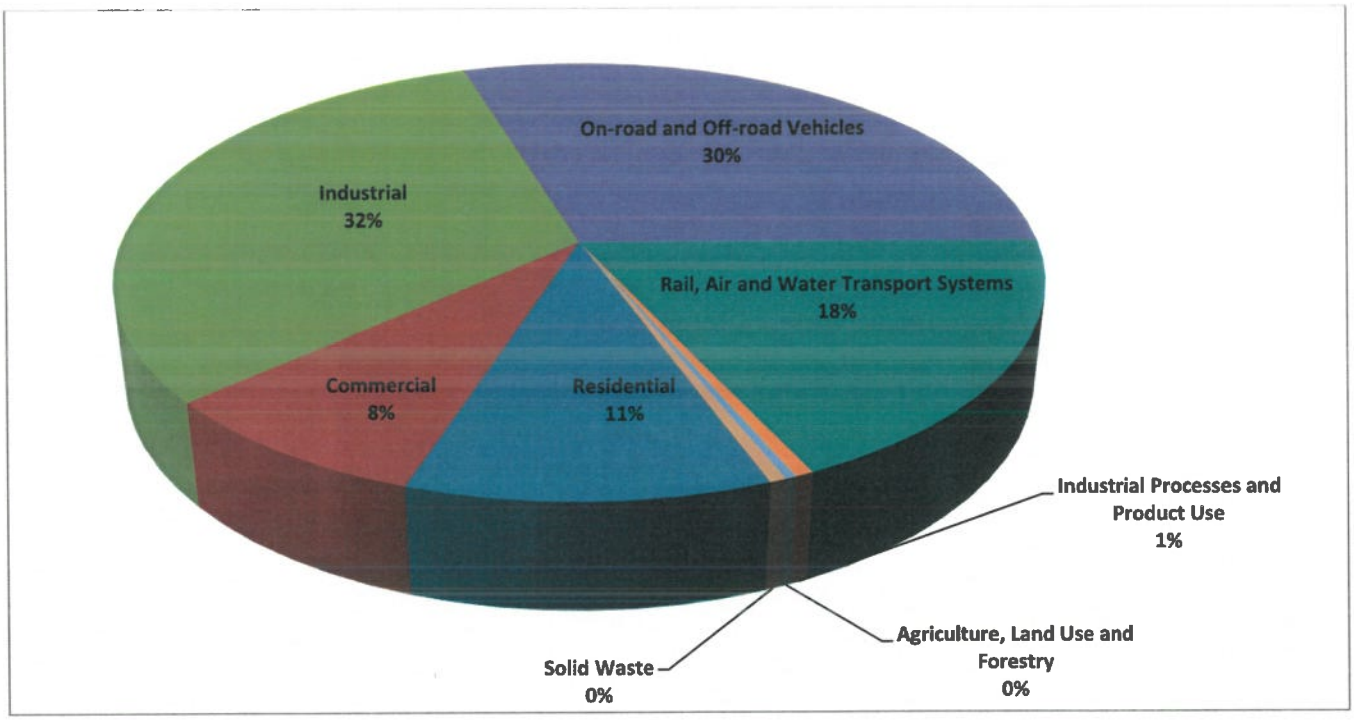

Figure 4: Total Community Emissions by Sector

Table 6: Community Operation Emissions by Sector and Source

Sector	Scope	Emission Sources	Emissions (tonnes CO_2e)
Residential	1	Stationary Fuel Combustion	491,897
	2	Electricity Consumption	2,271,252
Commercial	2	Electricity Consumption	2,186,732
Industrial	1	Stationary Fuel Combustion	4,899,196
	2	Electricity Consumption	3,332,586
On-road and Off-road Vehicles	1	Mobile Fuel Combustion	7,704,705
Rail, Air and Water Transport Systems	3	Air Travel	4,703,598
Solid Waste	1	Fugitive Emissions	128,038
Industrial Process and Product Use	1	Pulp & Paper Production	94,436
	1	F-gases	44,330
Agriculture, Land Use and Forestry	1	Enteric Fermentation	87,868
Total Community Emissions			25,944,639

5 Analysis of the GHG Inventory

5.1 Total Emissions

For 2024 reporting year, the total GHG emissions recorded for eThekwini Municipality was 27,585,873 tCO_2e. Municipal (local government) activities accounts for 6% of the total emissions as illustrated in Figure 1.

Figure 5 presents the distribution of emissions by primary source categories, indicating that transport-related activities constitute the largest share of emissions at approximately 45%. This is followed by emissions associated with electricity consumption, which account for approximately 33% of total emissions. Stationary fuel combustion represents the third-largest source, contributing approximately 20% to the overall GHG footprint.

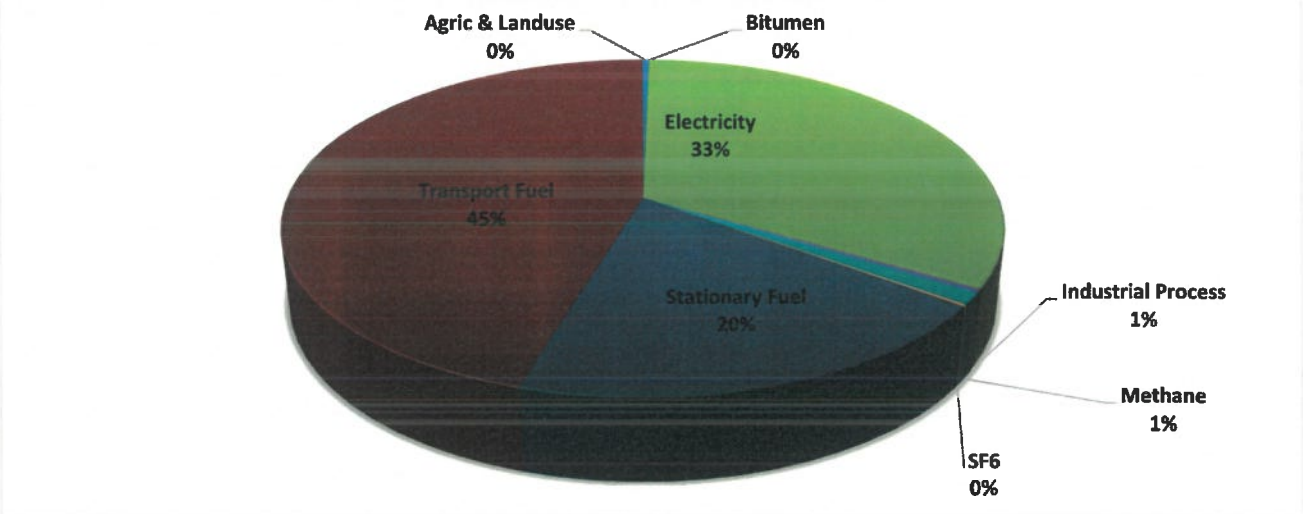

Figure 5: Carbon emissions by Source

The imported electricity supplied in the city was 9,814 GWh (99.9%) compared to local generators of electricity at 8 GWh (0.1%), Figure 6 below. This local generation is predominantly from the Municipal Landfill Gas and renewable energy embedded generators.

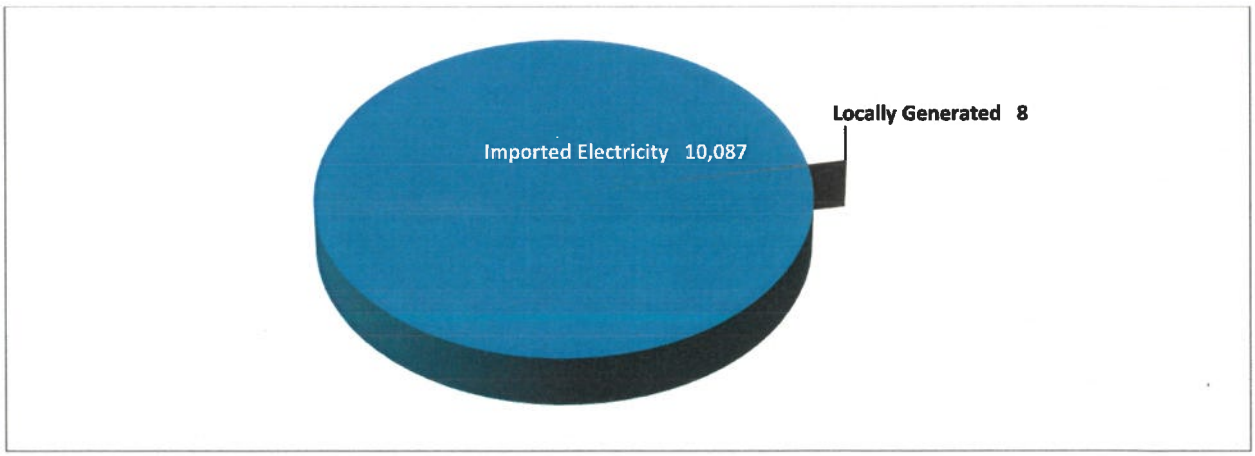

Figure 6: Electricity Supply by Source in the eThekwini Municipal Area (GWh)

5.2 Municipal Emissions

The municipal emissions profile is dominated by electricity-intensive infrastructure, particularly street lighting (29%) and water and sanitation services (22%), followed by solid waste management (20%) and fleet operations (16%). Secondary contributions arise from administrative buildings (10%), while other sectors collectively account for a negligible share. The results indicate a predominantly Scope 2-driven emissions structure, with significant contributions from methane emissions associated with waste and wastewater systems as illustrated in Figure 7.

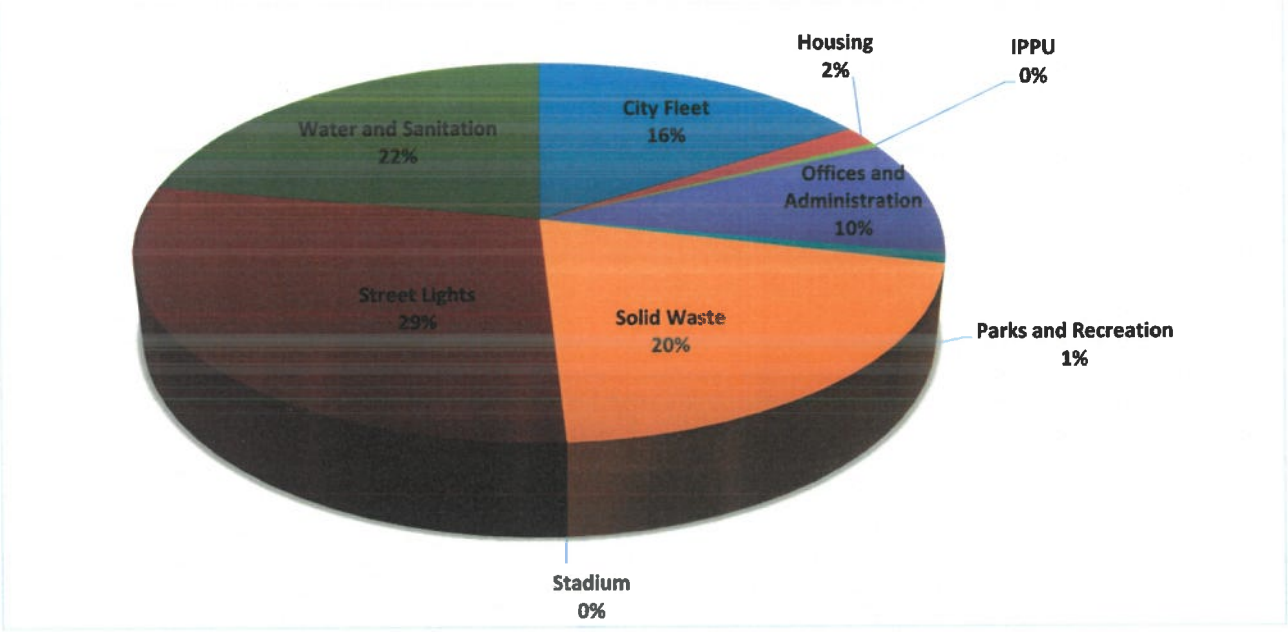

Figure 7: Municipal Emissions by Infrastructure Type tCO2e (excluding electricity transmission losses)

5.3 Intensity of Emissions

5.3.1 Government Intensity Figures

Emission intensity metrics for the Municipality are presented below in Table 8. These figures were derived by aggregating municipal Scope 1 and Scope 2 emissions and normalising them against relevant activity or performance metrics, enabling comparative assessment of emissions efficiency across municipal operations.

Table 7: Municipal Intensity Figures

Intensity Figure	Unit	Metric Numerator	Unit	Metric Denominator	Unit
R 25.11	tCO2e / million Rand of operating budget	1,612,121	tCO2e (Municipal Scope 1 & 2)	R 64,200.00	Million Rand Operating Budget (2023/ 2024)
R 227.06	tCO2e / million Rand of Capital budget	1,612,121	tCO2e (Municipal Scope 1 & 2)	R 7,100.00	Million Rand Capital Budget (2023/ 2024)
66.66	tCO2e / Permanent employee	1,612,121	tCO2e (Municipal Scope 1 & 2)	24,183	Permanent Employees

5.3.2 Community Intensity Figures

Community intensity metrics are presented below. These indicators were derived by aggregating relevant sectoral emissions by scope and normalising them against appropriate activity-based indicators, enabling comparative assessment of emissions intensity across community sectors.

Table 8: Community Emissions Figures

Intensity Figure	Unit	Metric Numerator	Unit	Metric Denominator	Unit
2.06	tCO2e / household	2,763,150	tCO2e (Residential Scope 1 & 2)	1,339,259	Number of households within the EMA
R 18.90	tCO_2e / million Rand of Capital budget	2,186,732	tCO2e (Commercial Scope 1 & 2)	R 115,700.00	2024 Annual retail trade sales

5.3.3 Total Emissions Intensity Figures

Total emission intensity figures (for the municipality and the community) are recorded below in Table 8. These emissions were calculated by combining relevant sector scope emissions and dividing them by the relevant indicators. A per capita figure has been calculated using total scope 1 and 2 emissions and separately using emissions from all three scopes to account for different methodologies of calculating this figure.

Table 9: Total Emissions Intensity Figures

Intensity Figure	Unit	Metric Numerator	Unit	Metric Denominator	Unit
5.13	tCO2e / Capita	22,853,163	tCO2e (Scope 1 & 2)	4,458,281	Population within the EMA
6.54	tCO2e / Capita	29,175,112	tCO2e (Scope 1, 2 & 3)	4,458,281	Population within the EMA

5.4 Comparison with previous GHGIE

The 2010 eThekwini GHGEI serves as the baseline inventory because the methodology for collecting and reporting data then was clearly defined for this period. This baseline provides a reference against which subsequent emissions trends are assessed. The emerging emissions trend is summarised in the table and graph below. Trend analysis indicates a general increase in emissions over time, driven by improved data accuracy and rising energy demand and carbon-intensive activities.

Table 10: Historic Emissions Data for the eThekwini Municipality (tCO2e)

Year	Government Emissions	Community Emissions	Total Emissions	% Change
Yr 2010	1,104,212	25,962,074	27,066,285	
Yr 2011	1,551,420	26,097,979	27,649,400	2.2%
Yr 2012	1,526,431	27,833,965	29,360,395	6.2%
Yr 2013	1,450,928	27,290,630	28,741,558	-2.1%
Yr 2014	1,586,674	27,505,329	29,092,003	1.2%
Yr 2015	1,715,259	25,352,653	27,067,912	-7.0%
Yr 2016	1,817,486	26,647,189	28,464,675	5.2%
Yr 2017	1,261,219	27,764,419	29,025,638	2.0%
Yr 2018	1,393,662	27,781,450	29,175,112	0.5%
Yr 2019	1,363,657	27,440,798	28,804,454	-1.3%
Yr 2020	1,715,465	26,426,352	28,141,817	-2.3%
Yr 2021	1,740,189	27,564,465	29,304,654	4.1%
Yr 2022	1,719,252	27,901,415	29,620,667	1.1%
Yr 2023	1,678,588	26,507,755	28,186,344	-4.8%
Yr 2024	1,641,233	25,944,639	27,585,873	-2.1%

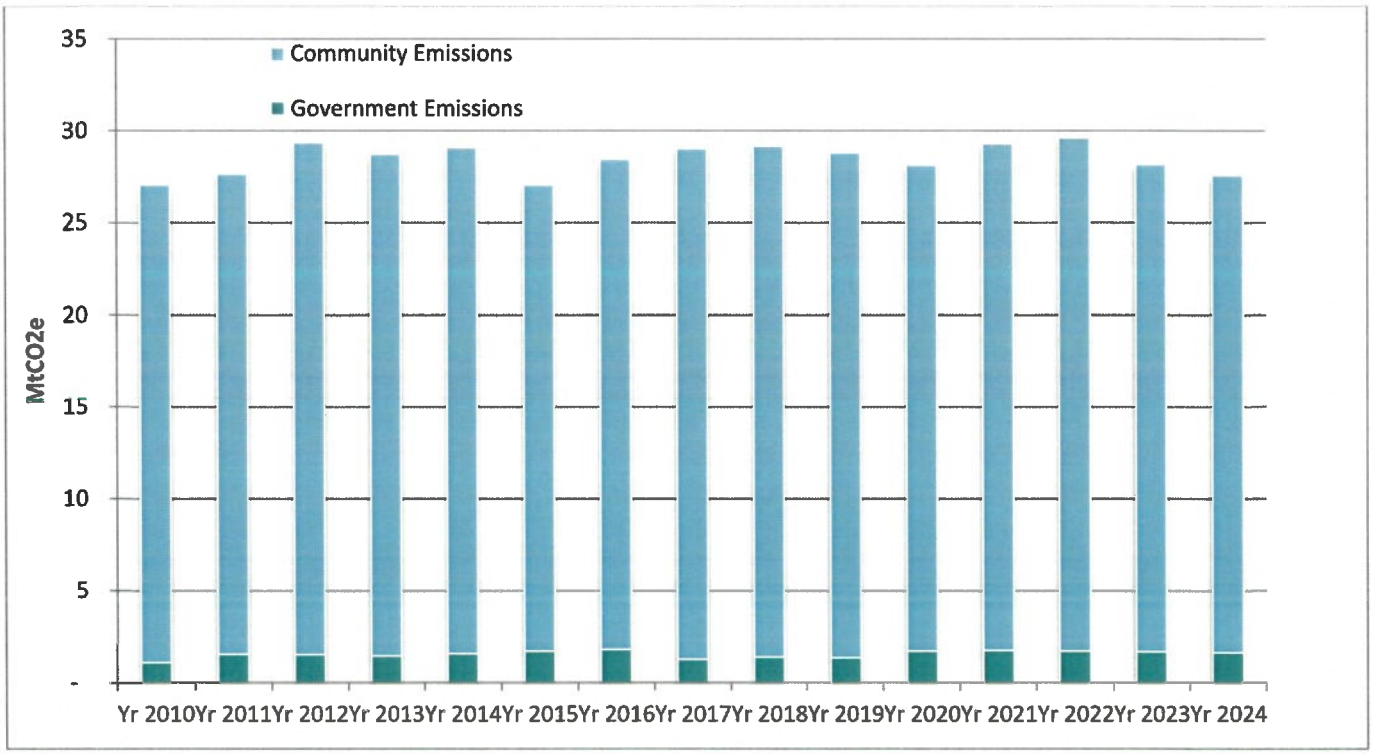

Figure 8: Historic Emissions Data for the eThekwini Municipality (tCO2e)

Total emissions have decreased by 600,471 tCO2e in 2024, the analysis shows a decrease in municipal and community emissions of 37,355 tCO_2e and 563,116 tCO_2e respectively. Table 11 shows a detailed summary of the differences between 2023 and 2024 emissions.

Table 11: Data Comparison between 2023 and 2024 Reporting Periods

Scope	Type	Sub-Type	2023 (tCO2e)	2024 (tCO2e)
Municipal Scope 1	Fuel Consumption	Stationary Fuel Combustion	517.3	517.3
		Vehicle Fleet	70,239.8	65,105.9
	Solid Waste	Solid Waste (CH4)	115,969.2	115,943.5
	Industrial Processes & Product Use	IPPU	2,582.4	2,582.4
	Wastewater Treatment	Wastewater (CH4)	68,440.5	70,510.2
Municipal Scope 2	Electricity Consumption	Buildings	84,704.1	69,564.5
		Streetlights & Traffic Signals	168,382.4	157,400.6
		Water Delivery Facilities	19,721.5	17,699.1
		Transmission and Distribution Losses	1,070,357.1	1,070,372.7
		Solid Waste Facilities	185.0	209.8
		Wastewater Facilities	47,445.5	42,215.4
Municipal Scope 3	Transport Systems	Streetlights	1,111.9	-
		Transit Fleet	28,503.7	28,746.2
		Flights	427.9	365.8
Subtotal Municipal			**1,678,588.4**	**1,64,233.3**
Community Scope 1	Fuel Consumption	Stationary Fuel Combustion	5,730,418.0	5,391,093.3
		Mobile Fuel Combustion	7,326,673.2	7,704,705.0
	Solid Waste	Solid Waste	130,851.0	128,038.0
	Industrial Processes & Product Use	Industrial Process	140,418.0	94,436.0
	Industrial Processes & Product Use	SF_6	44,330.0	44,330.0
	Agric & Land use	Agric & Land use	87,868.4	87,868.4
Community Scope 2	Electricity Consumption	Residential	2,414,046.9	2,271,252.1
		Commercial	2,296,322.5	2,186,732.4
		Industrial	3,644,124.8	3,332,586.5
Community Scope 3	Transport Systems	Air Transport Systems	264,946.1	275,841.2
		Water Transport Systems	4,427,756.4	4,427,756.4
Subtotal Community			**26,507,755.3**	**25,944,639.3**
Total			**28,186,343.7**	**27,585,872.7**

6 Conclusion

The GHGEI serves as a critical instrument for tracking and managing greenhouse gas emissions within the eThekwini Municipal Area that are contributing to human induced climate change. For the 2024 reporting period, total GHG emissions have decreased by 2% which is equivalent to 600,471.1 tCO2e, indicating modest progress in emission stabilisation. In 2024 the community and government emissions contributed 25,944,639 tCO2e and 1,641,233 tCO2e GHG emissions, respectively. The emissions profile continues to be driven primarily by the transport and industrial sectors, reflecting a strong reliance on energy-intensive mobility and economic activities.

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