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eThekweni Greenhouse Gas Emissions Inventory 2017

Technical Report

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1 INTRODUCTION

1.1 ETHEKWINI MUNICIPALITY

The eThekweni Municipal Area (EMA) covers an area of approximately 2 556 square kilometres of which 36% is rural and a further 29% is peri-urban. The Municipality is home to approximately 3.9 million people constituting a 7% share of the total South African population, making it the third most populated municipality in the country. The economy of the EMA is centred on the transport and logistics activities of the Port of Durban, domestic and export-oriented manufacturing and tourism. The Gross Domestic Product of the eThekweni Municipality during 2017 amounted to R303.1bn with a per capita income of R63, 319 (eThekweni Municipality Key Indicators 2017, Appendix A).

The EMA is governed by the eThekweni Municipality, with an Operating Budget of R37.2bn (2017/2018) and a Capital Budget of R7.3bn (eThekweni Municipality Key Indicators 2017, Appendix A). During 2017 the Municipality employed 23,510 employees on a permanent and temporary basis. Basic services provided by the eThekweni Municipality are described in **Table 1**.

Table 1: Basic services provided by the eThekweni Municipality

Description	Details	Description	Details
Basic Services	Housing	Infrastructure	Stormwater
	Water		Roads
	Sanitation		Sidewalks
	Electricity & Lighting		Pedestrian bridges
	Solid Waste		Footpaths
	Transport		
	Safety & Security		
	Health		

1.2 ETHEKWINI GREENHOUSE GAS INVENTORY

During December 2010 the eThekweni Municipality became a signatory of the Global Cities Covenant on Climate (“Mexico City Pact”). In terms of this agreement the Municipality has committed to registering the Municipality’s greenhouse gas (GHG) emissions inventory, commitments, climate mitigation and adaptation measures and actions in the Carbon Cities Climate Registry.

In addition to meeting the Municipality’s Mexico City Pact commitments, reporting the Municipality’s GHG emissions will aid policy makers in forecasting emission trends, identifying the point and mobile sources of emissions generated, and setting goals for future reductions and mitigation.

The reporting of a municipal inventory also aligns eThekweni Municipality with the intentions of the National Climate Change Response White Paper (Department of Environmental Affairs, 2011) and the broader national government policy on climate change.

2 INVENTORY PARAMETERS

2.1 PROTOCOLS

The eThekwini Municipality's 2017 GHG Inventory and Inventory Report were based upon the two Local Government GHG Emissions Analysis Protocols developed by ICLEI – Local Governments for Sustainability, namely the:

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

The protocols are designed to provide a standardized set of guidelines to assist local governments in quantifying and reporting GHG emissions associated with their government and community operations. Both protocols are based upon the Corporate GHG Protocol developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) as well as technical guidance provided by the United Nations Intergovernmental Panel on Climate Change (IPCC).

The protocols were followed closely to ensure that eThekwini's 2017 GHG Inventory can be compared with other municipalities and organisations around the world utilising the same protocol.

2.2 BOUNDARIES

2.2.1 Temporal Boundary

The 2017 eThekwini GHG Inventory comprises emissions occurring during the 2017 calendar year, as required by ICLEI.

2.2.2 Operational Boundaries

The municipal inventory separately accounts for emissions associated with the operations of the eThekwini Municipality (i.e. local government emissions) and the activities that occur within the EMA but which are not as a direct result of the Municipality's operations or assets (i.e. community emissions). These two sectors are broken down into the following analyses.

- Government Operations Analysis

The government operations analysis is defined by an organisational boundary and includes functions directly under the eThekwini Municipality's control and emissions arising from the use of all significant assets and services during 2017.

- Community Operations Analysis

The community operations analysis is defined by a geopolitical boundary and incorporates the physical area or region over which the eThekwini Municipality has jurisdictional authority. This analysis includes GHG emissions associated with activities (of the general public and industry / commerce) occurring within the eThekwini Municipality's geopolitical boundary generated during 2017.

2.3 SCOPES

The eThekwini Municipality 2017 GHG Inventory includes all important sources of GHG emissions occurring within the Municipality's geopolitical and organizational boundaries. Direct and indirect emissions are accounted for separately within each sector through the categorisation of emissions as either scope one, two or three emissions. Differentiating

between emission scopes helps to avoid the possibility of double counting emissions and misrepresenting emissions when reporting.

2.3.1 Municipal Operations Emissions Scopes

Municipal operations emissions included in the inventory were categorised into the following scopes:

- **Scope 1** – Direct emission sources owned or operated by eThekweni Municipality.
- **Scope 2** – Indirect emission sources.
- **Scope 3** – Indirect and embodied emissions over which eThekweni Municipality exerts significant control or influence. Certain emissions from contracted services were included in the municipal operations emissions inventory in instances where the service provided by the contractor is commonly provided by the municipality. These contractor emissions may be either direct or indirect but are classified as scope 3 emissions within the municipal operations inventory regardless.

Table 2 details the source of emissions included within each scope of the 2017 municipal operations emissions inventory.

Table 2: Emission sources included in the 2017 municipal operations inventory

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

2.3.2 Community-scale Emissions Scopes

Community-scale emissions included within the 2017 inventory were categorised into the following scopes:

- **Scope 1** - All direct emission sources located within the geopolitical boundary of eThekweni Municipality.
- **Scope 2** - Indirect emissions that result as a consequence of activity within eThekweni Municipality's geopolitical boundary
- **Scope 3** - Indirect and embodied emissions that occur as a result of activity within the geopolitical boundary.

Table 3 provides details of the source of emissions included within each scope of the 2017 community-scale emissions inventory.

Table 3: Emission sources included in the 2017 community inventory

Scope 1	Scope 2	Scope 3
Sources of Emissions		
Stationary Fuel Combustion	Electricity Consumption	Air Transport Systems
Mobile Fuel Combustion		Marine Transport Systems
Solid Waste Disposal		
Enteric Fermentation		
Pre-harvest Cane Burning		

3 INVENTORY DETAILS

3.1 MUNICIPAL EMISSIONS

This section provides a breakdown of GHG emissions calculated within the various municipal sectors. Included in the breakdown are details pertaining to data sources and calculations used to determine emissions.

3.1.1 Buildings and Other Facilities

The 'buildings and other facilities' sector includes, emissions generated by administrative facilities, public venues, libraries, parks and recreational facilities operated by the eThekweni Municipality (**Table 4**).

Table 4: Emissions inventory and data disclosure for municipal buildings and other facilities

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Stationary Combustion	4,964	5.3	16.3	2,961
<ul style="list-style-type: none"> ■ Emissions Source: Stationary combustion of fuel by municipal buildings and other facilities <ul style="list-style-type: none"> – Activity Data: ICLEI recommended data type - Known fuel use calculated from fuel purchase data – Emissions Factor: ICLEI recommended factor - Default by fuel type (Appendix B) – Data Description: Data on the quantity of fuel purchased, for stationary combustion, by the Municipality – Data Source: eThekweni Procurement Department 					
Scope 2	Purchased Electricity				51,286
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption by municipal buildings and other facilities <ul style="list-style-type: none"> – Activity Data: ICLEI recommended data type - Known electricity use – Emissions Factor: Eskom emission factor (Appendix B) – Data Source: Treasury Department ; Eskom 					

3.1.2 Streetlights and Traffic Signals

This sector includes electricity consumption by streetlights and traffic signals owned by the Municipality (**Table 5**). It is also noted that Eskom provides street lighting infrastructure within the outer regions of the EMA, categorised scope 3.

Table 5: Emissions inventory and data disclosure for streetlights and traffic signals

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 2	Purchased Electricity				139,072
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption by municipal owned and operated streetlights and traffic signals <ul style="list-style-type: none"> – Activity Factor: ICLEI specified alternative activity data - Installed wattage – Emissions Factor: Verified Eskom emission factor (Appendix B) – Data Description: Traffic Lights and streetlights 					
Scope 3	Electricity consumed by Eskom street lighting				1,092

- Emissions Source: Electricity consumption by Eskom owned and operated streetlights
 - Activity Data: ICLEI recommended activity data - Known electricity use
 - Emissions Factor: Verified Eskom emission factor (Appendix B)
 - Data Source: Electricity Department; Eskom

3.1.3 Water Delivery Facilities

The water delivery facilities sector includes any facilities used for the transportation, treatment and distribution of drinking water (**Table 6**).

Table 6: Emissions inventory and data disclosure for municipal water delivery facilities

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 2	Purchased Electricity				55,951
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption by water pump stations and reservoirs <ul style="list-style-type: none"> – Activity Data: ICLEI recommended activity data - Known electricity use – Emissions Factor: ICLEI recommended factor - Verified Eskom emission factor (Appendix B) – Data Source: Eskom 					

3.1.4 Wastewater Facilities

The wastewater sector includes all facilities used for the transportation and collection or treatment of wastewater/sewage. (**Table 7**).

Table 7: Emissions inventory and data disclosure for municipal wastewater facilities

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Stationary Combustion	-	17,308	-	17,308
<ul style="list-style-type: none"> ■ Emissions Source: Incomplete combustion of digester gas at a WWTP with anaerobic digestion <ul style="list-style-type: none"> – Activity Data: Population served; ICLEI Equation 10.2 – Data Description: Population served by wastewater treatment plants with anaerobic digesters 					
Scope 1	Process Emissions	-	1,588	24,377	43,273
<ul style="list-style-type: none"> ■ Emissions Source: Anaerobic and facultative treatment lagoons <ul style="list-style-type: none"> – Activity data: Population served- ICLEI Equation 10.4 – Data Description: Population served by treatment lagoons adjusted for industrial discharge ■ Emissions Source: WWTP with nitrification/denitrification <ul style="list-style-type: none"> – Activity Data: Population served- ICLEI Equation 10.7 – Data Description: Population served by the WWTP with nitrification/denitrification adjusted for industrial discharge ■ Emissions Source: WWTP without nitrification/denitrification <ul style="list-style-type: none"> – Activity Data: Population served- ICLEI Equation 10.8 – Data Description: Population served by the WWTP without nitrification/denitrification adjusted for industrial discharge 					

<ul style="list-style-type: none"> ■ Emissions Source: Effluent discharge to receiving aquatic environment <ul style="list-style-type: none"> – Activity Data: Population served- ICLEI Equation 10.10 – Data Description: Population served – Data Source: eThekwini Water & Sanitation 					
Scope 2	Purchased Electricity				20,948
<ul style="list-style-type: none"> ■ Emissions Source: Electricity Consumption <ul style="list-style-type: none"> – Activity Data: ICLEI recommended data type - Known electricity use – Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) – Data Source: Treasury, Eskom 					

3.1.5 Vehicle Fleet

The vehicle fleet sector includes all emissions generated by vehicles (on-road and off-road) owned by the eThekwini Municipality (**Table 8**). These vehicles are either managed by the City Fleet Department, Water Department, Solid Waste Department or Electricity Department.

Table 8: Emissions inventory and data disclosure for municipal vehicle fleet

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Mobile Combustion	46,038	42.25	460.79	46,543
<ul style="list-style-type: none"> ■ Emissions Source: Fuel combustion by on-road and off-road vehicles <ul style="list-style-type: none"> – Activity Data: ICLEI recommended activity data - Fuel purchases – Emissions Factor: ICLEI recommended factor - Default by fuel type (Defra 2011; Appendix B) – Data Description: Emissions calculated from records of internal and external refuelling – Data Source: City Fleet, EWS, DSW 					

3.1.6 Transit Fleet

The transit sector should include emissions from mass transit vehicles operated by the Municipality to service the community of the EMA. However, as the Municipality's transit fleet has been outsourced to a private contractor the emissions generated are classified as scope three instead of scope one emissions (**Table 9**).

Table 9: Emissions inventory and data disclosure for municipal transit fleet

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 3	Mobile Combustion	34,831	20	385	35,236
<ul style="list-style-type: none"> ■ Emissions Source: Fuel combustion by on-road transit fleet <ul style="list-style-type: none"> – Activity Data: ICLEI recommended activity data - Fuel purchases – Emissions Factor: ICLEI recommended factor - Default by fuel type (Defra 2011; Appendix B) – Data Description: Bulk monthly diesel consumption, by privately operated municipal busses – Data Source: Tansnat 					

3.1.7 Power Generation Facilities

The Municipality does not own or operate any fossil fuel power generation facilities any fossil fuel power generation facilities, it owns a large proportion of electricity distribution infrastructure within the EMA. Transmission and

distribution losses resulting from the transmission of electricity via the municipal owned infrastructure are therefore categorised as scope 2 (**Table 10**).

Table 10: Emissions inventory and data disclosure for municipal power generation and electrical distribution facilities

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Power Generation facilities: Fugitive Emissions				-
<ul style="list-style-type: none"> ■ Emissions Source: Sulphur Hexafluoride (SF6) <ul style="list-style-type: none"> - Activity Data: SF6 consumption data - Emissions Factor: ICLEI recommended factor type (Appendix B) - Data Description: Municipal consumption/purchase of SF6 					
Scope 2	Transmission & Distribution Losses: Technical				340,429
<ul style="list-style-type: none"> ■ Emissions Source: Technical transmission and distribution losses <ul style="list-style-type: none"> - Activity Data: eThekwini Electricity Department calculations - Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) - Data Description: Estimated technical losses data was provided by the Electricity Department. 					
Scope 2	Transmission & Distribution Losses: Non-Technical				458,336
<ul style="list-style-type: none"> ■ Emissions Source: Non-technical transmission and distribution losses <ul style="list-style-type: none"> - Activity Data: eThekwini Electricity Department calculations - Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) - Data Description: Estimated non-technical losses data was provided by the Electricity Department. - Data Source: eThekwini Electricity Department 					

3.1.8 Solid Waste Facilities

eThekwini Municipality owns four solid waste landfills, namely:

- Bisasar Road Landfill –operational, landfill gas (LFG) collection system in place;
- Mariannahill Landfill –operational, LFG collection system in place;
- La Mercy Landfill – closed, LFG collection system in place; and,
- Buffelsdraai Landfill – operational, no LFG collection system in place.

Fugitive methane emissions generated by these landfills are classified as scope one municipal emissions (**Table 11**).

Table 11: Emissions inventory and data disclosure for municipal solid waste facilities

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Fugitive Emissions	-	62,740	-	82 066
<ul style="list-style-type: none"> ■ Emissions Source: Landfills with comprehensive LFG collection systems <ul style="list-style-type: none"> - Activity Data: ICLEI recommended data type - ICLEI Equation 9.1 - Data Description: Annual LFG collected, fraction of methane in LFG and methane destruction efficiency of system - Data Source: eThekwini Cleansing and Solid Waste Department 					

<ul style="list-style-type: none"> ■ Emissions Source: Landfills with no LFG Collection System <ul style="list-style-type: none"> – Activity Data: ICLEI recommended model and data type – First Order Decay Model – Data Source: eThekweni Cleansing and Solid Waste Department 					
Scope 2	Purchased Electricity				514
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption <ul style="list-style-type: none"> – Activity Data: ICLEI recommended data type - Known electricity use – Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) – Data Source: Treasury Department 					

3.1.9 Air Travel

Greenhouse gas emissions generated from work-related air travel, by municipal employees, are categorised as scope three municipal emissions (Table 12).

Table 12: Emissions inventory and data disclosure for municipal air travel

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 3		804	0	8	812
<ul style="list-style-type: none"> ■ Emissions Source: Fuel combustion by air transport systems <ul style="list-style-type: none"> – Activity Data: GHG Protocol recommended data type – number of flights and destination data – Emissions Factor: DEFRA 2011 emissions factor – emission factor based on length of flight (Appendix B) – Data Description: Number of domestic and international flights boarded by the Municipal employees. – Data Source: Rennies Travel ; Turner Group 					

3.2 COMMUNITY EMISSIONS

3.2.1 Residential Sector

This emissions sector includes all emissions generated by the EMA's residential sector through electricity consumption as well as stationary fuel combustion (Table 13).

Table 13: Emissions inventory and data disclosure for community residential sector

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Stationary Combustion	279,917	587	755	281,158
<ul style="list-style-type: none"> ■ Emissions Source: Stationary combustion of fuel <ul style="list-style-type: none"> – Activity Data: ICLEI recommended activity data - Known fuel use – Emissions Factor: ICLEI recommended factor - Default by fuel type (Defra 2011, Appendix B) – Data Description: Data on the quantity of fuel purchased, for stationary combustion, within the EMA. – Data source: National Department of Energy 					
Scope 2	Purchased Electricity				3,450,318
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption <ul style="list-style-type: none"> – Activity Data: ICLEI recommended data type - Known electricity use – Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) – Data Description: Electricity consumption by all residences receiving electricity from the Municipality. 					

- Data Source: eThekwini Electricity Department

3.2.2 Commercial Sector

This emissions sector includes all emissions generated by the EMA's commercial sector through electricity consumption only (Table 14).

Table 14: Emissions inventory and data disclosure for community commercial sector

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 2	Purchased Electricity				1,985,963
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption <ul style="list-style-type: none"> - Activity Data: ICLEI recommended data type - Known electricity use - Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) - Data Description: Electricity consumption by all commercial enterprises receiving electricity. - Data Source: eThekwini Electricity Department; ESKOM 					

3.2.3 Industrial Sector

This emissions sector includes all emissions generated by the EMA's industrial sector through electricity consumption as well as stationary fuel combustion (Table 15).

Table 15: Emissions inventory and data disclosure for community industrial sector

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Stationary Combustion				4,883,185
<ul style="list-style-type: none"> ■ Emissions Source: Stationary combustion of fuel <ul style="list-style-type: none"> - Activity Data: ICLEI recommended activity data - Known fuel use - Emissions Factor: ICLEI recommended factor - Default by fuel type (Defra 2011; Appendix B) - Data Description: Data on the quantity of fuel purchased, for stationary combustion, within the EMA - Data Source: National Department of Energy 					
Scope 2	Purchased Electricity				4,825,185
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption <ul style="list-style-type: none"> - Activity Data: ICLEI recommended data type - Known electricity use - Emissions Factor: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) - Data Description: Electricity consumption by all industrial enterprises receiving electricity from the Municipality - Data Source: eThekwini Electricity Department 					

3.2.4 Transport

The community transport sector includes emissions generated by community owned on-road and off road vehicles as well as by the community's air and marine transport systems (Table 16). Air and marine transport systems are classified as scope 3 emissions.

Table 16: Emissions inventory and data disclosure for community transport sector

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			

Scope 1	Mobile Combustion	7,093,253	7,647	67,595	7,168,496
<ul style="list-style-type: none"> ■ Emissions Source: On-road and off road vehicles 					
Scope 3	Mobile Combustion – Air Travel	233,665	213	2,299	236,187
<ul style="list-style-type: none"> ■ Emissions Source: Air transport systems fuel combustion 					
Scope 3	Mobile Combustion – Water Travel	4 004 012	4 342	419 403	4 427 756
<ul style="list-style-type: none"> ■ Emissions Source: Water transport systems fuel combustion <ul style="list-style-type: none"> – Activity Data: ICLEI recommended activity data - Known fuel use – Emissions Factor: ICLEI recommended factor - Default by fuel type (Appendix B) 					

3.2.5 Agriculture

Emissions sources covered within the agriculture sector included enteric fermentation by livestock and pre-harvest sugarcane burning (Table 17). Both these emission sources are classified as community scope one emissions.

Table 17: Emissions inventory and data disclosure for community agricultural sector

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Enteric Fermentation		16 558		16 558
<ul style="list-style-type: none"> ■ Emissions Source: Enteric fermentation by livestock <ul style="list-style-type: none"> – Activity Data: IPCC 2006 recommended data – livestock type and numbers – Emissions Factor: IPCC 2006 emissions factor - Default by animal type (Appendix B) – Data Source: National Department of Agriculture, Forestry and Fisheries 					
Scope 1	Residue Burning		51 573	19 738	71 310
<ul style="list-style-type: none"> ■ Emissions Source: Infield pre-harvest sugarcane burning <ul style="list-style-type: none"> – Activity Data: IPCC 2006 Equation 2.27 Estimation of GHG Emissions – Emissions Factor: IPCC 2006 factors – Data Description: Area under sugarcane calculated from D'MOSS – Data Source: Environmental Planning & Climate Protection Department 					

3.2.6 Solid Waste

The community solid waste sector includes emissions generated by privately owned landfills situated within the Municipality's geopolitical boundary (Table 18).

Table 18: Emissions inventory and data disclosure for community solid waste sector

Scope	Emissions Source	CO ₂	CH ₄	N ₂ O	Total
		Tonnes CO ₂ e			
Scope 1	Fugitive Emissions		227,526		227,526
<ul style="list-style-type: none"> ■ Emissions Source: Fugitive emissions generated by two privately owned landfills <ul style="list-style-type: none"> – Activity Data: ICLEI recommended model and data type – First Order Decay Model – Data Description: Historical and inventory year waste disposal data provided by private facilities – Data Issue: The Bulbul (Wasteman) and Enviroserv sites closed 					

4 EMISSIONS ANALYSIS

Within both the Municipal Operations Analysis and the Community Operations Analysis the principal contributor to GHG emissions are scope 2 indirect emissions from electricity consumption, although community scope 1 emissions are almost as large as the community scope 2 (**Table 19**).

Table 19: GHG emissions inventory results

EMISSIONS SCOPE	MUNICIPAL EMISSIONS (tCO ₂ e)	COMMUNITY EMISSIONS (tCO ₂ e)
Scope 1	157,544 (12%)	12,838,995 (46%)
Scope 2	1,066,535 (85%)	11,328,001 (37%)
Selected Scope 3	37,140 (3%)	4,701,083 (17%)

4.1 MUNICIPAL EMISSIONS

The principal municipal emission source, contributing 69% to the Municipality's total 2017 GHG emission inventory, was electrical transmission and distribution losses (Power Generation Facilities) (scope 2).

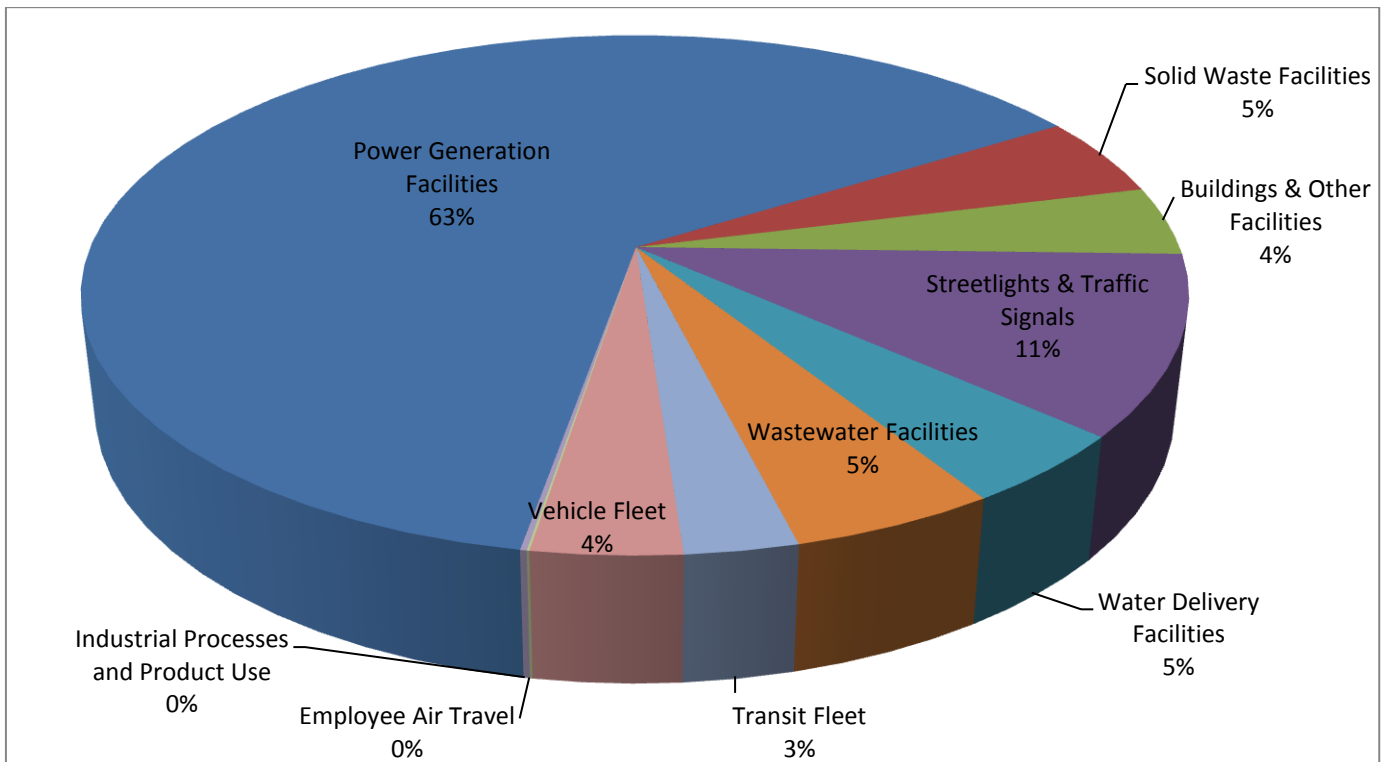


Figure 1: Municipal Sector Emissions

Table 20: Municipal sector emissions

Municipal Sector	Emissions Scope	Emissions (tonnes CO ₂ e)
Buildings and Other Facilities	Scope 1	2,961
	Scope 2	51,286
Additional Scope 3 Emissions	Scope 3	812
Power Generation Facilities	Scope 2	798,765
Sanitation and Solid Waste Facilities	Scope 1	62,740
	Scope 2	514
Streetlights and Traffic Signals	Scope 2	139,072
	Scope 3	36,327
	Scope 1	46,543
Wastewater Facilities	Scope 1	43,273
	Scope 2	20,948
Water Delivery Facilities	Scope 2	55,951
Industrial Process and Product Use	Scope 1	2,027

4.1.1 Municipal GHG Emissions Intensity Figures

Emissions intensity figures calculated for the Municipality are provided in **Table 21**. These figures were calculated by combining all municipal scope 1 and 2 emissions and dividing them by the relevant indicator.

Table 21: Municipal GHG intensity figures

Intensity Figure	Unit	Metric Numerator	Unit	Metric Denominator	Unit
R32.82	tCO ₂ e / million Rand of operating budget	1,224,079	tCO ₂ e (Municipal Scope 1 & 2)	R 37,300.00 ¹	Million Rand Operating Budget (2017/ 2018)
R167.68	tCO ₂ e / million Rand of Capital budget	1,224,079	tCO ₂ e (Municipal Scope 1 & 2)	R7,300.00 ²	Million Rand Capital Budget (2017/ 2018)
52.07	tCO ₂ e / Permanent employee	1,224,079	tCO ₂ e (Municipal Scope 1 & 2)	23,510 ³	Permanent Employees

4.2 COMMUNITY EMISSIONS

4.2.1 Community Emissions Analysis

¹Global Insight 2019, EThekwini Treasury Unit, Planning Unit. PSIR Dept

²Global Insight 2019, EThekwini Treasury Unit, Planning Unit. PSIR Dept

³EThekwini Municipality, Human Resources

The principal community sector emission source within the EMA during 2017 was the industrial sector, contributing 36% to total community emissions (**Figure 2, Table 22**). The second major contributor was the on-road and off-road (ground) transport sector contributing 25% to overall community emissions.

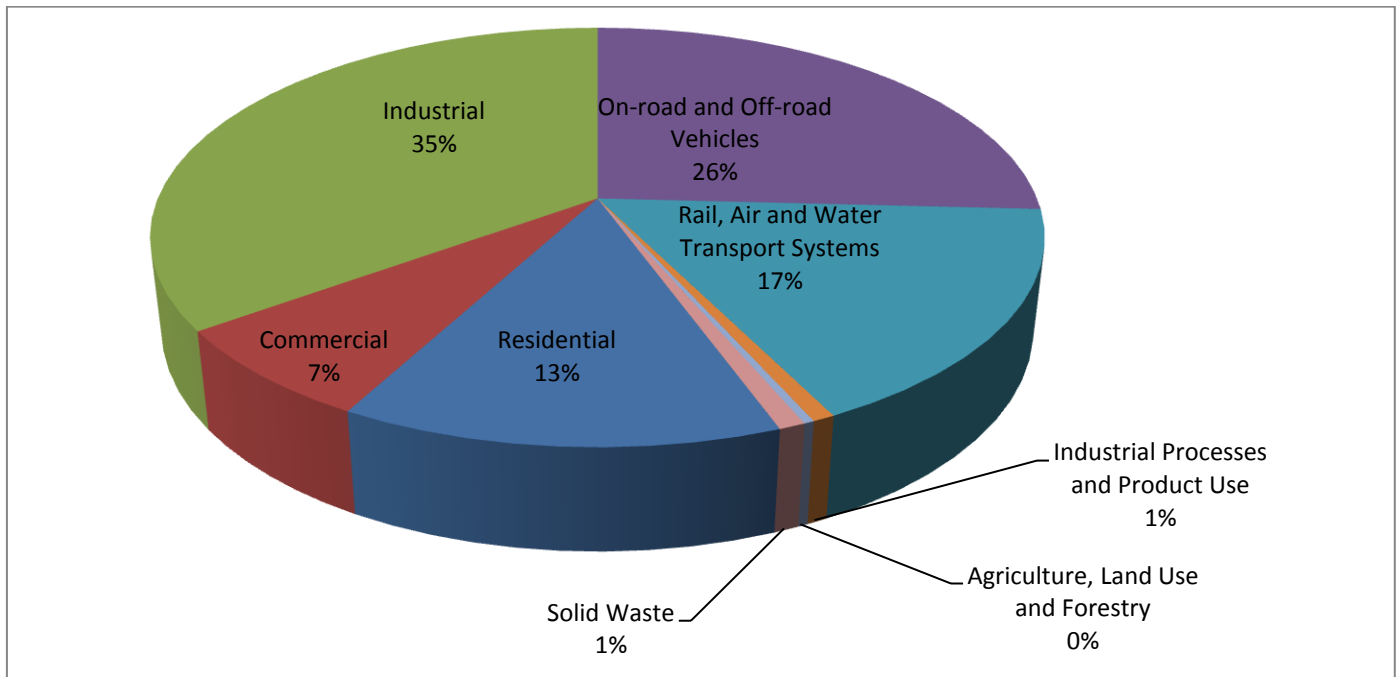


Figure 2: Community Sector Emissions

Table 22: Community sector emissions

Community Sector	Emissions Scope	Emissions (tonnes CO ₂ e)
Residential	Scope 1	281 258
	Scope 2	3 450 318
Commercial	Scope 2	1 985 963
Industrial	Scope 1	4 883 050
	Scope 2	4 825 185
On-road and Off-road Vehicles	Scope 1	7 168 511
Rail, Air and Water Transport Systems	Scope 3	4 663 943
Solid Waste	Scope 1	227 526
Industrial process & Product Use	Scope 1	190 797
Agriculture, Land Use and Forestry	Scope 1	87 868

4.2.2 Community Emissions Intensity Figures

Emissions intensity figures calculated for the EMA for 2017 are provided in **Table 23**. These emissions were calculated by combining relevant sector scope one and two emissions and dividing them by the relevant indicators.

Table 23: Community GHG intensity figures

Intensity Figure	Unit	Metric Numerator	Unit	Metric Denominator	Unit
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3.37	tCO ₂ e / household	3,731,576	tCO ₂ e (Residential Scope 1 & 2)	1,108,583	Number of households within the EMA
R 25.11	tCO ₂ e / million Rand of Capital budget	1,985,963	tCO ₂ e (Commercial Scope 1 & 2)	R 79,100.00	2017 Annual retail trade sales

4.2.3 Total Emissions Intensity Figures

Total emission intensity figures (for the municipality and the community) are recorded in the table below. 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 24: Total Emissions Intensity Figures

Intensity Figure	Unit	Metric Numerator	Unit	Metric Denominator	Unit
6.29	tCO ₂ e / Capita	24,324,555	tCO ₂ e (Scope 1 & 2)	3,866,505	Population within the EMA
7.36	tCO ₂ e / Capita	28,464,675	tCO ₂ e (Scope 1, 2 & 3)	3,866,505	Population within the EMA

5 COMPARISON AGAINST PREVIOUS INVENTORIES

The 2010 eThekwini GHG Inventory serves as the baseline inventory because the methodology for collecting and reporting data was clearly defined for this period. This emerging emissions trend is summarised in the table and graph below. As is evident from these data sets, there is a continued and steady increase in greenhouse gas emissions over time in the city. This trend is primarily a result of improved data collection methodologies but also due to increased uses of energy and carbon intensive processes in the city.

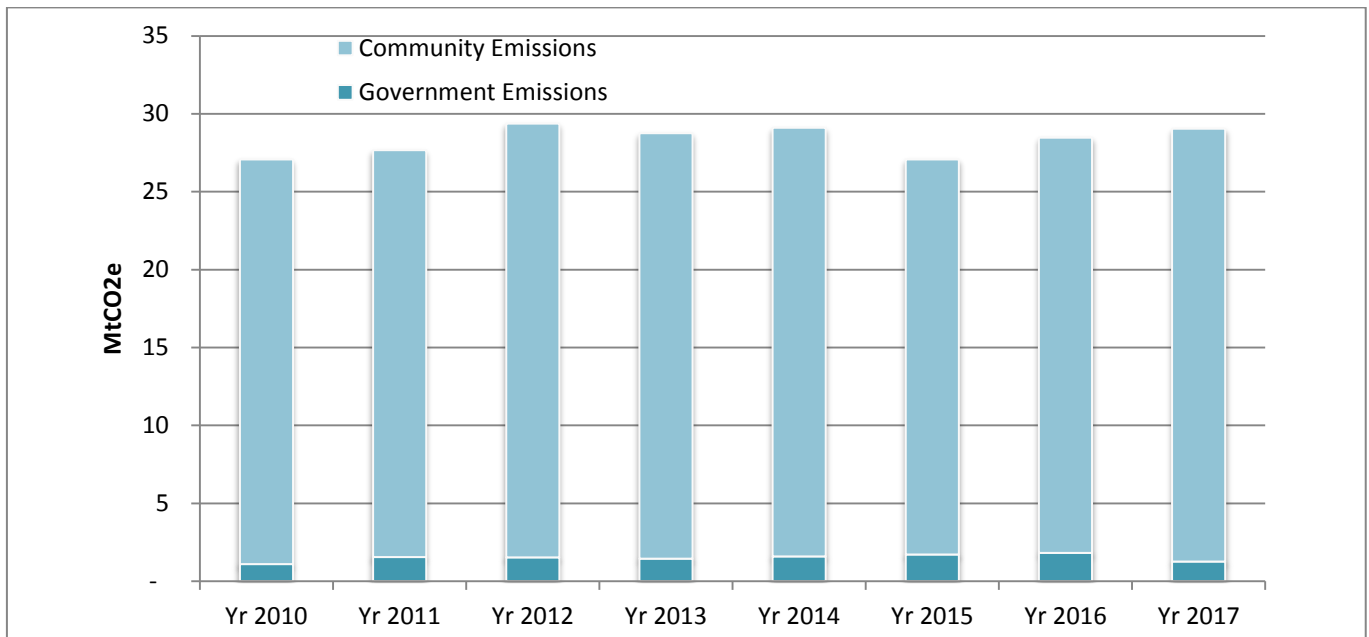


Figure 3: Comparison of Emissions 2010 through to 2017

Table 25: Percentage change of Emissions from baseline

Year	Government Emissions	Community Emissions	Total Emissions	% Change	% Change from 2010 Baseline
2010	1,104,212	25,962,074	27,066,285		
2011	1,551,420	26,097,979	27,649,400	2.2%	2.2%
2012	1,526,431	27,833,965	29,360,395	6.2%	8.3%
2013	1,450,928	27,290,630	28,741,558	-2.1%	6.2%
2014	1,586,674	27,505,329	29,092,003	1.2%	6.2%
2015	1,715,259	25,352,653	27,067,912	-7.0%	-0.8%
2016	1,817,486	26,647,189	28,464,675	5.2%	4.4%
2017	1,261,219	27,764,419	29,025,638	2.0%	6.4%

This technical report provides a detailed comparison of the difference in emissions between the years 2011 to 2017, as shown below in Table 25.

The total emissions for 2017 were estimated to be 29 025 638 tCO₂e; 27 764 419 tCO₂e (95%) from the Community sector, while 1 261 219 tCO₂e (5%) are produced from the Municipal sector.

Total emissions had increased by 2% from year 2014 to 2017, which is equivalent to an additional 559 80.7 tCO₂e emitted. The municipal emissions have decreased to 1 261 219 tCO₂e in 2017 compared to 1 817 486 tCO₂e in 2016, and community sectors have increased by 1 117 229.8 tCO₂e in 2017.

Table 26: Comparison of Emissions 2017 against 2016

Scope	Type	Sub-Type	2016 (tCO2e)	2017 (tCO2e)
Municipal Scope 1	Fuel Consumption	Stationary Fuel Combustion	2,909.5	2,960.7
		Vehicle Fleet	42,933.4	46,543.2
	Solid Waste	Solid Waste (CH4)	82,066.0	62,740.3
	IPPU	Bitumen	3,417.9	2,026.9
	Wastewater Treatment	Wastewater (CH4)	50,584.2	43,272.7
Municipal Scope 2	Electricity Consumption	Buildings	134,822.0	51,285.6
		Streetlights & Traffic Signals	120,054.8	139,071.9
		Water Delivery Facilities	77,567.7	55,950.9
		Transmission and Distribution Losses	1,226,866.9	798,764.9
		Solid Waste Facilities	2,149.5	514.3
		Wastewater Facilities	41,842.4	20,947.8
Municipal Scope 3	Transport Systems	Streetlights	1,095.0	1,091.6
		Transit Fleet	31,115.0	35,235.8
		Flights	1,157.2	812.4
Subtotal Municipal			1,817,486.5	1,261,219.0
Community Scope 1	Fuel Consumption	Stationary Fuel Combustion	4,577,351.8	5,164,307.9
		Mobile Fuel Combustion	6,450,835.2	7,168,510.8
	Solid Waste	Solid Waste	183,574.0	227,526.3
	Industrial Processes & Product Use	IPPU	156,422.0	146,466.6
	Industrial Processes & Product Use	IPPU	47,885.4	44,330.0
	Agric & Landuse	Agric & Landuse	87,868.4	87,868.4
Community Scope 2	Electricity Consumption	Residential	3,399,158.3	3,450,317.6
		Commercial	2,072,205.3	1,985,963.3
		Industrial	4,980,061.9	4,825,184.8
Community Scope 3	Transport Systems	Air Transport Systems	264,070.2	236,186.6
		Water Transport Systems	4,427,756.4	4,427,756.4
Subtotal Community			26,647,188.8	27,764,418.7
Total			28,464,675.3	29,025,637.6

6 CONCLUSIONS

Total emissions estimated for 2017 was 29,025,637.6 tCO₂e. The 2017 total emissions have increased by 555,870.7 tCO₂e from the 2016 emissions. The community sector accounts for 96% of all the emissions and the municipality sector accounts for 4%. The municipal sector emissions has decreased by 557,359.1 tCO₂e and the community sector emissions has increased by 1,117,229.8 tCO₂e as compared to the 2016 emission results.

Transportation and industrial sector have been identified as the largest emitters, sitting at 41% and 33% respectively as this was the case with the 2016 GHG emissions inventory.

There was a significant decrease in municipal emissions in the electricity consumption in solid waste facilities, building facilities, water delivery facilities, solid waste facilities, wastewater facilities and transmission and distribution losses.

Transport is the highest emitter in the community sector contributing 43% to the total emissions in the sector. Transport looked at on-road and off-road vehicles (26%) and rail, air and water transport system (17%).

The electricity consumption in the commercial and industrial sectors has observed a decrease of 4% and 3%.

APPENDIX A: ETHEKWINI MUNICIPALITY KEY INDICATORS 2017⁴

INDICATORS	2017
Gross Value Added (GVA) (Constant 2010 Prices)	R275.9 billion
Gross Domestic Product (GDP) (Constant 2010)	R303.1 billion
Gini Coefficient	0.62
Per Capita Income	R63,319
GVA Average Annual Growth (2011-2016/1996-2018)	2.1%
Population	3,866,505
Geographic Area	2,556km ²
Population Growth (2011-2016/2011-2018)	1,5%
Population Density	1 512 persons/ km ²
Number of people below food poverty line	1,000,834
Number of households	1,108,583
Urban Population Rate	81,2%
Annual Per household income (Current Prices)	R225,040
Human Development Index	0.66
Annual Disposable income (Constant Prices)	R146,7 billion
Tourism Spend (Current Prices)	R16.3 billion
Economically Active Population	1,519,047
Employment (Formal)	1,106,516
Employment (Informal)	212,537
Unemployment Rate	15.7%
Annual Expenditure	R244,9 billion
Annual Retail Trade sales	R79,1 billion
Council Operating Budget: 2017/18-2018/19	R37,2 billion
Council Capital Budget: 2017/18-2018/19	R7,3 billion
Total Exports	R72,7 billion
Total Imports	R105,5 billion
Total Trade	R178,2 billion
Exports as % of GDP	16.0%

8 APPENDIX B: EMISSION & CONVERSION FACTORS

⁴ Global Insight 2019, EThekwini Treasury Unit, Planning Unit. PSIR Dept

Emission & Conversion Factors

Emission Factors

Fuel Combustion Factors

Stationary Fuel

		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per unit				
HFO	tonnes	3212.5	2.8	13	3228.3	2011, Defra GHG Conversion Factors
Bitumen	TJ	80700	210	186	81096	2006 IPCC Guidelines
Natural Gas	cubic meters	2.0154	0.003	0.0012	2.0196	2011, Defra GHG Conversion Factors
LPG	litres	1.4884	0.001	0.0023	1.4917	
Coal (Industrial)	tonnes	2339	1.4	42.7	2383.1	
Coke	tonnes	2955.4	30.4	70.7	3056.5	
Illuminating Paraffin (Burning Oil)	litres	2.5299	0.0054	0.0069	2.5422	
Acetylene	litres	0.003719			0.003719	2012, The Climate Registry
Paraffin Wax	TJ	73300	210	186	73696	2006 IPCC Guidelines
Refinery Gas	GJ	54.2	0.02	0.03	54.25	NGA 2010

Road Transport Fuel

		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per unit				
Petrol	litres	2.30	0.0046	0.02	2.322	2011, Defra GHG Conversion Factors
Diesel	litres	2.64	0.0015	0.03	2.672	

Aviation Fuel

		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per unit				
Int. Jet Fuel (Aviation Turbine Fuel)	litres	2.52	0.0012	0.02	2.548	2011, Defra GHG Conversion Factors
Jet Fuel Local	litres	2.52	0.0012	0.02	2.548	
Aviation Gasoline	litres	2.21	0.0227	0.02	2.259	

Marine Fuel

		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per unit				
Marine Fuels	litres	2.7667	0.003	0.2898	3.0595	2011, Defra GHG Conversion Factors

Indirect Energy Source Factors

Electricity

		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per unit				
Eskom	KWh	n/a	n/a	n/a	1.03	Eskom Annual Report, 2011 (T&D losses not included)

Agriculture & Land use Factors

Livestock

		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per head per year				
Goats	head	n/a	105	n/a	105	2006 IPCC Guidelines
Cattle	head	n/a	651	n/a	651	
Sheep	head	n/a	105	n/a	105	

Aviation Factors						
Conversion Factors						
		CO ₂	CH ₄	N ₂ O	Total kg CO ₂ e	Reference
		kg CO ₂ e per passenger km				
Domestic Flights	Average	0.16313	0.0001	0.00161	0.16484	2011, Defra GHG Conversion Factors
Short-haul International	Average	0.09589	0.00001	0.00094	0.09684	
Long-haul International	Average	0.11037	0.00001	0.00109	0.11147	
Distances						

Global Warming Potential Factors

GWP's

GHG Global Warming Factors

Emissions	Chemical Formula	Conversion Factor	Reference
Carbon dioxide	CO ₂	1	2011, Defra GHG Conversion Factors
Methane	CH ₄	21	
Nitrous oxide	N ₂ O	310	

Conversion Factors

Conversion Factors

Common

1 barrel	159	litres	2011, Defra GHG Conversion Factors
1 gigagram	1000	tonnes	
1 cubic meter	1000	litres	
HFO			
1 cubic meter	977.5	kilograms	
Bitumen			
1 tonne	6.06	barrels	2006 International Energy Annual (IEA)
1 gigagram (Gg)	40.2	TJ	2006 IPCC Guidelines
Paraffin Wax			
1 tonne	7.87	barrels	2006 International Energy Annual (IEA)
1 gigagram (Gg)	40.2	TJ	2006 IPCC Guidelines
Lubricants			
1 cubic meter	950	kilograms	2011, Defra GHG Conversion Factors