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eThekweni Greenhouse Gas Emissions Inventory 2015

Technical Report

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1 INTRODUCTION

1.1 ETHEKWINI MUNICIPALITY

The eThekwini Municipal Area (EMA) stretches from Durban’s coastline in the East to Cato Ridge in the West and from Umkomaas in the South to Tongaat in the North. The EMA covers an area of approximately 2 292 square kilometres of which 36% is rural and a further 29% is peri-urban. The Municipality is home to approximately 3.8 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 eThekwini Municipality during 2015 amounted to R289.3bn with a per capita income of R56 903 (eThekwini Municipality Key Indicators 2015, Appendix A).

The EMA is governed by the eThekwini Municipality, with an Operating Budget of R33.1bn (2015/2016) and a Capital Budget of R6.0bn (2015/2016)¹. During 2015 the Municipality employed 22,420 employees on a permanent and temporary basis. Basic services provided by the eThekwini Municipality are described in **Table 1**.

Table 1: Basic services provided by the eThekwini 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 eThekwini 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 eThekwini 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.

¹ http://www.durban.gov.za/City_Government/City_Vision/IDP/Documents/Final%202015_15%20IDP.pdf

2 INVENTORY PARAMETERS

2.1 PROTOCOLS

The eThekwini Municipality's 2015 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).

2.2 BOUNDARIES

2.2.1 Temporal Boundary

The 2015 eThekwini GHG Inventory comprises emissions occurring during the 2015 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 2015.

- 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 2015.

2.3 SCOPES

The eThekwini Municipality 2015 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 a 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 2015 municipal operations emissions inventory.

Table 2: Emission sources included in the 2015 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 2015 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 2015 community-scale emissions inventory.

Table 3: Emission sources included in the 2015 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		
Industrial Processes and Product Use		

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, *inter alia*, 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	1 405	1.2	5.3	1 412
<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 activity data - Known fuel use calculated from fuel purchase data – Emissions Factor: ICLEI recommended factor - Default by fuel type (Defra 2011, IPCC 2006, TCR 2012; Appendix B) – Data Description: Data on the quantity of fuel purchased, for stationary combustion, by the Municipality during 2015 was obtained from the Procurement Department for all departments within the Municipality – Data Source: eThekweni Procurement Department 					
Scope 2	Purchased Electricity				164 888
<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: ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) – Data Description: Electricity charges supplied by the eThekweni Treasury Department and grouped according to the individual JDE code (Appendix C) Electricity supplied to departments by Eskom directly – consumption data provided by Eskom – Data Issues: Electricity charges were supplied by the Treasury department and grouped into JDE Business Units according to respective GI-codes. – 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. Emissions generated by Eskom owned streetlights are classified as the Municipality's scope 3 emissions.

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				120 162
<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 Data: <ul style="list-style-type: none"> ICLEI specified alternative activity data - Installed wattage – Emissions Factor: <ul style="list-style-type: none"> ICLEI recommended factor - Verified Eskom emission factor (Appendix B) – Data Description: <ul style="list-style-type: none"> Traffic Lights - Number of signalised intersections that the Municipality caters for, type (LED or incandescent) and the average energy drawn per intersection. Streetlights - Streetlight count and type (HID or LED) and actual kWh used per year. – Data Issues: <ul style="list-style-type: none"> Traffic Lights -An exact assessment value of electricity usage by Traffic lights is difficult to make since individual loads of traffic signals are not measured and several teams maintain the intersections, eliminating unnecessary LED modules. However, a sound calculation method with reasonable assumptions was made by the authority in providing a final consumption figure. – Data Source: Traffic Lights - Transport Authority; Streetlights - Electricity Department 					
Scope 3	Electricity consumed by Eskom street lighting				
<ul style="list-style-type: none"> ■ Emissions Source: Electricity consumption by Eskom owned and operated streetlights <ul style="list-style-type: none"> – Activity Data: <ul style="list-style-type: none"> ICLEI recommended activity data - Known electricity use – Emissions Factor: <ul style="list-style-type: none"> ICLEI recommended factor - Verified Eskom emission factor (Appendix B) – Data Description: <ul style="list-style-type: none"> Account numbers for traffic lights that fall within the eThekweni Municipality, number of lights and wattage. – Data Issues: <ul style="list-style-type: none"> Eskom has various options on streetlights supplies, including a normal streetlight tariff plus a maintenance contract. The latter system is usually what Municipalities opt for. Alternatively, municipalities may opt for only the streetlight tariffs without a maintenance contract, choosing to perform upkeep themselves. – Data Source: Electricity Department 					

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				102 104
<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 Description: Electricity charges were supplied by the Treasury department and grouped into business units according to their GI-code. All Business units labelled as “Water” were accounted here Electricity consumption data provided by Eskom for facilities supplied directly by Eskom. – 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. The eThekweni Municipality own/control and operate wastewater treatment plants (WWTP) encompassed within the inventory included KwaMashu, New Germany, Northern, Phoenix, Umdloti, Umhlanga, Tongaat Central, Gennazanno, Verulam, Kingsburgh, Umkomaas, Craigieburn, Magabeni, Amamzimtoti, Dassenhoek, Hillcrest, Hammarsdale, Cato Ridge, Fredville, Umhlatuzana and Umbilo (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	-	19 412	-	19 412
<ul style="list-style-type: none"> ■ Emissions Source: Incomplete combustion of digester gas at a WWTP with anaerobic digestion of biosolids <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. The population served was estimated by the Water & Sanitation Department based on a consumption value of 400 litres per person per day. – Model Issue: The model specified by ICLEI assumes biogas is flared; however, certain eThekweni’s WWTP’s do not flare. When calculating methane emissions for these facilities the model parameter ‘Methane Destruction Efficiency’ was assumed to be zero. – Data Source: Water and Sanitation Department 					

Scope 1	Process Emissions	-	4 371	25 928	30 299
<ul style="list-style-type: none"> ■ Emissions Source: Anaerobic and facultative treatment lagoons <ul style="list-style-type: none"> - Activity data: <ul style="list-style-type: none"> Population served - ICLEI Equation 10.4 - Data Description: <ul style="list-style-type: none"> Population served by treatment lagoons adjusted for industrial discharge ■ Emissions Source: WWTP with nitrification/denitrification <ul style="list-style-type: none"> - Activity Data: <ul style="list-style-type: none"> Population served - ICLEI Equation 10.7 - Data Description: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Population served - ICLEI Equation 10.8 - Data Description: <ul style="list-style-type: none"> Population served by the WWTP without nitrification/denitrification adjusted for industrial discharge ■ Emissions Source: Effluent discharge to receiving aquatic environment <ul style="list-style-type: none"> - Activity Data: <ul style="list-style-type: none"> Population served - ICLEI Equation 10.10 - Data Description: <ul style="list-style-type: none"> Population served, adjusted for industrial discharge ■ Data Source: eThekwini Water & Sanitation 					
Scope 2	Purchased Electricity				38 921
<ul style="list-style-type: none"> ■ Emissions Source: Electricity Consumption <ul style="list-style-type: none"> - Activity Data: <ul style="list-style-type: none"> ICLEI recommended data type - Known electricity use - Emissions Factor: <ul style="list-style-type: none"> ICLEI recommended factor type - Verified Eskom emission factor (Appendix B) - Data Description: <ul style="list-style-type: none"> Electricity charges were supplied by the Treasury department and grouped into business units according to their GI-code. All Business units labelled as "Sanitation" were accounted here. Electricity consumption data provided by Eskom for facilities directly supplied by Eskom. - Data Source: Treasury Department; Eskom 					

3.1.5 Vehicle Fleet

The vehicle fleet sector includes all emissions generated by vehicles (on-road and off-road) owned by the eThekweni 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	30 880	29.55	305.45	31 217
<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 held by the City Fleet Department during 2015. – Data Source: City Fleet (internal & external refuelling); Electricity Fleet; Water & Sanitation Fleet; DSW Fleet; Emergency Services (Specialised vehicles only) 					

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	31 130	18	344	31 492
<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, for calendar year 2015. – Data Source: Tansnat 					

3.1.7 Power Generation Facilities

Although the Municipality does not own or operate any fossil fuel power generation facilities, it does own a large proportion of the 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 two municipal emissions (**Table 10**). In addition, the 2015 GHG EI has started reported the Municipal consumption of Sulphur Hexafluoride (SF6), which is used in electrical switch gear; this is classified as Scope 1.

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				3 552
<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. – Data Source: eThekwini Electricity Department 					
Scope 2	Transmission & Distribution Losses: Technical				339 598
<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. Losses were estimated using best practice calculations dependent on distribution infrastructure. Real values for street lights and traffic signals were used for 2012 calculations, as well as energy generated from landfills and CPV solar. – Data Source: eThekwini Electricity Department 					
Scope 2	Transmission & Distribution Losses: Non-Technical				709 642
<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. Losses were calculated by subtracting total municipal energy sales/consumption (internal and external) from total electricity purchased by the municipality from Eskom. Real values for street lights and traffic signals were used for 2011 calculations, as well as energy generated from landfills and CPV solar. – 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	-	82 700	-	82 700
<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 – Marc Wright (Appendix C) ■ 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 Description: Historical and inventory year waste disposal data - Data Source: eThekwini Cleansing and Solid Waste Department 					
Scope 2	Purchased Electricity				3 109
<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 charges were supplied by the Treasury department and grouped into business units according to their GI-code. All Business units labelled as “Cleansing and Solid Waste” were accounted for. - 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	966	1 863	1	18	1 882
<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 during 2015 obtained from contracted travel agents. New routes travelled during 2015 have been included – Data Source: Rennies Travel; BCD 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	217 174	425	561	218 160
<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 received from the Department of Energy. – Data source: National Department of Energy 					
Scope 2	Purchased Electricity				2 568 723
<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 obtained from the eThekweni Electricity Department 					

Electricity consumption by the EMA residential sector which receives electricity directly from Eskom provided by Eskom (prepaid accounts and accounts type S)

- 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				2 048 862
<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 from the Municipality obtained from the eThekwini Electricity Department Electricity consumption by the EMA commercial and Industrial sector which receives electricity directly from Eskom provided by Eskom (all accounts type L) - 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				4 401 865
<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 received from the Department of Energy. - Data Source: National Department of Energy 					
Scope 2	Purchased Electricity				4 732 537
<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 was obtained from the eThekweni Electricity Department;
Electricity consumption by the EMA industrial sector which receives electricity directly from Eskom provided by Eskom was quantified together with the commercial category and already included in Table 14 above
- Data Source: eThekweni Electricity Department; Eskom

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	6 147 554	7 118	57 116	6 211 788
<ul style="list-style-type: none"> ■ Emissions Source: On-road and off road vehicles <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 amount of petrol and diesel consumed within the EMA during 2011 was provided by the Department of Energy. - Data Source: National Department of Energy 					
Scope 3	Mobile Combustion – Air Travel	270 853	219	2 664	273 783
<ul style="list-style-type: none"> ■ Emissions Source: Air 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) - Data Description: Data on the amount of jet fuel and aviation gasoline purchased within the EMA during 2015 was provided by the Department of Energy. - Data Source: National Department of Energy 					
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) - Data Description: - Data Source: National Department of Energy 					

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 Description: Livestock survey results for 2015 obtained from the Department of Agriculture, Forestry and Fisheries – 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 from Fire – Emissions Factor: IPCC 2006 factors – Data Description: Area under sugarcane calculated from D'MOSS database provided by Municipality's Environmental Management Department – Data Source: Environmental Management 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		190 683		190 683
<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; for previous years where disposal data was not available, data published in the Integrated Waste Management Plan for eThekweni Municipality and in the 2005/06 eThekweni Municipality GHG inventory was used to estimated emissions for the various landfills. – Data Source: Enviroserv 					

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	203 461 (12%)	11 300 993(45%)
Scope 2	1 478 424 (86%)	9 350 121 (37%)
Scope 3	33 374 (2%)	4 701 539 (19%)

4.1 MUNICIPAL EMISSIONS

The principal municipal emission source, contributing 61% to the Municipality's total 2015 GHG emission inventory, was electrical transmission and distribution losses (Power Generation Facilities) (scope 2).

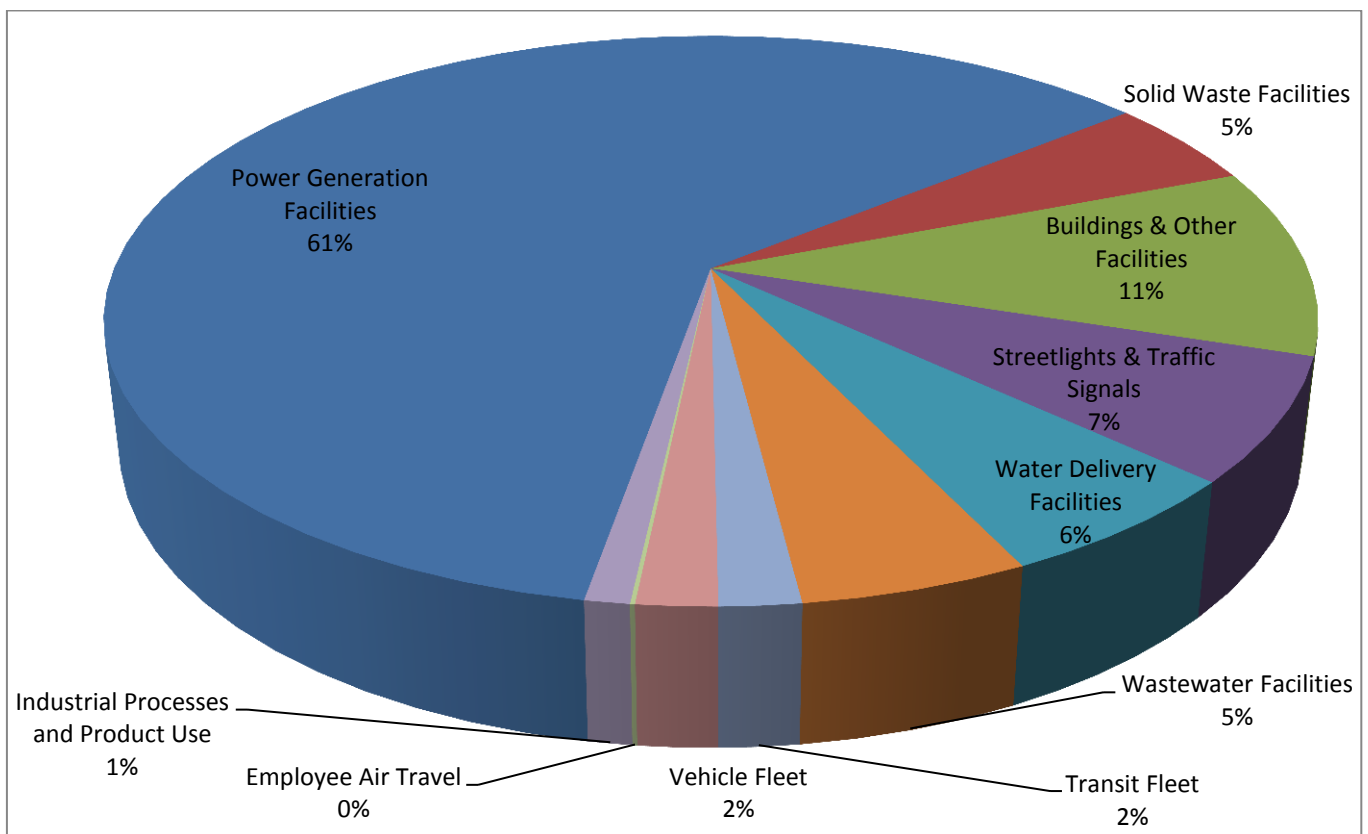


Figure 1: Municipal Sector Emissions

Table 20: Municipal sector emissions

Municipal Sector	Emissions Scope	Emissions (tonnes CO ₂ e)	%
Buildings and Other Facilities	Scope 1	18 847	10.7%
	Scope 2	164 888	
Additional Scope 3 Emissions	Scope 3	1 882	0.1%
Power Generation Facilities	Scope 1	3 552	61.4%
	Scope 2	1 049 239	
Sanitation and Solid Waste Facilities	Scope 1	82 700	5.0%
	Scope 2	3 109	
Streetlights and Traffic Signals	Scope 3	120 162	7.0%
Vehicle Fleet	Scope 3	31 492	1.8%
	Scope 1	31 217	1.8%
Wastewater Facilities	Scope 1	49 711	5.2%
	Scope 2	38 921	
Water Delivery Facilities	Scope 2	43 755	6.0%
Industrial Process and Product Use	Scope 1	17 435	1.0%

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
R 50.81	tCO ₂ e / million Rand of operating budget	1 681 885	tCO ₂ e (Municipal Scope 1 & 2)	R 33 100.00 ²	Million Rand Operating Budget (2015/ 2016)
R 275.72	tCO ₂ e / million Rand of Capital budget	1 681 885	tCO ₂ e (Municipal Scope 1 & 2)	R 6 000.00 ³	Million Rand Capital Budget (2015/ 2016)
75.02	tCO ₂ e / Permanent employee	1 681 885	tCO ₂ e (Municipal Scope 1 & 2)	22 420 ⁴	Permanent Employees

4.2 COMMUNITY EMISSIONS

4.2.1 Community Emissions Analysis

The principal community sector emission source within the EMA during 2015 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.

²http://www.durban.gov.za/City_Government/City_Vision/IDP/Documents/Final%202015_15%20IDP.pdf

³http://www.durban.gov.za/City_Government/City_Vision/IDP/Documents/Final%202015_15%20IDP.pdf

⁴EThekweni Municipality, Human Resources

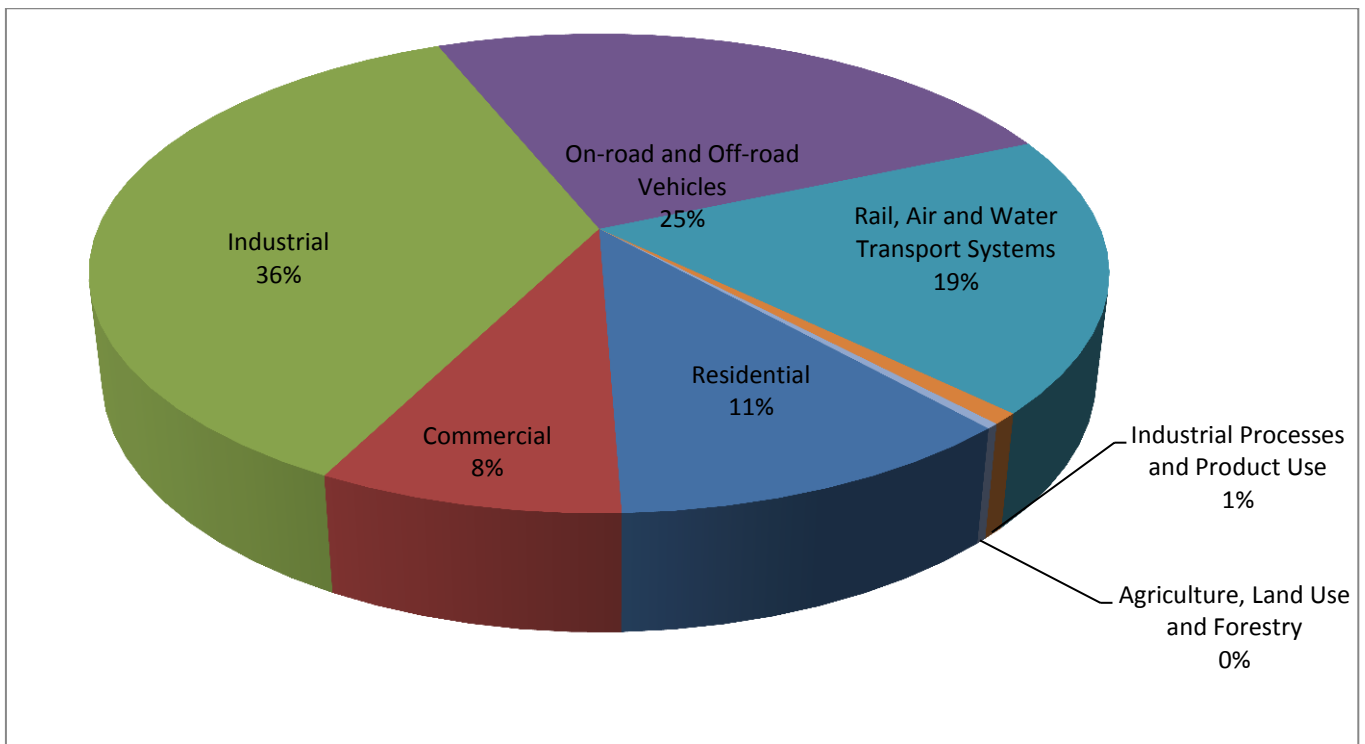


Figure 2: Community Sector Emissions

Table 22: Community sector emissions

Community Sector	Emissions Scope	Emissions (tonnes CO ₂ e)	%
Residential	Scope 1	218 160	11.00%
	Scope 2	2 568 723	
Commercial	Scope 2	2 048 861	8.08%
Industrial	Scope 1	4 401 865	36.03%
	Scope 2	4 732 537	
On-road and Off-road Vehicles	Scope 1	6 211 788	24.50%
Rail, Air and Water Transport Systems	Scope 3	4 701 539	18.54%
Solid Waste	Scope 1	190 683	0.75%
Industrial process & Product Use	Scope 1	146 295	0.58%
	Scope 1	44 333	0.17%
Agriculture, Land Use and Forestry	Scope 1	87 868	0.35%

4.2.2 Community Emissions Intensity Figures

Emissions intensity figures calculated for the EMA for 2015 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
2.62	tCO ₂ e / household	2 786 883	tCO ₂ e (Residential Scope 1 & 2)	1 063 243 ⁵	Number of households within the EMA
R 34.55	tCO ₂ e / retail trade sales	2 048 861	tCO ₂ e (Commercial Scope 1 & 2)	R59 300.00 ⁶	2015 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
6.28	tCO ₂ e / Capita	22 332 999	tCO ₂ e (Scope 1 & 2)	3 555 868	Population within the EMA
8.08	tCO ₂ e / Capita	28 741 558	tCO ₂ e (Scope 1, 2 & 3)	3 555 868	Population within the EMA

5 COMPARISON AGAINST PREVIOUS INVENTORY

The 2010 eThekwini GHG Inventory serves as the baseline inventory because the methodology for collecting and reporting data was clearly defined for this period. However data for Greenhouse Gas Emissions Inventories in the eThekwini Municipality dates back to 2002. 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.

⁵Global Insight/Economic Development & Investment Promotion Unit/Procurement & Infrastructure: Development engineering

⁶Global Insight/Economic Development & Investment Promotion Unit/Procurement & Infrastructure: Development engineering

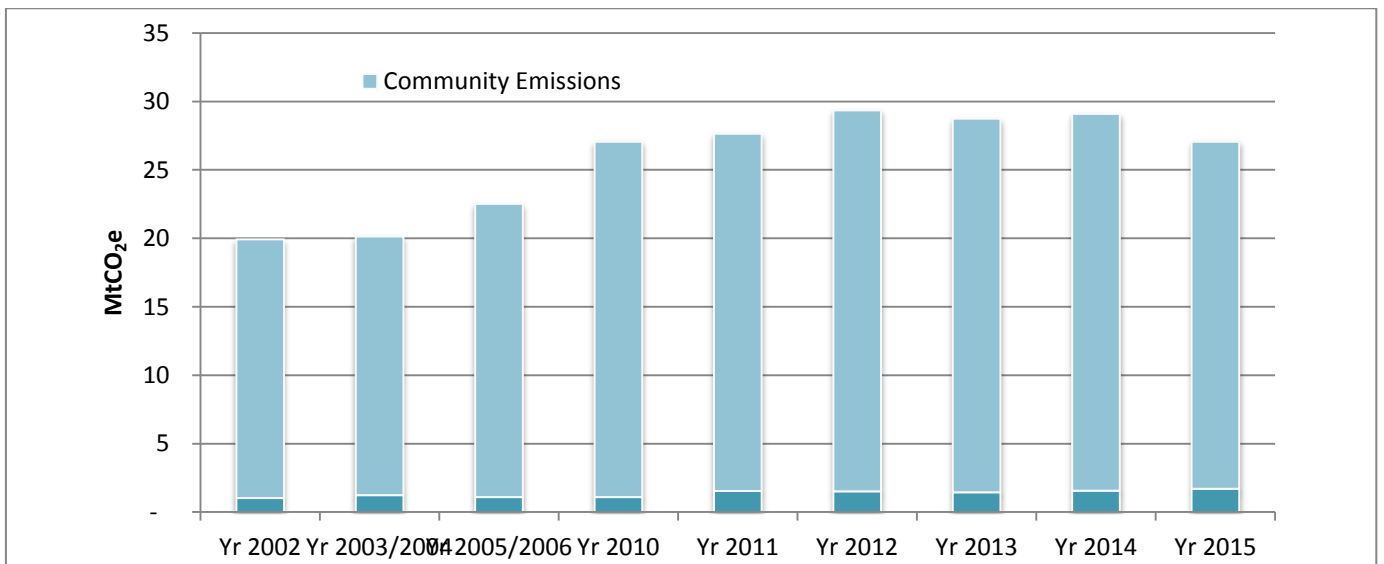


Figure 3: Comparison of Emissions 2002 through to 2015

Table 25: Percentage change of Emissions from baseline

Year	Government Emissions	Community Emissions	Total Emissions	% Change	% Change from 2010 Baseline
Yr 2002	1 047 000	18 890 000	19 937 000		
Yr 2003/2004	1 247 000	18 890 000	20 137 000	1.0%	
Yr 2005/2006	1 118 061	21 413 906	22 531 967	11.9%	
Yr 2010	1 104 212	25 962 074	27 066 285	20.1%	
Yr 2011	1 551 420	26 097 979	27 649 400	2.2%	2.2%
Yr 2012	1 526 431	27 833 965	29 360 395	6.2%	8.3%
Yr 2013	1 450 928	27 290 630	28 741 558	-2.1%	6.2%
Yr 2014	1 586 673	27 505 329	29 092 002	1.2%	6.2%
Yr 2015	1 715 259	25 352 653	27 067 912	-7.0%	-0.8%

This technical report provides a detailed comparison of the difference in emissions between the years 2011 to 2015, as shown below in Table 25.

The estimated total emissions for 2015 were 27 067 912 tCO₂e, decreasing by 7% which is equivalent to 1 819 944 tCO₂e; 25 352 653 tCO₂e from the Community sector, while 1 715 259 tCO₂e are produced from the Municipal sector. Municipal emissions have increased by 332 732 tCO₂e and community decreased by 2 152 676 tCO₂e.

Table 26: Comparison of Emissions 2015 against 2014

Scope	Type	Sub-Type	Sub-Type	2014 (tCO ₂ e)	2015 (tCO ₂ e)
Municipal Scope 1	Fuel Consumption	Stationary Fuel Combustion	Stationary Fuel	19 315.8	18 846.7
		Vehicle Fleet	Transport Fuel	31 211.3	31 216.6
	Solid Waste	Solid Waste (CH ₄)	Methane	92 911.3	82 700.2
	Power Generation Facilities	Fugitive Emissions	SF ₆	3 552.0	3 552.0
	Industrial Processes & Product Use	IPPU	Bitumen	-	17 435.0
	Wastewater Treatment	Wastewater (CH ₄)	Methane	49 093.1	49 711.1
	CERs	Certified Emissions Reduction	CERs	204 146.	
Municipal Scope 2	Electricity Consumption	Buildings	Electricity	152 564.9	164 888.4
		Streetlights & Traffic Signals	Electricity	114 256.9	120 161.7
		Water Delivery Facilities	Electricity	56 845.8	102 104.2
		Transmission and Distribution Losses	Electricity	755 638.9	1 049 239.5
		Solid Waste Facilities	Electricity	516.5	3 108.6
		Wastewater Facilities	Electricity	75 316.1	38 921.3
Municipal Scope 3	Transport Systems	Streetlights	Electricity	1 140.0	-
		Transit Fleet	Transport Fuel	29 291.8	31 491.8
		Flights	Transport Fuel	872.9	1 882.4
Subtotal Municipal				1 586 673.7	1 715 259.3
Community Scope 1	Fuel Consumption	Stationary Fuel Combustion	Stationary Fuel	4 529 667.1	4 620 025.2
		Mobile Fuel Combustion	Transport Fuel	6 813 121.2	6 211 787.7
	Solid Waste	Solid Waste	Methane	198 068.0	190 683.0
	Industrial Processes & Product Use	IPPU	Industrial Process	436 980.0	146 295.0
	Industrial Processes & Product Use	IPPU	SF ₆	44 333.4	44 333.4
Agric & Land use	Agric & Land use	Agric & Land use	87 868.4	87 868.4	
Community Scope 2	Electricity Consumption	Residential	Electricity	3 632 683.8	2 568 723.2
		Commercial	Electricity	2 307 886.0	2 048 861.0
		Industrial	Electricity	4 815 559.0	4 732 537.2
Community Scope 3	Transport Systems	Air Transport Systems	Transport Fuel	211 406.0	273 782.6
		Water Transport Systems	Transport Fuel	4 427 756.4	4 427 756.4
Subtotal Community				27 505 329.2	25 352 653.0
Total				29 092 002.9	27 067 912.3

5.1 MUNICIPAL EMISSIONS:

Municipal emissions has increased by 332 732 tCO₂e due to increase encountered within electricity consumption and transport systems with flights increasing from 872.9 tCO₂e to 1 882.4 tCO₂e. Electricity is more carbon intensive than fuel and thus it contribute most. Wastewater facility has decreased to 38 921.3 tCO₂e

5.2 COMMUNITY EMISSIONS:

Community emissions has decreased by 8% which is equivalent 2 152 676.2 tCO₂e mostly due to decrease in electricity consumption.

6 CONCLUSIONS AND RECOMENDATIONS

Total emissions for 2015 are estimated to be 27 067 912 tCO₂e, which is a decrease that translates to 1 627 tCO₂e more than the 2010 baseline and 2 024 091 tCO₂e less than the 2014 inventory. The community sector accounts for 94% of all the emissions and the municipality sector accounts for 6%.

Transportation was the largest emitter in the eThekwini Municipal Area at 40%. Industrial sector is the second largest emitter at 34%.

Many changes and moves in departments within municipal buildings affect electricity consumption impacting on the emissions from electricity. In some instances City buildings and facilities that are rented out whose accounts are not being paid, the city is accountable for the consumption. This is impacting to an increase to the electricity consumption by the council. Unaccounted electrical losses contribute most to the increase of the overall emissions for the city.

Recommendations

- Baseline year should be revisited as there are changes in the data sets.
- Energy audits and retrofits should be done for all municipal buildings and facilities.
- Reduce fleet size, improve scheduling and route efficiency.
- Increase office recycling, encourage municipal composting program.

7 APPENDIX A: ETHEKWINI MUNICIPALITY KEY INDICATORS 2015

EThekwini Municipality: Key Indicators: 2015 ⁷	
Indicators	2015
Gross Value Added (GVA)	R263,1bn(Constant 2005 Prices)
Gross Domestic Product (GDP)	R289,3bn
Gini Coefficient	0.63
Per Capita Income	R56,903
GVA Average Annual Growth (1996–2011/2012)	1.5%
Population	3,765,088 ⁸
Geographic Area	2, 273km ²
Population Growth (1996-2011/2012)	1,6%
Population Density	1,617 persons/ km ²
Number of people living with < \$2 per day	1,491,985
Number of households	1,063,245
Urbanization Rate	84%
Percentage of people in poverty	32%
Annual Per household income	202,667
Human Development Index	0.65
Annual Disposable income	R146,356
Municipal Staff Employed	21 567 ⁹
Unemployment Rate	15%
Annual Expenditure	R208,8bn
Annual Retail Trade sales	R59,3bn
Council Operating Budget: 2013/14	R33,1 bn
Council Capital Budget: 2013/14	R6.0 bn
Total Exports:	R63.9 bn
Total Imports:	R95,8bn

⁷ Global Insight/Economic Development & Investment Promotion Unit/Procurement & Infrastructure: Development engineering

⁸ STATSSA: Census 2011: Municipal Fact Sheet

⁹ EThekwini Municipality, Human Resources

8 APPENDIX B: EMISSION & CONVERSION FACTORS

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 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 C	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 per unit				
Int. Jet Fuel (Aviation Turbine F	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 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

9 APPENDIX C: JDE BUSSINESS UNITS

CATEGORIES FOR GROUPING OF MUNICIPAL ENERGY ACCOUNTS
Airport services
Area based management
Assessment rates
Audit
Business support
City enterprises
City fleet
City hall admin & city secretary
City manager's office
Cleansing & solid waste
Communications
Community participation & acti
Corporate GIS
Corporate policy
Development planning & management
Disaster management
Durban energy office
Durban transport
Economic development & facility
Electricity
Electricity depo
Emergency control centre-admin
Emergency services
Engineering
EThekwini transport authority
Expenditure
Finance & major projects
Formal housing
Gas to electricity
General - JSB
Health
Housing
Human resources
Income
Information technology
Ink
Internal control & business sy
Investigations
Legal services
Management services & org stru
Markets
Metropolitan police
Miscellaneous
Occupational health & safety
Office of dcm:health & social
Office of dcm:safety & security
Office of international & government

Office of the d c m:corp & hum
Office of the d c m:governance
Office of the d c m:procuremen
Office of the d c m:sust.devel
Office of the d c m:Treasury
Ombudsperson & head: investigate
Parks, recreation & culture
Performance management
Real estates
Regional centres
Retail market
Sanitation
Sdb
Security management
Skills development
Strategic projects
Stadium
Supply chain management
Trading results
Transport
Vat claims - SARS
Water