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# Final Summary Document: eThekwini Greenhouse Gas Emissions Inventory 2022

## 1 Synopsis

A Greenhouse Gas Emissions Inventory (GHGEI) for the eThekwini Municipality has been compiled for the 2022 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 to help develop climate change mitigation strategies within the Municipality.

The GHGEI is divided into two sub-inventories, one for the broader eThekwini community and one for the municipality or local government emissions. The local government "sub-inventory" includes GHG emissions from activities under the control of the eThekwini Municipality entity, whilst the community inventory includes GHG emissions from various sectors within the boundary of the eThekwini Municipal Area.

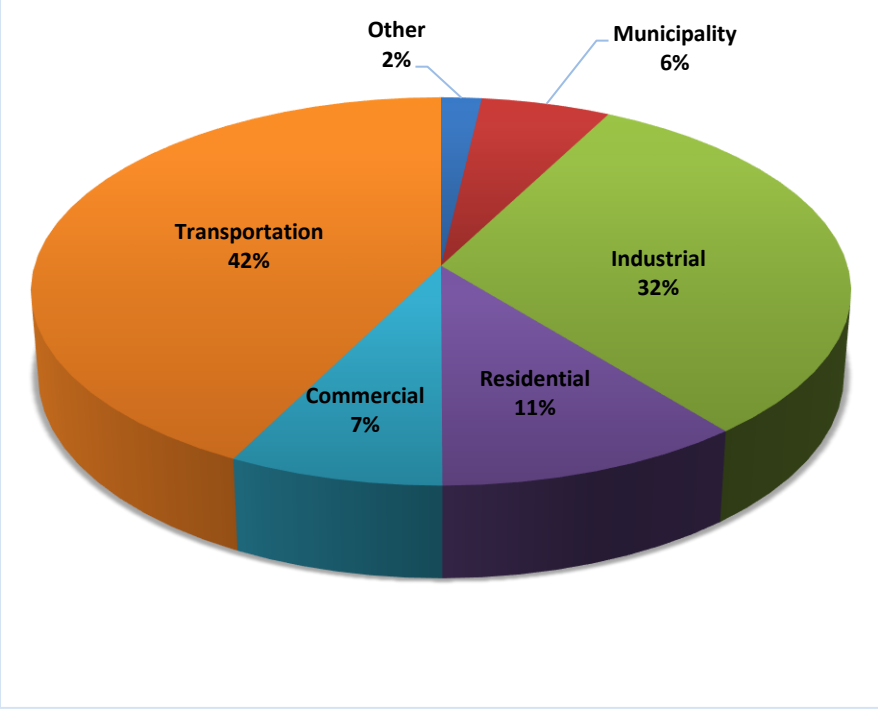


Figure 1: GHG emissions by sector

The total greenhouse emissions recorded for the entire eThekwini Municipal Area in this current review is 29,620,667 $tCO_2e$[1] for the 2022 calendar year. As with previous GHGEIs reviews, the largest contribution to this carbon footprint emanated from the transportation sector (42% of the total GHGs) followed closely by Industry emissions (32%). A graph Figure 1 is showing the inventory by sector.

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

# 2 Background

In 2010 eThekwini Municipality, together with a number of cities across the globe, became a signatory of The Global Cities Covenant on Climate (the "Mexico City Pact"). Through this covenant, the Municipality committed to record its annual GHG emissions, climate change commitments, climate mitigation and adaptation measures, and actions. The 2010 baseline GHGEI was developed as an easy to use Excel sheet and that allows for updating and reporting of GHG emissions on an annual basis.

The eThekwini GHG Inventory assist in meeting the Municipality's commitments to The Global Cities Covenant on Climate. Furthermore the GHGEI, is meant to aid the Municipality in forecasting emission trends and setting emission targets and goals for future emissions reductions and inform climate change strategies and other strategic planning processes.

# 3 Methodology Used

The following Local Government GHG Emissions Analysis Protocols, developed by ICLEI – Local Governments for Sustainability, were used to guide the development of the eThekwini 2022 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 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[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). Activities that cause emissions are recorded in different emission scopes:

- 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.

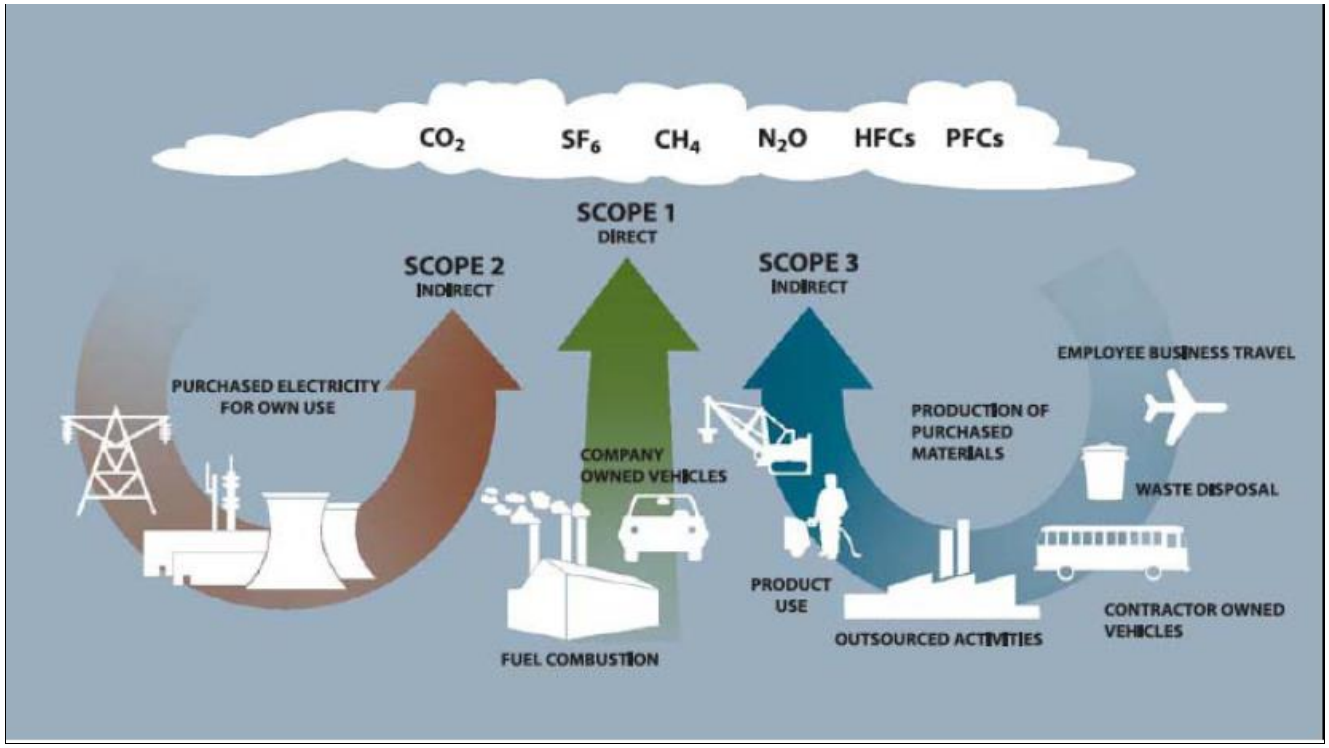


Figure 2: Total Government Emissions by Sector (Image Source: www.ghgprotocol.org)

It is important that emission scopes are differentiated as this helps to avoid the possibility of double counting emissions and misrepresenting emissions when reporting. Scope 1 and 2 emission reporting is compulsory under the WRI's GHG Protocol.

The eThekwini 2022 GHG Emissions Inventory comprises 2 sub-inventories, includes emissions from the government sector and a separate sub-inventory documenting emissions from the broader community. The government inventory includes GHG emissions from direct and indirect activities under the control of the eThekwini Municipality. The communityinventory however, includes GHG emissions from industry, commercial and residential sectors which include transport, waste and agriculture sectors within the boundary of the eThekwini Municipal Area. Table 1 and table 2 show the emissions sources for government and community that are included in the Inventory.

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 | | |

In order to standardise reporting, activity data (such as fuel consumption) is multiplied by an emissions factor to convert all data to tonnes carbon dioxide equivalent ($tCO_2e$). Emission factors are generally internationally accepted values published by a range of different entities. To date South Africa has not published a comprehensive list of emission factors for use in South Africa, with an exception of 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 calendar year 2022 the total carbon emissions recorded for the entire eThekwini Municipal Area was 29,304,654$tCO_2e$. The following section provides more detail on this figure but is divided into emissions from the Municipality and emissions from the broader community. The division into government and community emissions is standard practice as data for local government emissions is generally more readily available.

## 4.1 Local Government Emissions

Total local government emissions for the 2022 period were 1,719,252 $tCO_2e$. The government emissions sub-inventory included operations that are directly under the eThekwini Municipality's control and emissions arising from the use of all significant assets and services during 2022. Table 3 summarises the municipal emissions by GHG scope.

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 | 252,021 (14.7%) |
| Scope 2 | Electricity Consumption, Electricity Transmission & Distribution (Technical and Non-technical losses) | 1,438,670 (83.7%) |
| Scope 3 | Employee Air Travel, Transit vehicles operated by contractor, Electricity consumption by Eskom owned streetlights | 28,561 (1.7%) |

The graph below (Figure 3) shows the distribution of emissions by sector for the government emissions for 2022. A breakdown of the sectors by emission source is provided in Table 4. The highest municipal emission source, contributing

[5] 1kWh = 1.03kg $CO_2$

70% to the Municipality's total 2022 emission inventory, was electrical transmission and distribution losses (scope 2) and was followed by streetlights and traffic signals at 10%.

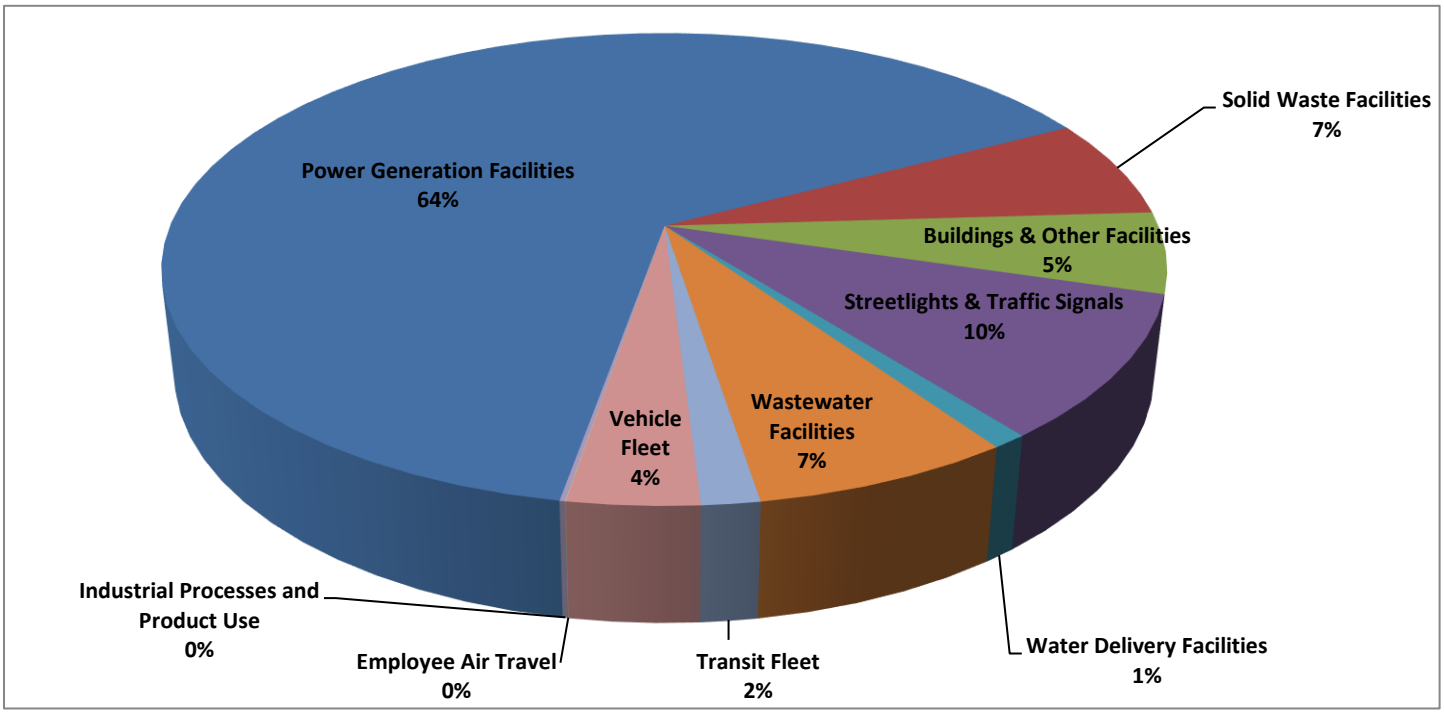


Figure 3: Total Government Emissions by Sector

Table 4: Municipal Operation Emissions by Sector and Source

| Sector | Scope | Emission Sources | Emissions (tonnes $CO_2e$) |
|---|---|---|---|
| Buildings & Other Facilities | 1<br>2 | Stationary Fuel Combustion<br>Purchased Electricity | 517<br>94,598 |
| Streetlights & Traffic Signals | 2 | Electricity consumption by municipal owned | 168,348 |
| | 3 | Streetlights | 1,112 |
| Water Delivery Facilities | 2 | Purchased electricity | 16,674 |
| Wastewater Facilities | 1<br>2 | Stationary and process emissions<br>Purchased electricity | 71,631<br>50,387 |
| Vehicle Fleet | 1 | Mobile fuel combustion | 61,275 |
| Transit Fleet | 3 | Mobile fuel combustion | 27,202 |
| Power Generation Facilities | 2 | Electrical distribution losses | 1,108,477 |
| Solid Waste Facilities | 1<br>2 | Fugitive emissions<br>Purchased electricity | 116,015<br>186 |
| Industrial Process and Product Use | 1 | Bitumen | 2,582 |
| Employee Air Travel | 3 | Mobile fuel combustion | 248 |
| **Total Municipal Emissions** | | | **1,719,252** |

## 4.2 Community Emissions

Total community emissions recorder for 2022 were equated to 27,901,415 $tCO_2e$. The community emissions inventory includes GHG emissions associated with activities occurring within the eThekwini Municipality's geopolitical boundary generated during 2022. The table below shows community emissions by scope.

**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 | 14,299,888 (51.3%) |
| Scope 2 | Electricity Consumption | 8,905,732 (31.9%) |
| Scope 3 | Air Transport Systems, Marine Transport Systems | 4,695,795 (16.8%) |

The largest sector contributing 34% to the total community GHG emissions is the industrial sector through purchased electricity and stationary fuel combustion. The second major contributor was the on-road and off-road (ground) transport sector contributing 28% to overall community emissions. The third highest contributor to community emissions was the air and water transport systems sector deriving its emissions from fuel consumption at 17%. Collectively (ground, air and water) transport sector emissions contribute the most significant proportion at 45%. Figure 4 below illustrates the total community emissions produced in eThekwini by sectors. 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**

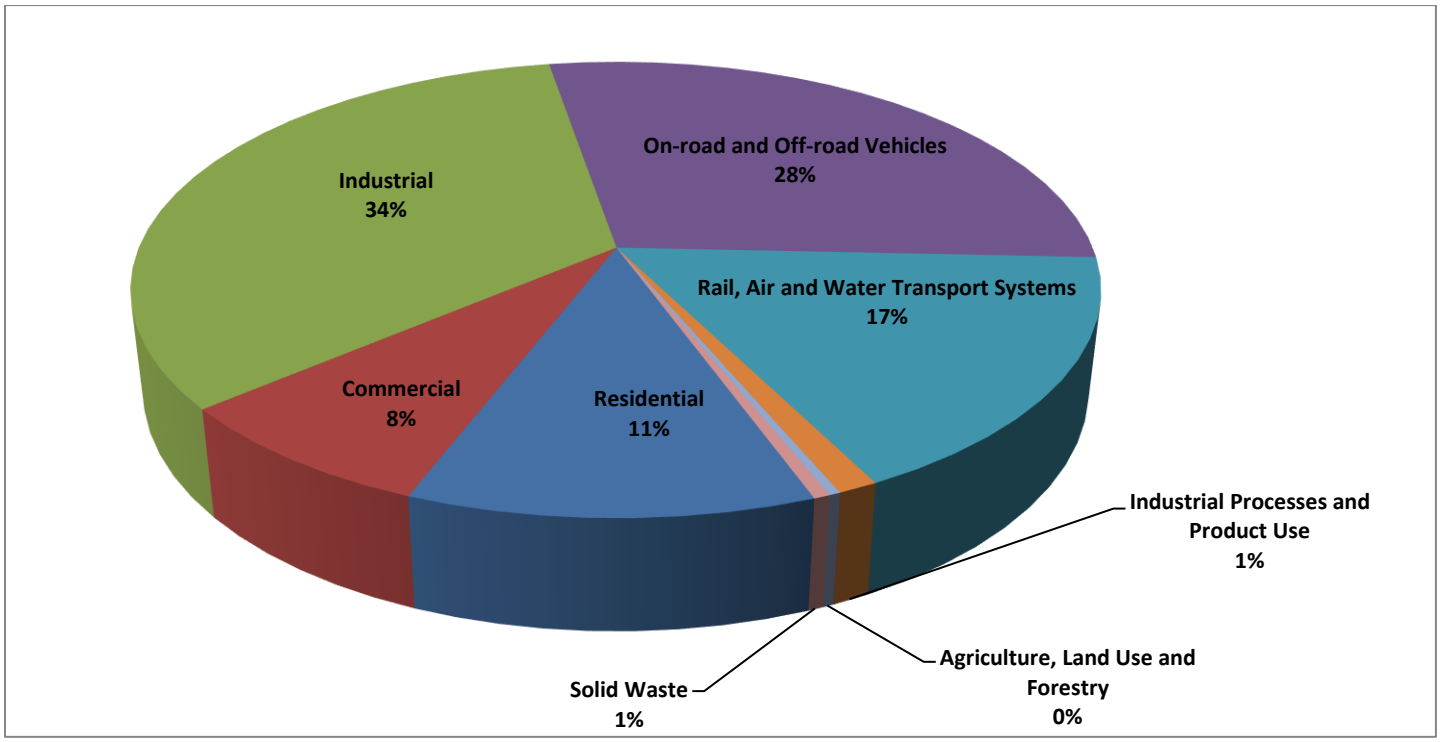

Table 6: Community Operation Emissions by Sector and Source

| Sector | Scope | Emission Sources | Emissions (tonnes $CO_2e$) |
|---|---|---|---|
| Residential | 1 | Stationary Fuel Combustion | 630,555 |
| | 2 | Electricity Consumption | 2,556,034 |
| Commercial | 2 | Electricity Consumption | 2,216,962 |
| Industrial | 1 | Stationary Fuel Combustion | 5,221,843 |
| | 2 | Electricity Consumption | 4,132,737 |
| On-road and Off-road Vehicles | 1 | Mobile Fuel Combustion | 7,909,465 |
| Rail, Air and Water Transport Systems | 3 | Air Travel | 4,695,795 |
| Solid Waste | 1 | Fugitive Emissions | 130,733 |
| Industrial Process and Product Use | 1 | Pulp & Paper Production | 275,094 |
| | 1 | F-gases | 44,330 |
| Agriculture, Land Use and Forestry | 1 | Enteric Fermentation | 87,868 |
| **Total Community Emissions** | | | **27,901,415** |

# 5 Analysis of the GHG Inventory

## 5.1 Total Emissions

For 2022 the total carbon emissions recorded for eThekwini Municipality was 29,620,667 $tCO_2e$. Municipal activities accounts for 6% of the total emissions (Figure 1).

Below is a graph (Figure 5), which indicates that most of the carbon emissions in the city come from transport activities at 43%. Electricity consumption is the second largest source of emissions at 35%. Stationary Fuel Combustion also contributes to the overall GHG footprint with 20% of the total emissions.

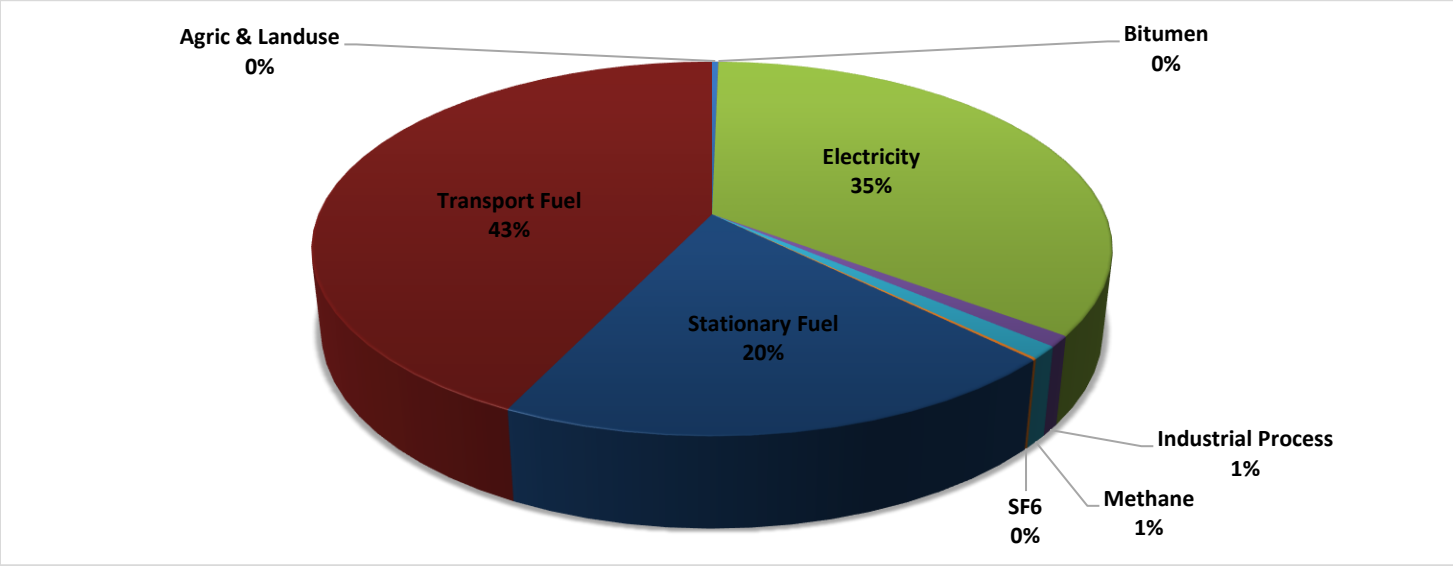

Figure 5: Carbon emissions by Source

The imported electricity supplied in the city was 10,154 GWh (99.9%) compared to local generators of electricity at 11 GWh (0.10%), Figure 6 below. This local generation is predominantly from the Municipal Landfill Gas and renewable energy embedded generators.

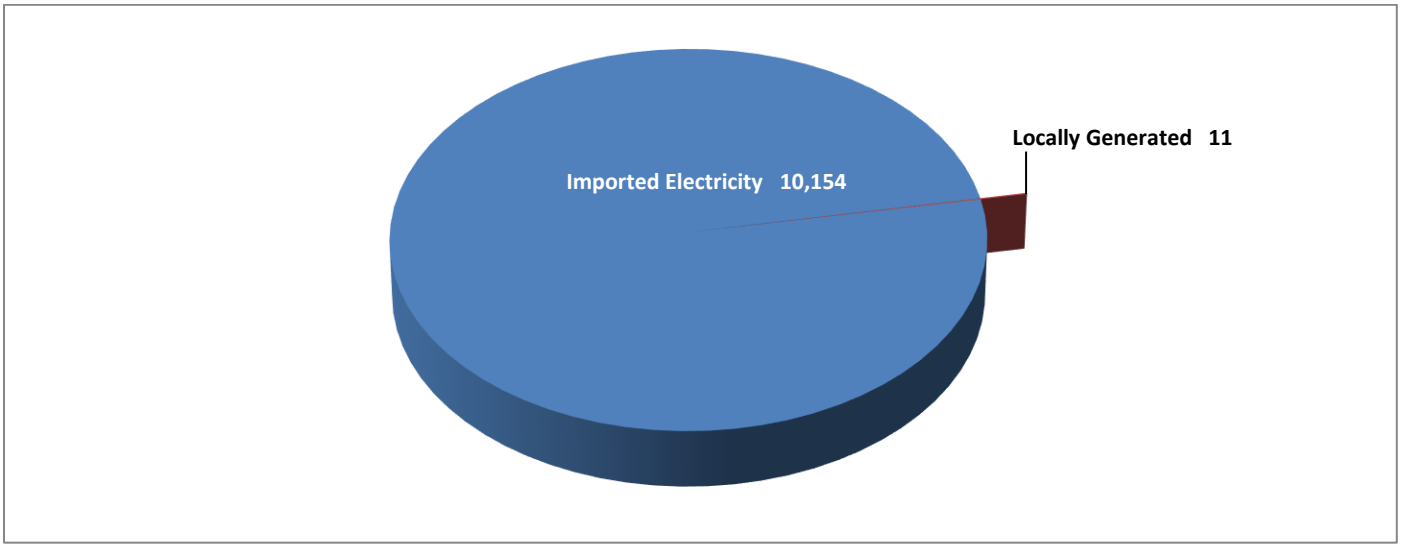


Figure 6: Electricity Supply by Source in the eThekwini Municipal Area (GWh)

## 5.2 Municipal Emissions

The spread of municipal emissions by infrastructure type is provided in Figure 7 below, which excludes electricity transmission. Streetlights were responsible for the largest component of the municipal footprint followed by Water and Sanitation, City Fleet and Solid waste. The bulk of the infrastructure emissions are from electricity usage, Solid Waste emissions are predominantly from methane and Water and Sanitation facilities also contributes to the methane.

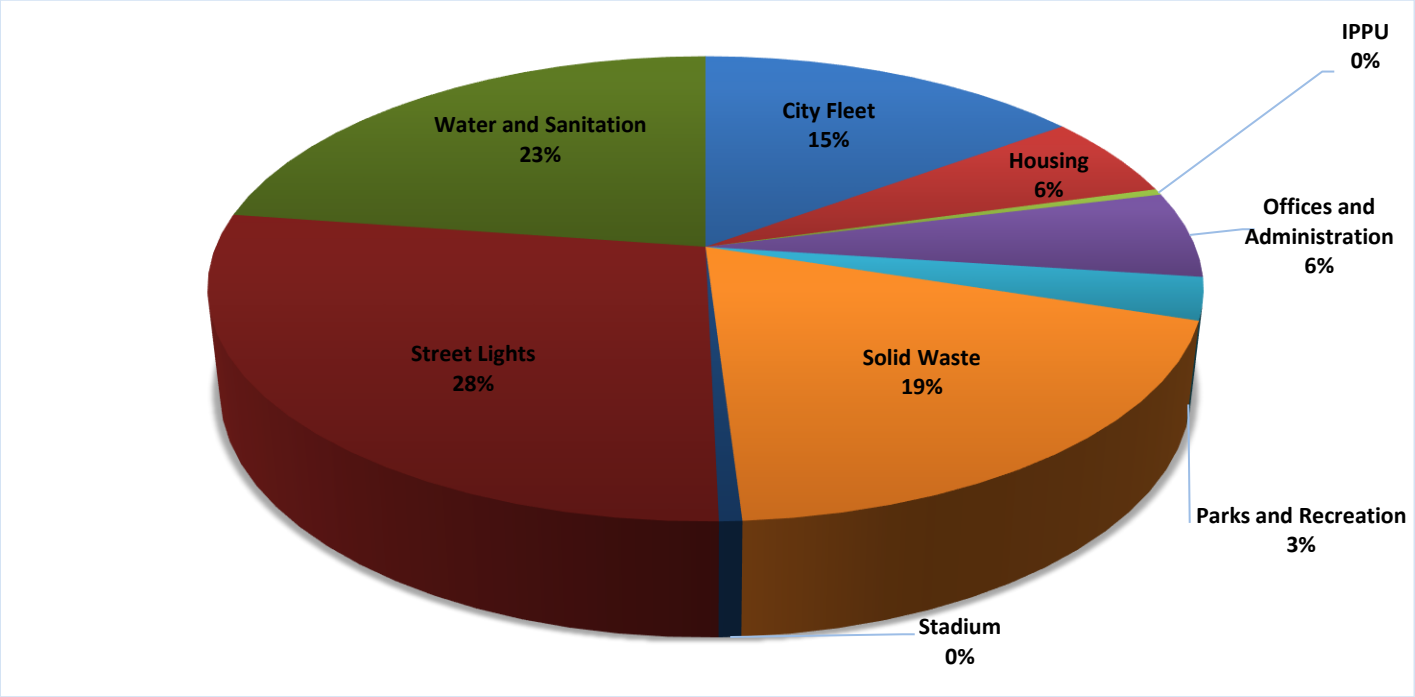


Figure 7: Municipal Emissions by Infrastructure Type tCO2e (excluding electricity transmission losses)

## 5.3 Intensity of Emissions

### 5.3.1 Government Intensity Figures

Emission intensity figures for the Municipality are recorded below in Table 8. These figures were calculated by combining all municipal scope 1 and 2 emissions and dividing them by the relevant indicator.

Table 7: Municipal Intensity Figures

| Intensity Figure | Unit | Metric Numerator | Unit | Metric Denominator | Unit |
|---|---|---|---|---|---|
| R29.25 | $tCO_2e$ / million Rand of operating budget | 1,690,691 | tCO2e (Municipal Scope 1 & 2) | R57,800.00 | Million Rand Operating Budget (2021/ 2022) |
| R208.73 | $tCO_2e$ / million Rand of Capital budget | 1,690,691 | tCO2e (Municipal Scope 1 & 2) | R8,100.00 | Million Rand Capital Budget (2021/ 2022) |
| 67.87 | $tCO_2e$ / Permanent employee | 1,690,691 | tCO2e (Municipal Scope 1 & 2) | 24,911 | Permanent Employees |

### 5.3.2 Community Intensity Figures

Community intensity figures are recorded below. These emissions were calculated by combining relevant sector scope emissions and dividing them by the relevant indicators.

Table 8: Community Emissions Figures

| Intensity Figure | Unit | Metric Numerator | Unit | Metric Denominator | Unit |
|---|---|---|---|---|---|
| 5.95 | tCO2e / household | 3,186,589 | tCO2e (Residential Scope 1 & 2) | 1,240,807 | Number of households within the EMA |
| R 23.81 | $tCO_2e$ / million Rand of Capital budget | 2,216,962 | tCO2e (Commercial Scope 1 & 2) | R 101,000.00 | 2022 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 |
|---|---|---|---|---|---|
| 5.95 | tCO2e / Capita | 24,896,311 | tCO2e (Scope 1 & 2) | 4,184,944 | Population within the EMA |
| 6.97 | tCO2e / Capita | 29,175,112 | tCO2e (Scope 1, 2 & 3) | 4,184,944 | Population within the EMA |

## 5.4 Comparison with previous GHGIE

The 2010 eThekwini GHG Inventory serves as the baseline inventory because the methodology for collecting and reporting data then was clearly defined for this period. The 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 as a result of improved data collection methodologies but also due to increased uses of energy and carbon intensive processes in the city.

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** | **1,715,465** | **26,426,352** | **28,141,817** | **-3.0%** |
| **Yr 2019** | **1,363,657** | **27,440,798** | **28,804,454** | **2.4%** |
| **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** | **27,901,667** | **29,620,667** | **1.1%** |

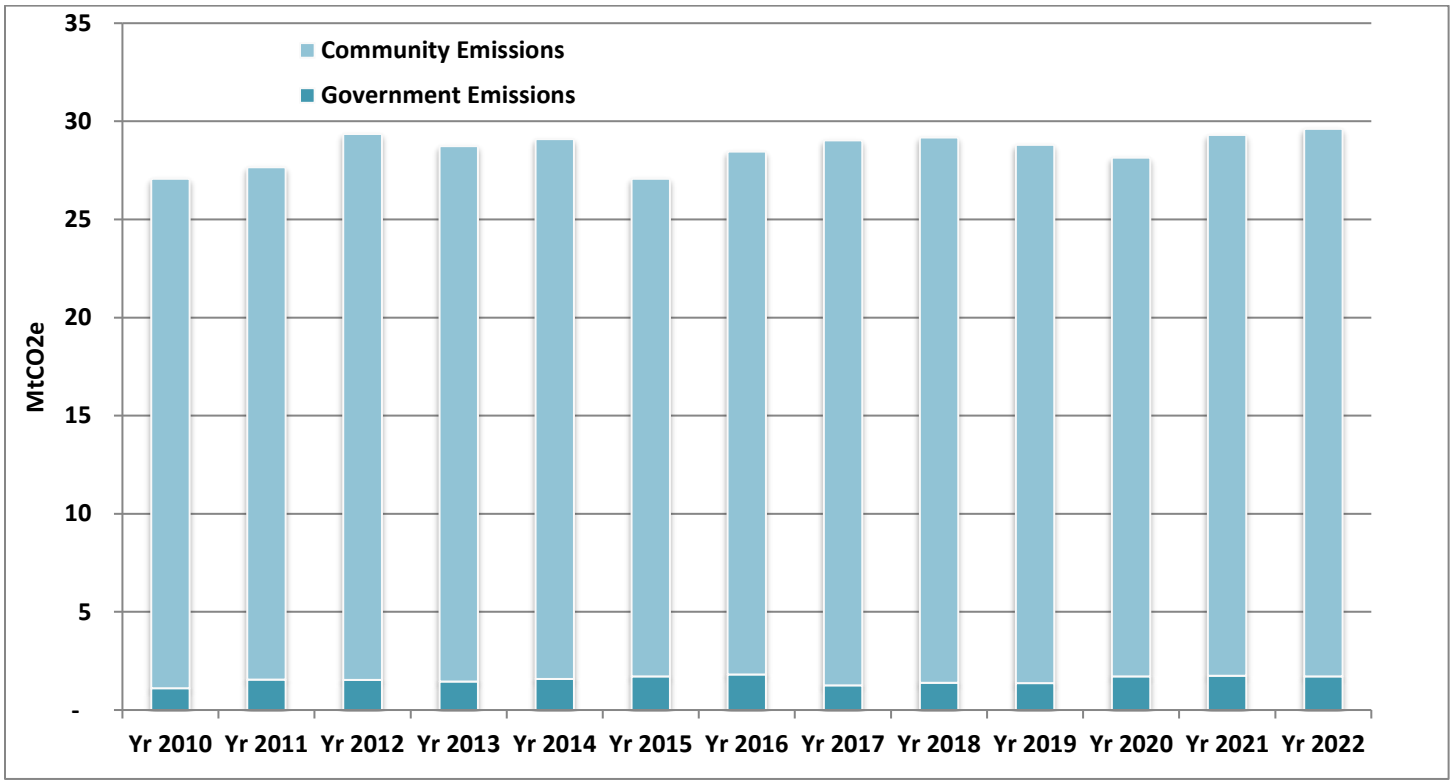


Figure 8: Historic Emissions Data for the eThekwini Municipality (tCO2e)

Total emissions have increased by 316,014 tCO2e in 2022 compared to the total emissions in 2021, the analysis shows a decrease of 20,937 $tCO_2e$ from municipal emissions however there was an increase of 336,951 $tCO_2e$ from community emissions. Table 11 shows a detailed summary of the differences between 2021 and 2022 emissions.

Table 11: Data Comparison between 2021 and 2022 Reporting Periods

| Scope | Type | Sub-Type | 2021 (tCO2e) | 2022 (tCO2e) |
|---|---|---|---|---|
| Municipal Scope 1 | Fuel Consumption | Stationary Fuel Combustion | 517.3 | 517.3 |
| | | Vehicle Fleet | 61,277.9 | 61,275.1 |
| | Solid Waste | Solid Waste (CH4) | 34,875.0 | 116,015.5 |
| | Industrial Processes & Product Use | IPPU | 2,582.4 | 2,582.4 |
| | Wastewater Treatment | Wastewater (CH4) | 71,007.5 | 71,630.6 |
| Municipal Scope 2 | Electricity Consumption | Buildings | 81,209.5 | 94,597.8 |
| | | Streetlights & Traffic Signals | 168,426.3 | 168,347.8 |
| | | Water Delivery Facilities | 14,013.9 | 16,674.0 |
| | | Transmission and Distribution Losses | 1,227,835.8 | 1,108,477.4 |
| | | Solid Waste Facilities | 180.5 | 185.7 |
| | | Wastewater Facilities | 48,398.4 | 50,387.0 |
| Municipal Scope 3 | Transport Systems | Streetlights | 1,109.1 | 1,111.9 |
| | | Transit Fleet | 28,723.1 | 27,201.7 |
| | | Flights | 32.0 | 247.7 |
| **Subtotal Municipal** | | | **1,740,188.6** | **1,719,251.9** |
| Community Scope 1 | Fuel Consumption | Stationary Fuel Combustion | 5,258,155.1 | 5,852,398.2 |
| | | Mobile Fuel Combustion | 8,376,157.1 | 7,909,464.7 |
| | Solid Waste | Solid Waste | 145,270.0 | 130,733.0 |
| | Industrial Processes & Product Use | Industrial Process | 142,126.0 | 275,094.0 |
| | 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 | 2,560,995.9 | 2,556,034.0 |
| | | Commercial | 2,216,894.2 | 2,216,961.6 |
| | | Industrial | 4,132,570.9 | 4,132,736.7 |
| Community Scope 3 | Transport Systems | Air Transport Systems | 172,341.0 | 268,038.5 |
| | | Water Transport Systems | 4,427,756.4 | 4,427,756.4 |
| **Subtotal Community** | | | **27,564,464.9** | **27,901,415.5** |
| **Total** | | | **29,304,653.5** | **29,620,667.3** |

# 6 Conclusion

The compilation of the eThekwini GHG Emissions Inventory is an important step in documenting the eThekwini Municipality's government and community emissions that are contributing to human induced climate change. Comparison between 2021 and 2022, a notable slightly increase of 1,1% is observed. The 2022 total GHG emissions have increased by 316,013.8 tCO2e, from 29,304,653.5 tCO2e in 2021 to 29,620,667.3 tCO2e. Community and government emissions contributed 27,901,415.5 tCO2e and 1,719,251.9 tCO2e GHG emissions, respectively. The biggest contributions in government emissions between 2021 to 2022 came from Electricity Consumption (Wastewater Facilities, Buildings) as depicted on Table 11. Meanwhile the highest contributions to the informed increase in community emissions between 2021 to 2022, is due to fuel consumption (Stationary Fuel Combustion), Industrial Processes & Product Use (IPPU) as well as transport Systems (Air Transport Systems). Therefore, going forward more efforts and more impactful climate reduction actions are recommended in these sectors, which will consequently this will result in reducing the carbon dioxide emissions and the city achieving its climate goals as outlined in several strategies.