SUSTAINABLE ENERGY AFRICA

2015

STATE OF ENERGY IN SOUTH AFRICAN CITIES

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SEA SUSTAINABLE ENERGY AFRICA

STATE OF ENERGY IN SOUTH AFRICAN CITIES 2015

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This data review has been developed through the participation of a wide range of stakeholders. However, Sustainable Energy Africa are responsible for the views expressed and any errors that might appear in this final report.

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- Ekurhuleni
- EThekwini
- George
- City of Johannesburg
- King Sabata Dalindyebo
- KwaDukuza
- Mangaung
- Mbombela (Nelspruit)
- Nelson Mandela Bay
- Polokwane
- Rustenburg
- Saldanha Bay
- Sol Plaatje
- Steve Tshwete
- City of Tshwane

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ACRONYMS

AMEU	Association of Municipal Electricity Undertakings
BAU	Business as Usual
BRT	Bus Rapid Transit
CO_2	Carbon Dioxide
CPD	Continuing Professional Development
CPI	Consumer Price Index
DEA	Department of Environmental Affairs
DCOG	Department of Cooperative Governance and Traditional Affairs
DME	Department of Minerals and Energy (now the Department of Energy)
DOE	Department of Energy (formerly known as the Department of Minerals and Energy)
DOT	Department of Transport (National)
EE	Energy Efficiency
EEDSM	Energy Efficiency and Demand Side Management
ETM	eThekwini Municipality
FBAE	Free Basic Alternative Energy
FBE	Free Basic Electricity
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GHG	Greenhouse Gas
GJ	Gigajoule
GVA	Gross Value Added
GWh	Gigawatt Hours (a unit of electrical energy equal to 1000 megawatt hours)
HFO	Heavy Furnace Oil
HSRC	Human Sciences Research Council
IBT	Inclining Block Tariff
ICLEI	International Council for Local Environmental Initiatives
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
ITP	Integrated Transport Plan
IRP 2010	Integrated Resource Plan for Electricity, 2010–2030
kWh	Kilowatt Hour
kWp	Kilowatt Peak (a measure of peak output of a photovoltaic [solar electric] system)
LEDs	Local Emission Development Strategies
LPG	Liquid Petroleum Gas
LTMS	Long Term Mitigation Scenarios (for South Africa)
MVA	Megavolt ampere (a unit of measure of apparent power)
MW	Megawatts
NDP	National Development Plan
NERSA	National Energy Regulator of South Africa (formerly known as National Electricity Regulator)
NETFIT	Net Feed-In Tariff
NGO	Non-Government Organisation
NMT	Non-Motorised Transport
NRS	National Regulatory Standards
PPA	Power Purchase Agreements
PV	Photovoltaic
RE	Renewable Energy
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SACN	South African Cities Network
SALGA	South African Local Government Association
SANS	South African National Standards
SAPIA	South African Petroleum Industry Association
SDC	Swiss Development Cooperation
SDF	Spatial Development Framework
SE4ALL	Sustainable Energy For All
SEA	Sustainable Energy Africa
SEED	Sustainable Energy for Environment and Development
SSEG	Small Scale Embedded Generation
Stats SA	Statistics South Africa
SWH	Solar Water Heater
UCT	University of Cape Town
UNDP	United Nations Development Programme
WCDEADP	Western Cape Department of Environmental Affairs and Development Planning
WSSD	World Summit on Sustainable Development
WWTW	Waste Water Treatment Works

FOREWORD

As moden cities are defined by their energy mix, so are they increasingly defining the energy mix of their nations. As the frontline of the developmental state in South Africa, cities must forge the next generation of energy security solutions in real-time, building innovative approaches to meeting present energy needs which begin to future-proof our energy systems.

Leading global thinkers are increasingly describing the planetary challenge of the unsustainable linked demand for more food, energy and water as a perfect storm. By 2030, on current predictions, these linked areas of demand will reach a common – and catastrophic- breaking point if the planet does not act decisively. No city and no national government can resolve these alone, but metropolitan regions are and will be at the frontlines of dealing with the consequences. We have to be part of the collective process that steers us away from the perfect storm, becoming an organised lobby for international action and translating international commitments so that they find local expression

This third State of Energy in South African Cities report examines the sustainable energy development path of 18 key cities in South Africa. It builds on the data collection and analysis work of the first two reports dated 2006 and 2011.

The 2006 State of Energy report was the first of its kind and highlighted the important role of cities in the South African energy picture. The report found that the 15 study cities were responsible for consuming almost half of the country's energy, making them extremely energy-intensive nodes in the national fabric, and made the case for development of city-level energy planning.

The second report, in 2011, provided an updated picture of the energy profile of the cities studied. It included a more qualitative story, tracking the progress towards low-carbon, energy efficient, resilient and more productive cities. The report revealed that cities were taking enormous strides in tackling energy and climate change issues.

This third report builds on the first two reports. For the first time, we are able to track changes and identify possible trends emerging in the sustainable energy development of cities over almost a decade, particularly the metros. The report also includes some of the growing secondary cities in South African and examines their energy-related development trajectory.

South Africa continues to experience rapid urbanisation, with approximately 64% of the population living in urban areas in 2012. The cities covered in this report are home to nearly half of South Africa's population and yet occupy only 4.5% of the country's land area. They account for over a third (37%) of national energy consumption and half (52%) of the country's petrol and diesel consumption, and produce some 70% of the country's economic wealth. These dense urban centres therefore have a fundamental role to play in the development of our country.

The report finds that cities have overall slightly increased their energy consumption and related emissions. Given the growth in population and the economy, a higher increase might have been expected. The modest change is partly due to electricity supply challenges and rising prices, but also reflects the results of actions taken by the cities. Many cities have adopted sustainable energy strategies and solutions in all the sectors – residential, transport, own buildings, commercial – and are even looking at generating renewable supply of their own. Indeed, compared to the picture in 2006, the report confirms that cities are the seat of pioneering transformation.

Nevertheless, much remains to be done, if we are to move to sustainable urban energy that will help meet the national goals of improving welfare, supporting economic activity and reducing carbon emissions to acceptable levels. We hope that the picture unveiled in this report will inspire continued change.

Mr. Parks Tau
Honourable Executive Mayor of Johannesburg

The Unfolding Urban Energy Experience



1

INTRODUCTION

THE STATE OF ENERGY IN SOUTH AFRICAN CITIES REPORT[1] FOCUSES ON CITIES AND TOWNS, BECAUSE URBAN AREAS ARE CRUCIAL TO THE DEVELOPMENT AND IMPLEMENTATION OF GLOBAL, NATIONAL AND LOCAL ENERGY AND CLIMATE STRATEGIES.

The cities covered in this report are home to half (52%) of South Africa's population, but occupy only 4.5% of the country's land area. They account for over a third (37%)[2] of national energy consumption and nearly half (46%) of national electricity consumption. They also consume half (52%) of the country's petrol and diesel and produce approximately 70% of the country's economic wealth. These dense urban centres therefore have a fundamental role to play in the development of South Africa, and the city energy picture is crucial for the development and implementation of any national and local energy and climate strategies.

One of the most critical issues facing the world today is the global impact of climate change on society, environment and economy, in particular in cities where most of the world's population live. Cities need to be in a position to respond proactively to the impact of climate change, which means moving towards sustainable energy. Energy is required for all aspects of our life, but globally most energy is generated by fossil fuels, which result in high greenhouse gas (GHG) emissions. Access to energy increases the resilience of the poor to climate impacts.

South Africa is the 12th highest GHG emitter in the world, because most of its electricity is produced from coal. This is why moving towards a sustainable and low-carbon approach[3] is a priority, and tracking energy consumption is essential to map the transition to a lower carbon future. The Intergovernmental Panel on Climate Change (IPCC) fifth assessment report (IPCC, 2014) identified cities as being major players in reducing global emissions.

South Africa continues to experience rapid urbanisation, with approximately 64% of the country's population living in urban areas (of which 40% are located in the metropolitan municipalities). Urban populations are forecast to reach 70% of the national total by 2030 and 80% by 2050 (NPC, 2011; SACN, 2011; DCOG, 2013).

1 See www.cityenergy.org.za for previous State of Energy in South African cities reports (2006, 2011)

2 The data constraints encountered in acquiring energy data (data on aviation and marine fuels was not consistently available for the study cities) mean that this figure is an underestimate; the actual figure is likely to be close to 50%.

3 Sustainable energy is defined as the production and consumption of energy in ways that support social and economic development in an environmentally benign manner (UNDP, 2000).

If managed well, urbanisation will generate significant opportunities for growth, poverty reduction and environmental sustainability. However, to achieve this, cities must be well planned, managed and governed, and supported through good coordination and alignment among the spheres of government; and have access to resources. Energy is central to livelihoods and the economy and is a key resource to manage.

This report examines the sustainable energy development path of 18 key cities in South Africa using a baseline year of 2011/12. It builds on the data collection and analysis work of the first two reports dated 2006 and 2011. For the first time, the data from over a decade provides the opportunity to track changes and identify possible trends emerging in the sustainable energy development of cities, particularly the metros. The report also examines the energy-related development trajectory of some of the rapidly growing secondary cities in South Africa. Evidence shows that the growth in cities into the future will be in the smaller secondary cities and this provides an opportunity for doing things differently.

After outlining the method and systems of data collection and collation in Chapter 2, Chapter 3 describes the energy profile for the different city types represented in the report. Chapter 4 then provides an analysis of the key trends and issues that emerge from the data primarily for the metros. The importance of transitioning to a sustainable energy future while ensuring economic development is the starting point of Chapter 5, which examines the main drivers of a sustainable city, i.e. renewable energy, energy efficiency, mobility and urban form and energy access. Chapter 6 reviews governance and implementation, while Chapter 7 provides concluding thoughts and recommendations. Chapter 8 presents the data collected per city studied and provides detailed notes on how to interpret individual city energy data sheets. This section gives insight into the urban energy development for each city against a set of indicators for sustainable energy development.

This report shows clearly that the urban energy data available has improved over the past decade and that cities are embracing sustainable energy approaches, although initiatives are often still in their infancy. The data indicates that the energy and emissions profiles of cities have started to shift, probably for a variety of reasons. However, much remains to be done in order to move to a sustainable urban energy profile in support of the national goals of improving welfare, supporting economic activity and reducing carbon emissions to acceptable levels. Challenges that remain revolve around the institutionalising of sustainable energy work in municipal practice, associated capacity development in local government, and greater coordination and support from national government at the local government level.

Map of South Africa indicating the location of the 18 review cities and towns

Figure 1: Map showing cities covered in this report

LIMPOPO
Polokwane
Mbombela
Rustenburg
Tshwane
GAUTENG
Steve Tshwete
Johannesburg
Ekurhuleni
NORTH WEST
MPUMALANGA
FREE STATE
KWAZULU-NATAL
Mangaung
KwaDukuza
eThekwini
EASTERN CAPE
King Sabata Dalindyebo
Buffalo City
Nelson Mandela Bay
Key:
Metros
Secondary Cities
Smaller Towns

2

METHODOLOGY AND DATA

THIS CHAPTER PROVIDES AN OVERVIEW OF THE METHODOLOGY. ANNEXURE 1 CONTAINS DETAILED METHOD NOTES AND AN OVERVIEW OF DATA SOURCES.

Through a detailed participation process with a range of stakeholders, the first State of Energy in South African Cities Report (SEA, 2006) produced priority indicators (in line with international protocols) that are used in all 3 reports: 2006, 2011 and 2015. Indicators are important for informing the process of data collection, collation and analysis, helping to quantify and simplify information and to analyse the data. The purpose of developing energy indicators is to stimulate the generation of data to support policy decisions, provide a benchmark against which the progress of work in the field can be measured over time and, ultimately, raise city energy issues on the local and national policy agenda through highlighting the key questions and their implications.

For this report, data was collected from questionnaires sent to participating municipalities, telephone interviews with municipal and energy industry officials, energy and demographic datasets available online, as well as the state of energy reports and GHG inventories undertaken by the various municipalities.

Compared to previous reports, the data quality and reliability for this report is much improved, due to the extraordinary expansion of local-level energy data collection and energy strategy development in recent years. Despite this, energy data collection remains a challenge, as the data is not always collated along municipal political boundaries, which makes putting together the energy picture of individual municipalities difficult. Other difficulties include obtaining Eskom data and coal data (the sourcing of coal data has changed over the years), and the quality of municipal data (municipalities provide data, but much depends on which department is holding a particular dataset and how they have collated their data).

2.1 THE STUDY AREA

The municipalities selected for this report were based on the following criteria:

- Cities and towns actively involved in the Sustainable Energy Africa (SEA) learning network and the urban energy platform with the South African Local Government Association (SALGA), the South African Cities Network (SACN) and the International Council for Local Environmental Initiatives (ICLEI).[4]

4 ICLEI helps cities improve their overall resource efficiency and better manage their natural resources.

- Cities and towns participating in key national programmes, such as the municipal energy efficiency demand side management (EEDSM) programme and the ICLEI Local Emission Development Strategies (urban LEDS) for secondary cities.
- An attempt to have a degree of geographic, economic and social (including municipal type and size) representation by including metros, secondary cities, industrial cities and small towns.

The municipalities in this study include the eight metros, seven secondary cities and three smaller towns.

Category A[5]/Metros: Cape Town, Johannesburg, Ekurhuleni, Tshwane, eThekwini, Buffalo City, Mangaung.

Category B2[6]/Secondary cities: Sol Plaatje, George, Drakenstein, Steve Tshwete, Rustenburg, Polokwane, Mbombela.

Category B3/Smaller municipalities: Saldanha Bay, KwaDukuza, King Sabata Dalindyebo.

The metros were chosen because they are the economic hubs of South Africa and often pioneers of energy efficiency and renewable energy strategies, policies and projects. The secondary cities and smaller towns were chosen to represent an economic and social range from rural to industrial. Secondary cities are also emerging and growing urban nodes.

As far as possible, municipalities from previous State of Energy reports (2006 – based on 2004 data, 2011 – based on 2007 data) are included in this study, to allow for comparisons over time. The metros represent the most complete datasets for the three iterations of data collection and so are used to compare energy consumption and emissions production over time. The exception is Mangaung, for which there was no data for the 2011 report (2007 data year).

5 A municipality that has exclusive municipal and executive and legislative authority in its area.

6 A municipality that shares municipal and executive and legislative authority in its area with a Category C municipality within whose area it falls. A category C municipality has municipal and executive and legislative authority in an area that includes more than one municipality.

2.2 ENERGY DATA

The baseline data year for this report is 2011, which is the most recent year for which a comprehensive national household dataset is available (Stats SA, 2011) that contains reliable demographic and energy services information.

In order to compare energy sources, units were converted to joules, the standard energy unit. The energy conversion factors were drawn from the national Department of Energy's (DOE) Draft 2012 Integrated Energy Planning Report (DOE, 2013a). Locally appropriate emissions conversion factors were sourced from www.emissionfactors.com (using the IPCC's 4th Assessment Report Global Warming Potential) and from Eskom in the case of electricity (See Appendix 1).

The data analysis disaggregates the cities into sectors: residential, commercial, industrial and transport, according to the premise that energy demand (the where and how energy is consumed) is the basis of local-level energy management and meeting energy service needs of citizens.

City data: Energy-related data collection is becoming increasingly mainstream in municipalities. During 2010–2012 eThekwini collected year-on-year energy data for its Greenhouse Gas Inventories (ETM, 2012). Data for some municipalities could be drawn from their respective State of Energy Reports.

Electricity: In a municipal area, electricity is distributed to customers either directly by Eskom or by the municipality who buys electricity from Eskom and may also generate its own electricity for sale. Eskom distribution data is not available to the public and was not available for most municipalities, but (in many cases) municipal officials were able to provide estimates of the electricity supply percentage split between the municipality and Eskom.

Municipalities were able to supply data on total electricity bought from Eskom and total municipal sales broken down by tariff. However, comparisons were difficult because electricity tariff categories and user categories differ across municipalities. Losses can be calculated by considering the difference between electricity purchased from Eskom and the amount sold to consumers. Tariff categories also do not always align neatly with a particular sector. For example, electricity sold to small industrial and large commercial consumers falls under one tariff, while electricity sold to municipal buildings may be captured along with sales to the commercial sector. Where there was uncertainty, municipal officials gave input as to the main sector served by each tariff.

Liquid fuel: Liquid fuels included in this report are petrol, diesel, liquefied petroleum gas (LPG), paraffin, international marine fuels (only for Cape Town and eThekwini), jet fuel, aviation gasoline, and heavy fuel oil. The South African Petroleum Industry Association (SAPIA) used to be official body that collected and held data relating to liquid fuel consumption in the country, but since 2009 this function resides with the national DOE.

Liquid fuel data is collected by magisterial district boundaries, but a municipality may straddle more than one magisterial district. Magisterial district sales were assigned to municipal areas according to the percentage geographic overlay of the two areas. This method does have its limitations, but is the best approximation given the original data source format.[7] SEA has developed this methodology on a nationwide basis for all municipalities.

Sales by fuel type data is available publicly on the DOE's website. However data on sales by trade category require a non-disclosure agreement. Sales by trade category data allows some disaggregation by sector of liquid fuel consumption, enabling a deeper understanding of demand within the sectors, but this level of data was only available for one municipality. In all other municipalities the following assumptions applied:

- All petrol consumption was assigned to the transport sector.
- All diesel consumption was assigned to the transport sector, although an unknown proportion of diesel is used for stationary combustion in the commercial and industrial sectors. Diesel use at Eskom's Ankerlig power plant, based in the Cape Town municipal area, was subtracted from Cape Town's diesel use figure to avoid double-counting (the fuel is used to generate electricity, which is accounted for in the electricity use data).
- All heavy fuel oil consumption was assigned to the industrial sector.
- Paraffin use was assigned entirely to the residential sector due to the data age and uncertainty about where to apportion the 30% of paraffin not consumed by households: according to a 2003 National Treasury Report (PDC & SCE 2003), households consume over 70% of paraffin.
- LPG consumption was split 25% residential, 25% commercial and 50% industrial use, based on LPG allocations in the Cape Town Long-term Mitigation Scenarios (LTMS) work, which was based on interviews with LPG suppliers. There have been no detailed studies on LPG use in the country. More research is required in the future.
- All jet fuel and aviation gasoline was assigned to the transport sector. Like in the case of Ankerlig, the use of jet fuel at Eskom's Acacia power plant (also situated within the Cape Town municipal boundaries) was subtracted from total jet fuel use.

7 At the time of going to print the magisterial boundary adjustments for Polokwane had not been integrated into this report.

Transport: Transport by mode analysis was excluded from the report because of the lack of available data. Data on the main mode of transport per household was collected for the Stats SA Census 2001, but not for the 2011 Census. The National Household Travel Survey (DOT, 2013) does include data on the main mode of transport used for work, medical and study trips, but at the time of analysis this data was not yet available at the municipal level. The availability of disaggregated data relating to different modes within the transport sector is critical in deepening the understanding of energy demand and its link to spatial form.

Coal: Unlike liquid fuel, coal sales are not regulated. Coal consumption data is available at a national level in the DOE's energy balances, but no single data portal exists for local-level coal use. Municipal air quality departments collect data on coal use, as industries need to report polluting fuel use for licensing purposes, but indications are that air quality figures may be lower than actual coal use.[8] Cities with detailed and up-to-date state of energy reports (or GHG inventories) have the most reliable coal data (notably Cape Town and eThekwini), but recent coal data was unavailable for the majority of municipalities. In most cases the latest coal data available was from 2004 and was also used in the 2011 report. Communication with coal suppliers provided some indication of total consumption levels for regions, but was not disaggregated to the local level, and thus was not applicable to this data exercise.

2.3 SOCIO-ECONOMIC DATA

Electrification, Free Basic Electricity (FBE) and housing backlogs: This data was sourced from relevant municipal departments, state of energy reports, municipal annual reports and integrated development plans (IDPs).

Indigent households: Indigent household data was extracted from Stats SA (2011) and grouped into two categories: extreme indigent households (<R400/month) and indigent households (R400–R3200/month). Obtaining a realistic picture of the number of indigent households in municipalities is challenging, as municipalities use different criteria to determine an indigent. This also impacts on the actual number of poor households accessing FBE.

Population: The broad population data (population of each municipality, number of households, unemployment rates) was sourced from Stats SA (2011). Census 2001 data was also used to compare trends.

Density: Density was measured using the whole municipal area, including both the city centre and outlying rural areas. This provides total area population density and not city-specific population density.

Economic data: For the purposes of comparison over time, all gross value added (GVA) values are presented in 2005 South African rand value using Stats SA

8 Personal communication with coal suppliers to Cape Town, February 2015

Consumer Price Indices (CPI). It is very difficult to find a single data source that provides the GVA for all municipalities. To this end, data was sourced from Global Insight, Quantec, Human Sciences Research Council and official municipal reports.

2.4 WAY FORWARD

Despite more accurate and detailed local-level energy data collection and collation, challenges remain. A more uniform and comprehensive manner of data collection and collation needs to be established at municipal level. Such data is critical for supporting local-level energy management and climate response in line with national policies such as the Energy Act and the National Climate Change Response Strategy.

Detailed local-level energy data is critical for providing a picture of what a municipality has been able to achieve in terms of sustainable energy. However, collecting accurate and reliable data usually requires far more capacity than anticipated upfront. Municipal staff are already under enormous capacity constraints and are asked for data from a number of different places, such as national departments and the National Energy Regulator of South Africa (NERSA). Therefore, the following is recommended:

- A more efficient and simpler system for capturing information should be prioritised. This will require setting up a task team to develop a centrally coordinated data collection and collation process and to address the many challenges.
- National, provincial and local government need to address the problem of obtaining reliable data, through better coordination and simplification of local energy data from municipalities, and the development of capacity locally and nationally.
- A more detailed and disaggregated data collection, which will allow for deeper analysis is necessary. This will ultimately affect South Africa's ability to see where energy consumption changes are taking place.

A sound data collection and collation system deepens the understanding of energy demand (and its impact across different sectors) and provides the basis for energy strategy development and action planning in cities. This will enable cities to respond proactively in an era of steeply increasing electricity prices, national electricity supply constraints, oil price increases, and a rapidly changing climate induced by excessive energy consumption.

3

ENERGY PROFILE OF DIFFERENT TYPES OF CITIES

DIFFERENT TYPES OF CITIES DISPLAY DIFFERENT ENERGY CONSUMPTION AND EMISSIONS GENERATION PROFILES.

This chapter presents representative energy demand (consumption) pictures of the different South African city 'types' that form part of this study: a typical metro, a secondary city, an industrialised city and a smaller town. These pictures provide an important overview of the energy consumption and carbon emission profiles across fuel types and sectors, as well as over time for the metros.

The cities in this study consume at least 37%[9] of national energy, making them important drivers of change in South Africa's economy. The data helps to bore down to the issues that lie at the heart of local government's mandate to deliver services to meet basic needs and promote sustainable development. To this end, the collated data and analysis form a key tool for targeted energy planning, strategy and policy development at the local, provincial and national level.

Metropolitan Municipalities	Secondary Cities	Small Towns
Buffalo City	Mbombela	King Sabata Dalindyebo
Cape Town	Polokwane	KwaDukuza
Johannesburg	Rustenburg (industrial)	Saldanha Bay (industrial)
Ekurhuleni	Sol Plaatje	
Tshwane	Steve Tshwete (industrial)	
EThekwini	Drakenstein	
Nelson Mandela Bay	George	
Mangaung		

3.1 TYPICAL METRO

The most concentrated energy consumption occurs in the eight metros, which account for 31% of national energy consumption, 36% of national electricity consumption and 47% of petrol and diesel consumption. Figure 2 gives the typical energy use and emissions (by fuel type and by sector) for a metro, as represented by the City of Johannesburg.

9 The data constraints encountered in acquiring energy data mean that this figure is an underestimate; the actual figure is likely to be close to 50%.

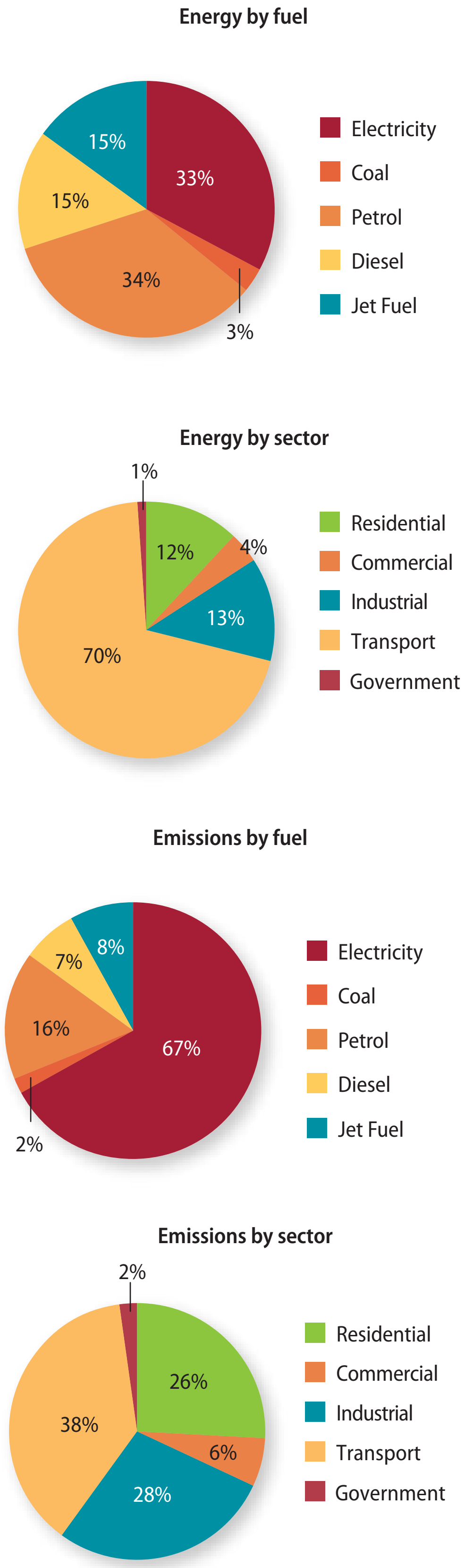


Figure 2: Typical energy use and carbon emissions for a metro (City of Johannesburg)

The **major fuels** consumed in metros are electricity, which is used predominantly for lighting, heating, cooling and cooking, and petrol/diesel, which is mostly used for transport. Diesel is used for freight and passenger transport, as well as for industrial applications (stationary combustion, e.g. generators). Petrol is used almost exclusively for passenger transport (i.e. not freight), largely for private passenger transport (except for minibus taxis, which use a negligible amount).

The **transport sector**, which is made up of passenger, commercial and industrial transportation, generally include liquid fuels such as petrol, non-industrial diesel, aviation gas, international marine fuel and jet fuel. This sector dominates the municipal energy picture, accounting for 60–70% of total energy consumption in metros (Figure 2). This is higher than for other types of municipalities largely because metros may contain substantial airports, a wealthier populace (greater car ownership) and more economic activity (freight). The **residential, commercial and industrial sectors**, whose dominant energy source is electricity, account for the remaining energy consumption of a metro.

When energy use is examined from a **carbon emissions** or climate-change perspective, the picture is somewhat different. Despite substantially higher energy use, the transport sector contributes proportionally less to carbon emissions than the residential (mainly mid- to high-income households), commercial and industrial sectors. This is because carbon emissions per unit of energy consumed is much higher for electricity than for liquid fuels, as electricity is generated from coal-fired power stations using low-grade coal.

South African cities are some of the least dense cities in the world, giving rise to a heavy reliance on transport fuels to ensure mobility of residents and commercial activity. This in turn renders the city vulnerable to oil price increases and accounts for a sizeable economic cost. This data provides important indications of the influence of urban spatial form, urban management and local transport options on energy consumption within metros. Moreover, transport fuels are burnt at the point of consumption (compared to electricity which may be imported), directly affecting a city's air pollution levels and 'liveability'.

3.2 TYPICAL SECONDARY CITY

In sharp contrast to the metros, the seven secondary cities account for only 4% of national energy consumption and 9% of national electricity consumption. The energy picture for secondary cities is not as uniform as for metros, with cities having slightly different energy profiles depending on their size and industries. Figure 3 gives the typical energy use and emissions for a secondary city, as represented by Polokwane.

The **major fuels** typically consumed in a secondary city are electricity, coal, petrol and diesel, with coal representing a higher proportion than in metros. Coal is used largely in the industrial sector, and its consumption produces more emissions per unit of energy than liquid fuel. As a result, the **industrial sector** contributes disproportionately towards carbon emissions. The **transport sector** in secondary cities contributes less (in the range of 40–60%) to energy consumption than in metros (60–70%). This may in part be because secondary cities are more industry-focused, whereas metros have larger finance/service sectors that are less energy intensive.

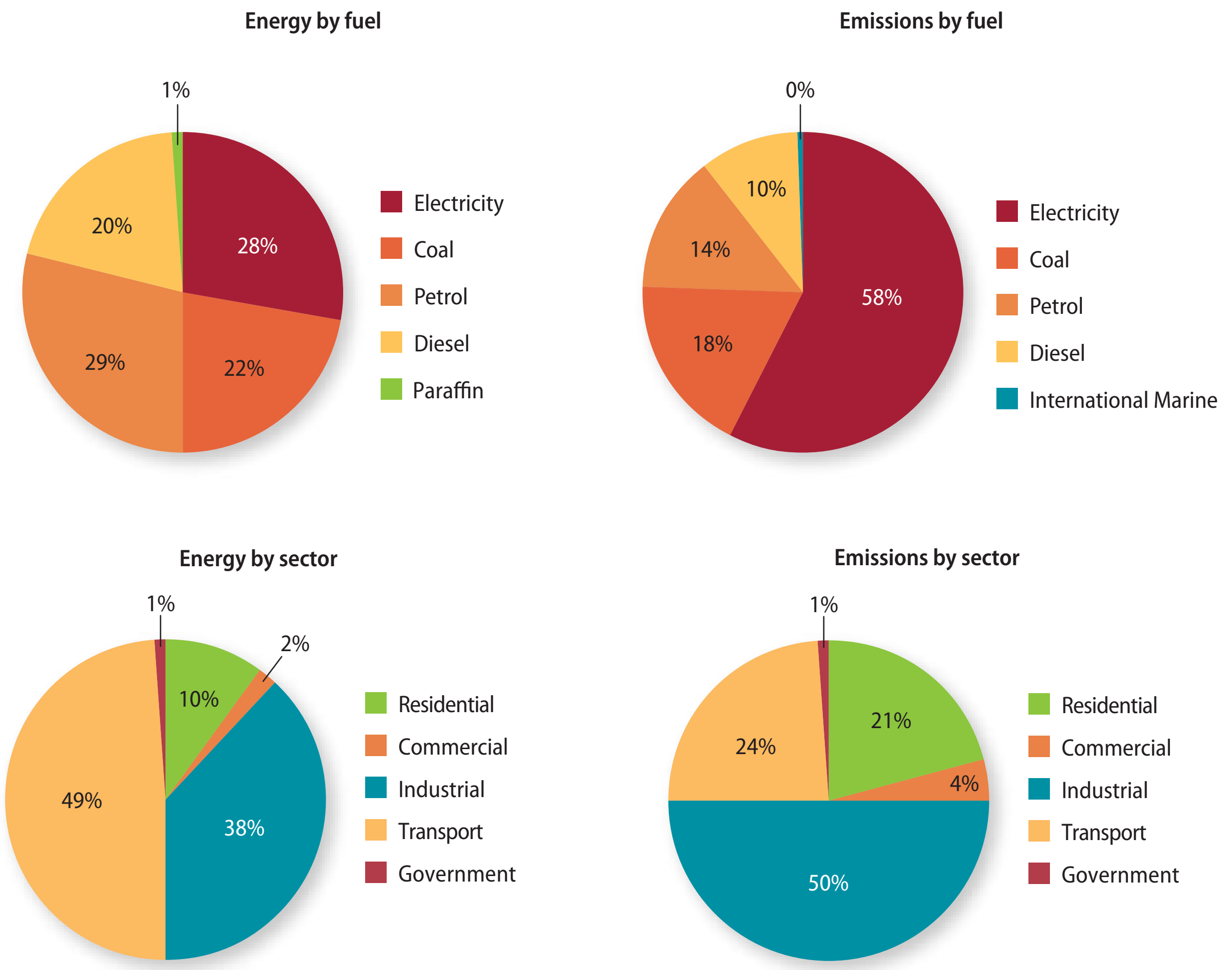


Figure 3: Typical energy and carbon emissions for a secondary city (Polokwane)

3.3 TYPICAL INDUSTRIALISED SECONDARY CITY

The industrial nature of certain municipalities dominates their energy and emissions profile. Figure 4 gives the typical energy use for an industrialised secondary city, as represented by Rustenburg (platinum mining).

The **industrial sector** overshadows the energy consumption and carbon emissions of all other sectors. Industries rely heavily on either electricity (e.g. electric arc furnaces) or coal (e.g. blast furnaces), both energy sources that produce significant emissions per energy unit. Emissions from the industrial sector range between 80–90%, while energy consumed by this sector ranges between 55–90%.

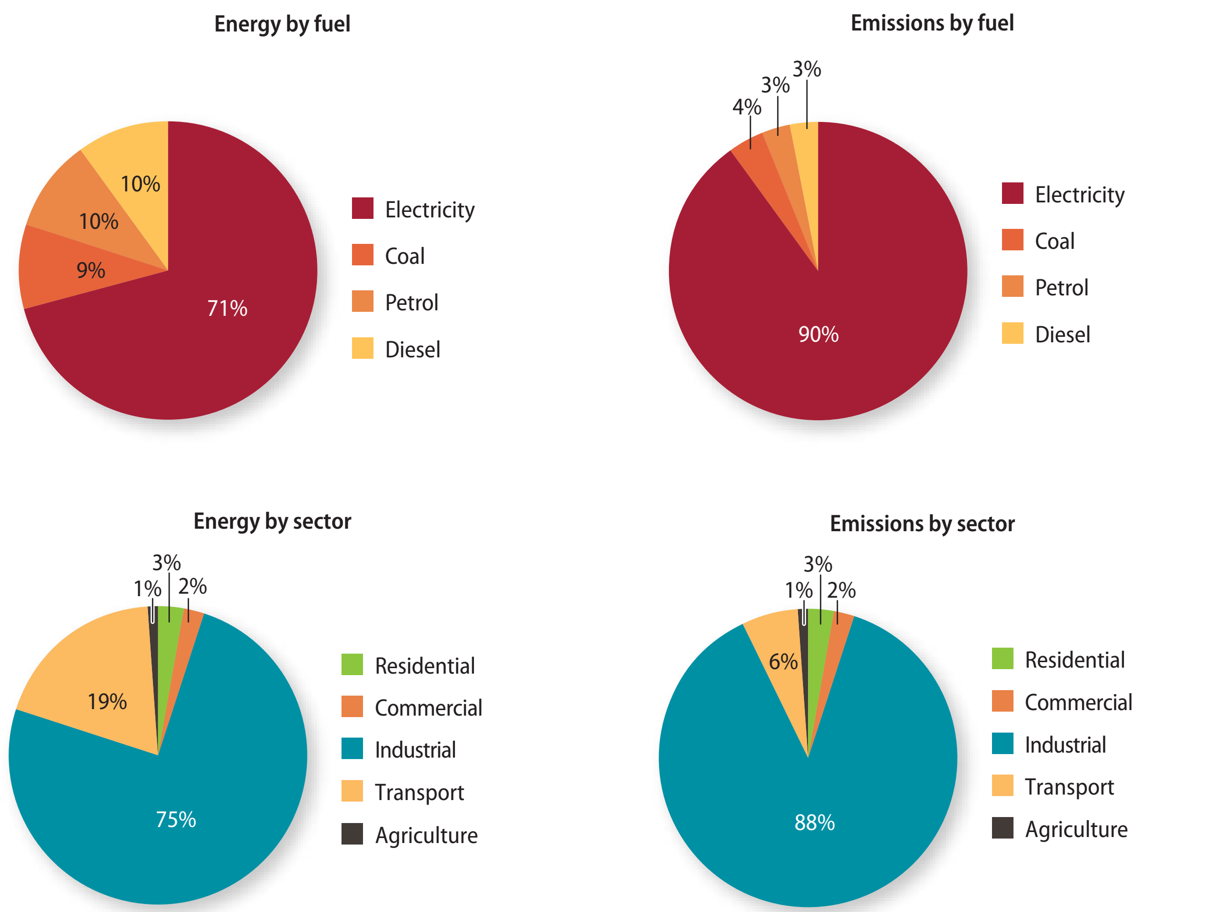
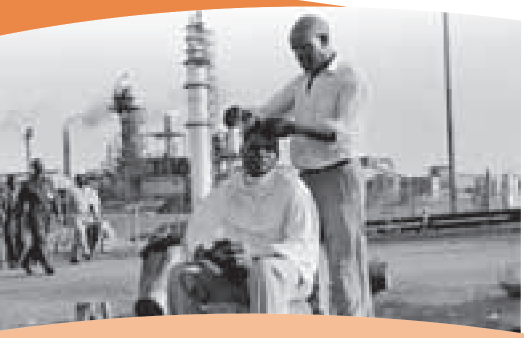


Figure 4: Typical energy and carbon emissions for an industrialised town (Rustenburg)



3.4 TYPICAL SMALL TOWN

The energy picture of smaller, more rural and/or less developed towns is more variable than that found within secondary cities and metros. This is due to a number of factors, including whether the municipality falls within former 'Bantustan' areas created by the Apartheid government (and so its infrastructure is less developed than other municipalities), whether it is largely residential or industrial, and whether it is on a major through-route. If a national highway passes through a small municipality, vehicles tend to stop and fill up for petrol or diesel. This means that the transport sector can sometimes account for a very large amount of energy consumption, greater than in the metros, but the consumption does not necessarily take place in that town. This characteristic is demonstrated very clearly in King Sabata Dalindyebo, which is on one of the busiest transport routes in South Africa (being on the N2 highway), where the transport sector accounts for 74% of total municipal energy consumption (Figure 5).

An industrialised small town will have a very different energy profile to that of other typical municipality 'types' (such as metros, secondary cities and smaller towns). For example, Saldanha Bay municipality has a large steel production industry, resulting in the industrial sector accounting for nearly 90% of municipal energy consumption.

An energy profile of a rural small South African town is illustrated by KwaDukuza, which is located outside of Durban, in the KwaZulu-Natal province. In KwaDukuza, the transport sector accounts for 40% of all energy consumed, followed by the residential (24%), commercial (17%) and industrial (16%) sectors.

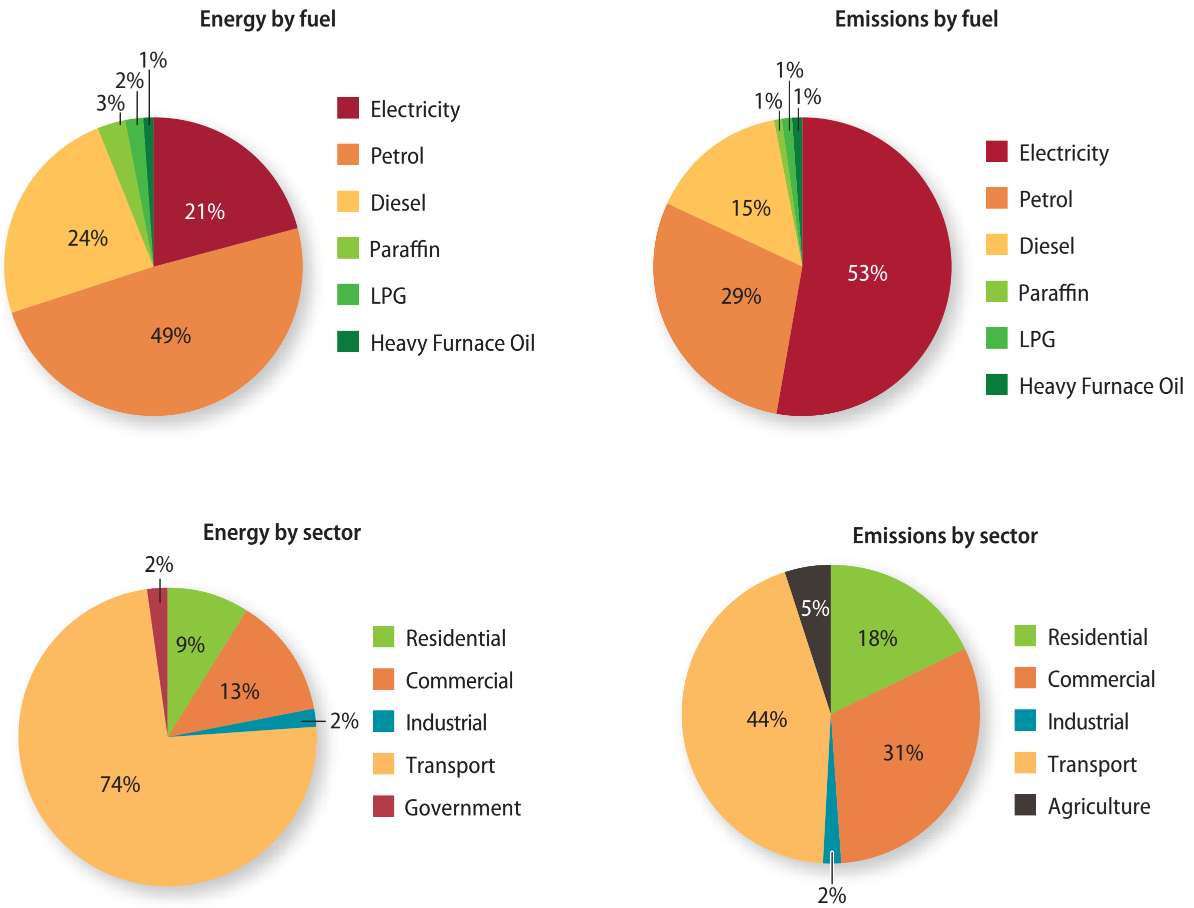


Figure 5: Typical energy and carbon emissions for a small town in South Africa (King Sabata Dalindyebo)



4 UNDERSTANDING CITY ENERGY TRENDS

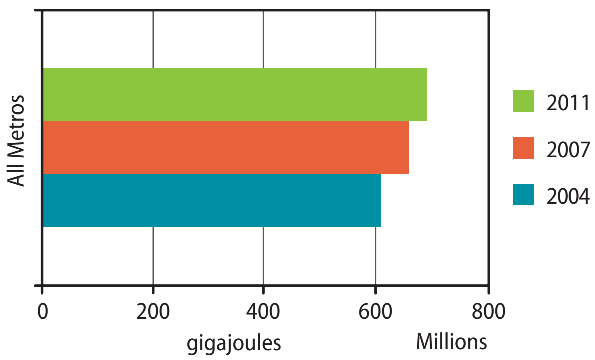
THE CITIES IN THIS REPORT FORM MUCH OF THE 'BACKBONE' OF THE SOUTH AFRICAN ECONOMY AND ACCOUNT FOR OVER A THIRD OF NATIONAL ENERGY CONSUMPTION AND MORE THAN HALF OF THE COUNTRY'S PETROL AND DIESEL CONSUMPTION. THEREFORE, THEIR ROLE IS KEY IN MANAGING NATIONAL ENERGY CONSUMPTION AND GREENHOUSE GAS (GHG) EMISSIONS.

Fossil fuels dominate the energy consumed, i.e. electricity generated primarily from coal, and petrol and diesel for transport produced from oil and coal.[10] This is particularly important for GHG emissions and energy intensity (the amount of energy used for producing goods and services) of urban areas.

To understand the changes over time and to identify trends, this chapter explores the energy consumption of the metros using data from the two earlier State of Energy reports (2006 and 2011) and recent data collected for this report. Metros are used to examine trends, because the best data available over time is for seven of the eight metros: Mangaung Metropolitan Municipality is excluded, because no data was available for the 2011 report.

4.1 ENERGY CONSUMPTION

Over the past decade, total energy consumption in metros has grown steadily (Figure 6), as a consequence of population and economic growth.



Note: excludes aviation and marine fuels

Figure 6: Energy consumption for metros (2004–2011)

This growth is consistent in a developing context, where economic growth is considered synonymous with

10 Sasol coal-to-oil synfuels production

development. Between 2004 and 2011, the metros' population grew by an annual average of 2.9% and their economy[11] by an annual average of 4.2%. Energy consumption also grew as a result of national government's impressive electrification programme, which saw the percentage of households with electricity increase from 36% in 1994 to 87% in 2012.

Total electricity consumption increased between 2004 and 2007 but then decreased between 2007 and 2011 (Figure 7), despite the growth in urban population and households.

Electricity per capita consumption followed a similar trend, with an overall growth of 7.5% for the period 2004–2007, followed by an overall decrease of 10.5% from 2007 to 2011. This is likely a result of the blackouts of 2008 and the steep electricity price increases from 2008 (Figure 8).

The response to price increases in the electricity sector indicates some degree of elasticity of demand, whereby energy needs can be met through alternative means. However, this appears not to be the case for the transport sector, which is the main sector that consumes liquid fuels. Despite sizeable price increases (Figure 9), both petrol and diesel consumption increased at an average

11 Economic growth has been determined by the gross value added (GVA), which is a measure of the value of goods and services produced at the city level.

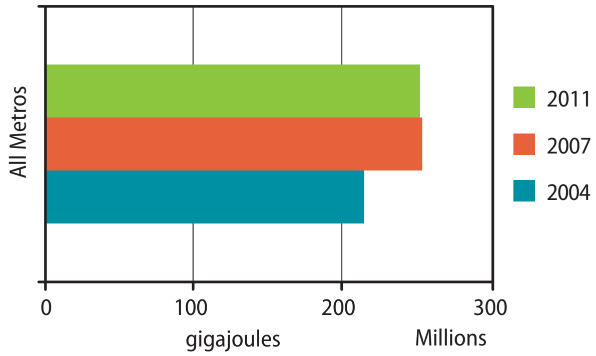
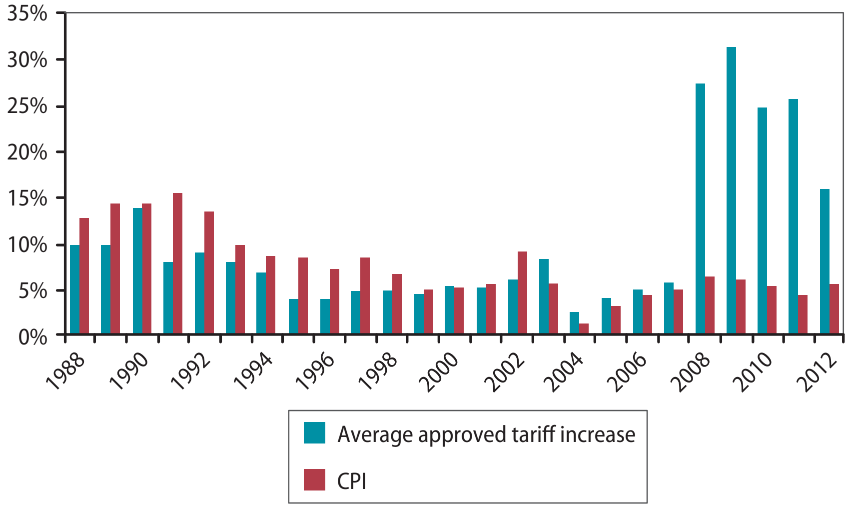
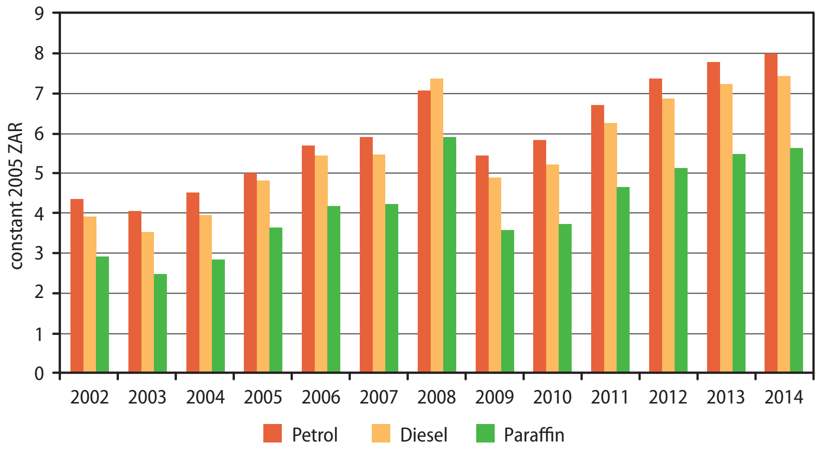


Figure 7: Electricity consumption over time



Source: http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Pages/Tariff_History.aspx

Figure 8: History of electricity tariffs in South Africa (1988–2012)



Source: DOE (2014)

Figure 9: South African liquid fuel prices (ZAR constant 2005/litre) 2002–2014

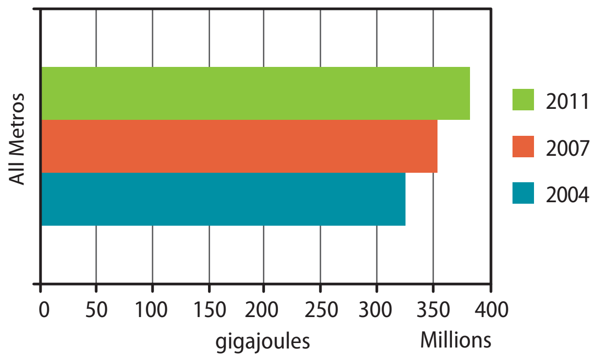
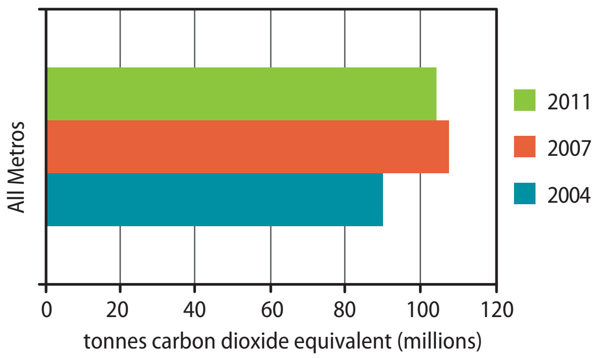
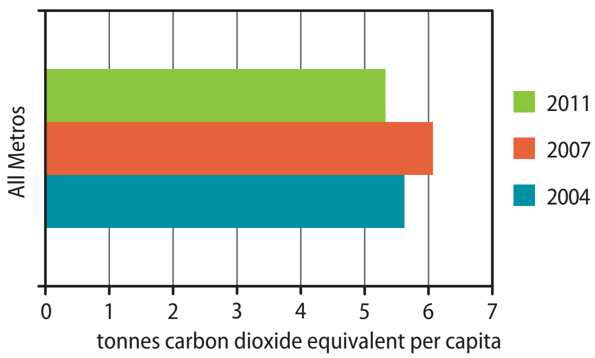


Figure 10: Diesel and petrol consumption (2004–2011)



Note: excludes aviation and marine fuels

Figure 11: Energy-related emissions for metros (2004–2011)



Note: excludes aviation and marine fuels

Figure 12: Energy-related emissions per capita for metros (2004–2011)

annual rate of 2.3% between 2004 and 2011 (Figure 10). However, over the period 2004–2011 per capita consumption of petrol and diesel decreased by 4%, which is possibly explained by the increase in population. According to national data (DOT, 2013), car ownership and passenger fuel consumption increased, which is likely because of the growth in household income.

4.2 ENERGY-RELATED CARBON EMISSIONS

As noted previously, electricity consumption contributes substantially more to GHG emissions than liquid fuel consumption. Between 2004 and 2011, absolute energy consumption increased, but energy-related emissions (Figure 11) and per capita emissions[12] (Figure 12) show an overall decrease. Carbon emissions per capita dropped from 5.6 tonnes carbon dioxide equivalent in 2004 to 5.3 tonnes carbon dioxide equivalent in 2011 (indicating an average annual decrease of 0.8% over the period). The decrease in electricity consumption from 2007 to 2011 would have had a significant influence on this reduction in per capita emissions.

4.3 ENERGY AND THE ECONOMY

Energy intensity is the amount of energy consumed to produce a unit of economic output. If less energy is used to produce a unit of economic output, this could indicate that resources are being used more efficiently. Emission intensity is directly related to energy intensity and is the amount of carbon emissions generated from the use of energy to produce a unit of economic output. This indicator provides a measure of how carbon intensive

12 Emissions per capita is a common global indicator of emission levels for a country or city. For purposes of comparison over time, the figures exclude aviation and international marine fuels, as these were not consistently available for all the metros.

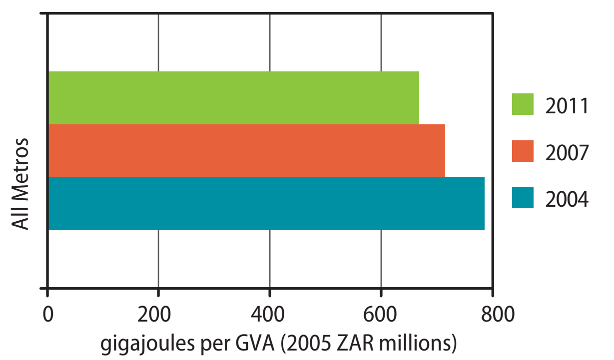
the economy is. Together these indicators provide a perspective on the country's or city's progress in moving towards a low-carbon future.

There appears to have been a slight decoupling[13] of energy from the economy, i.e. economic value is produced from lower levels of energy input into the system. Between 2004 and 2011, the metros' economy grew by an average annual rate of 4.2%, while energy consumption grew by 1.8% (Figure 13). At a national level, energy consumption declined by an average annual rate of 0.1%, while the economic value contribution grew by an average annual increase of 3.6%. Such decoupling, although slight, is a common global phenomenon and could reflect the economy's improved resource efficiency.

A slight decoupling of economic growth and emissions is also apparent (Figure 14), which is significant for a developing country. A similar trend is found at the national level, where growth in carbon emissions (average annual growth of 2%) was lower than growth in economic value contribution (average annual increase of 3.6%) during the period 2004–2011.[14]

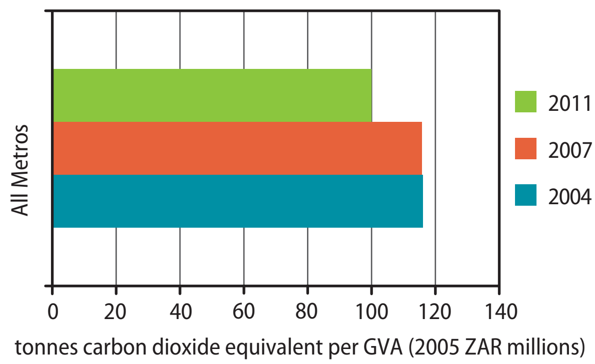
The critical question is to what extent this slight decoupling is due to a systemic shift (in line with the low-carbon and sustainable energy policies at national and local level) or to a temporary shift in response to more immediate pressures, such as the national electricity crisis and associated regular blackouts in 2008 and 2014/15 and steeply increasing electricity prices from 2008 onwards. If this is simply a temporary shift, then once the crisis is over or price increases stabilise, the decoupling could weaken or stop altogether.

Chapters 5 and 6 present some of the developments that have clearly led to more sustainable energy use and lower carbon intensity in cities. While this might not represent a



Note: excludes aviation and marine fuels

Figure 13: Energy consumption per economic output for metros (2004–2011)



Note: excludes aviation and marine fuels

Figure 14: Energy-related emissions per economic output for metros (2004–2011)

13 In economic and environmental fields, decoupling is becoming increasingly used in the context of economic production and environmental quality. When used in this way, it refers to the ability of an economy to grow without corresponding increases in environmental pressure. An economy that is able to sustain GDP growth without having a negative impact on environmental conditions, is said to be decoupled. (http://en.wikipedia.org/wiki/Eco-economic_decoupling)

14 The DEA GHG inventory trends (DEA, 2013) match data trends for this study

solid systemic shift, it does point to significant integral changes happening at the city level, for example:

- Many municipalities are driving energy efficiency within their boundaries, which could contribute to lower energy emissions.
- Small-scale embedded generation (SSEG), mainly rooftop solar photovoltaic (PV) systems, is starting to take root in cities, with some associated reductions in carbon emissions.
- Many municipalities have energy and climate strategies, or have included sustainability aspects into existing transport or other strategies. This has led to the implementation of other sustainable energy initiatives and an associated increase in staff capacity.

In addition, some cities are showing a shift away from the more energy-intensive sectors of manufacturing and industry towards the financial and services sectors, which have relatively low energy intensities.

The energy efficiency and renewable energy interventions implemented in cities (see Chapter 5) are unlikely to account for the bulk of the reduction in energy and emissions intensity. Electricity growth in metros has reversed from a steady increase of around 6% per year (up to 2007) to a decrease of 0.2% per year (from 2007 to 2011). Sustainable energy interventions could only account for a small proportion of this trend. For example, a proactive metro, which has over several years implemented energy efficiency programmes, rolled out solar water heaters (SWHs) and promoted SSEG, may achieve a reduction in average electricity demand of around 1% in total.[15] Therefore, the likelihood is that price increases and the electricity supply crisis have been stronger drivers in this trend.

In tracking energy-related developments within the cities, clearly much promising work is being done that is slowly changing the local energy trajectory. In many cases cities have moved beyond pilot implementation and are mainstreaming more sustainable practices, but in general sustainable energy interventions are not yet occurring on a scale that fundamentally alters the city energy and emissions profile. Therefore, while cities clearly have the power and opportunity to transform the energy profile of the country (indeed the national trajectory cannot be transformed without transforming our cities) and are moving to a sustainable energy trajectory, greater mobilisation at local government level is needed to meet the country's energy-related welfare, carbon and economic sustainability objectives.

15 This estimate is based on an average metro electricity demand of 1800MW and an optimistic average reduction of 17MW from a combination of solar water heaters (12MW), small scale embedded generation PV systems (2MW), and energy efficiency programmes (3MW).



5 SUSTAINABLE ENERGY TRANSITION

SOUTH AFRICA FACES MANY CHALLENGES: THE ECONOMY IS LARGELY ENERGY INEFFICIENT AND RESOURCE INTENSIVE; HUMAN DEVELOPMENT INDICES REMAIN LOW, WHILE INEQUALITY, UNEMPLOYMENT AND JOBLESS GROWTH ARE HIGH.

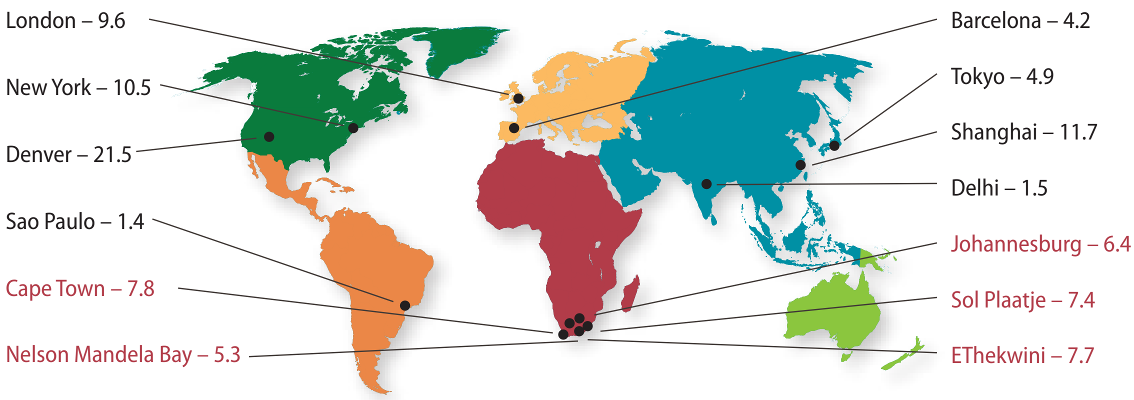
Energy and other resource-use patterns need to be addressed in order to move towards a sustainable, low-carbon and equitable country in a resource-constrained future. This is a mammoth task for a country with an economy dependent on coal for 93% of its electricity, an energy-intensive industrial sector and an energy sector responsible for 82% of total GHG emissions, making South Africa the 12th largest world emitter of GHG (DEA, 2013). Adding to the challenge is the need to address energy poverty, which manifests in the lack of access to affordable, adequate, reliable, safe and environmentally benign energy services (UNDP, 2000; SE4ALL, 2013).

At the same time, economic growth is needed for development, in order to create employment. Traditionally economic growth has implied the increased use of finite resources and increased energy use. However, energy also has the potential to act as an engine of inclusive and sustainable growth.

An urgent and sustained effort is needed to change how resources are used and to move to an economy that is growing but emits substantially lower levels of carbon – all in a very short timeframe. It is increasingly apparent that national government requires strong support from local government to meet national objectives in energy, low-carbon and related environment and economic development targets. This chapter looks at the potential at the city level – the key role that cities have to play, as major energy consumers and source of carbon emissions in the country, and the four areas of intervention that characterise a sustainable city: renewable energy, energy efficiency, mobility and urban form (based on a modal shift to public transport), and energy access and affordability.

5.1 CITIES ARE KEY

The international consensus is that global temperature rise should be kept below 2°C above pre-industrial levels, but many believe this goal is already unachievable, particularly in Africa. In December 2009, President Zuma announced South Africa's commitment (under the Copenhagen Accord) to cut emissions by 34% from business as usual (BAU) by 2020 and by 42% by 2025.



Sources: Kennedy et al. Greenhouse Gas Emission Baselines for Global Cities and Metropolitan Regions (2011); GHG data collection and emissions inventory report 2005/2006 prepared for eThekwini Municipality by ECOSERV (Pty) Ltd (ETM, 2007); Sustainable Energy Africa (2012).

Figure 15: Per capita carbon emissions for some of the global cities

These targets represent a relative, not absolute, decline in emissions and are conditional on international support. The announcement was in line with the Long Term Mitigation Scenarios (LTMS)[16] that outline three scenarios:

(i) growth without constraints,
(ii) business as usual, or current development paths, and
(iii) 'required by science' in order to provide the shift needed to arrest the catastrophic effects of climate change.

Under the third scenario, GHG emissions should plateau by 2020 and decline from 2030, thanks to extensive energy efficiency measures, a split between nuclear and renewable energy production by 2050 and the introduction of a carbon tax.

South Africa's cities demonstrate high carbon emissions per capita relative to their level of development. In metros, the average energy-related emissions is six tonnes of carbon dioxide equivalent per person, which is on a par with cities such as Paris, London or Berlin that have larger populations and higher levels of development (Figure 15). Among the industrial secondary and smaller South African municipalities, heavy industry drives per capita carbon emissions to exceptionally high levels (e.g. Saldanha Bay).

Cities have a critical role to play in transforming the country's carbon profile. As Figures 16, 17, 18 and 19 show, the 18 cities and towns covered in this report account for some 37% of the country's energy consumption,[17] 46% of electricity consumption and 53% of the country's petrol and diesel consumption, as well as 36% of the country's energy-related carbon emissions. This is substantial given that 46% of the total population live in these 18 urban areas, which together occupy only 4.6% of land space.

As mentioned, heavy industry drives per capita emissions to exceptionally high levels in some of the secondary cities and smaller municipalities, for example Steve Tshwete, Rustenburg and Saldana Bay (Figures 20 and 21). Steve Tshwete has a large mining and manufacturing sector, Saldana Bay has an important working port and major steel facility, while Rustenburg is a platinum mining town. However, in other secondary cities and smaller towns, the per capita carbon emissions range between 1–3.6 tonnes of carbon dioxide equivalent (CO_2e), which is relatively low

16 The national LTMS project was endorsed by South Africa's Cabinet in 2008. It models the carbon future for the country and defines the carbon trajectory required by science to align with international climate change targets. It identified electricity supply and energy demand interventions to promote energy efficiency and cleaner energy supply.

17 As noted in earlier chapters, the data constraints encountered in acquiring energy data mean that this figure is an underestimate; the actual figure is likely to be close to 50%.

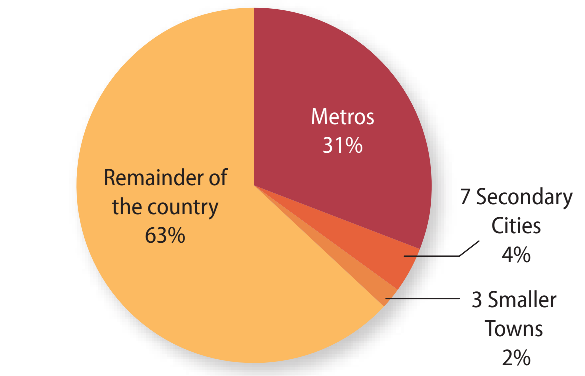


Figure 16: Energy consumption as a share of national (2012)

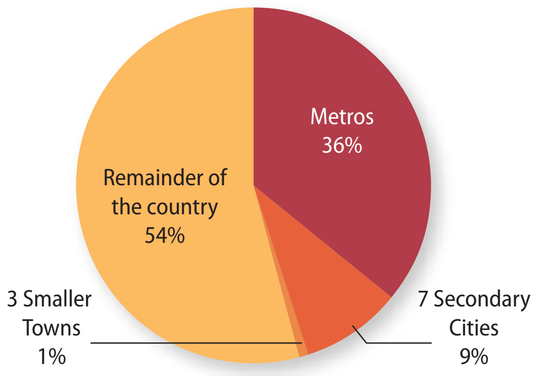


Figure 17: Electricity consumption as a share of national (2012)

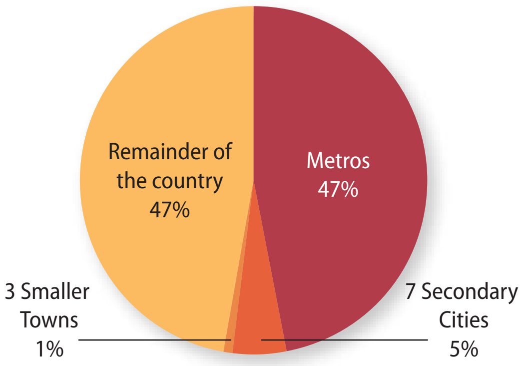


Figure 18: Diesel and petrol consumption as a share of national (2012)

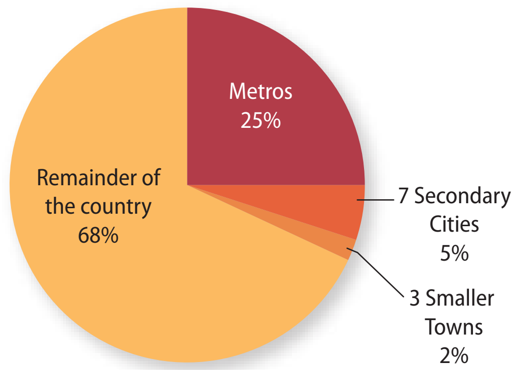
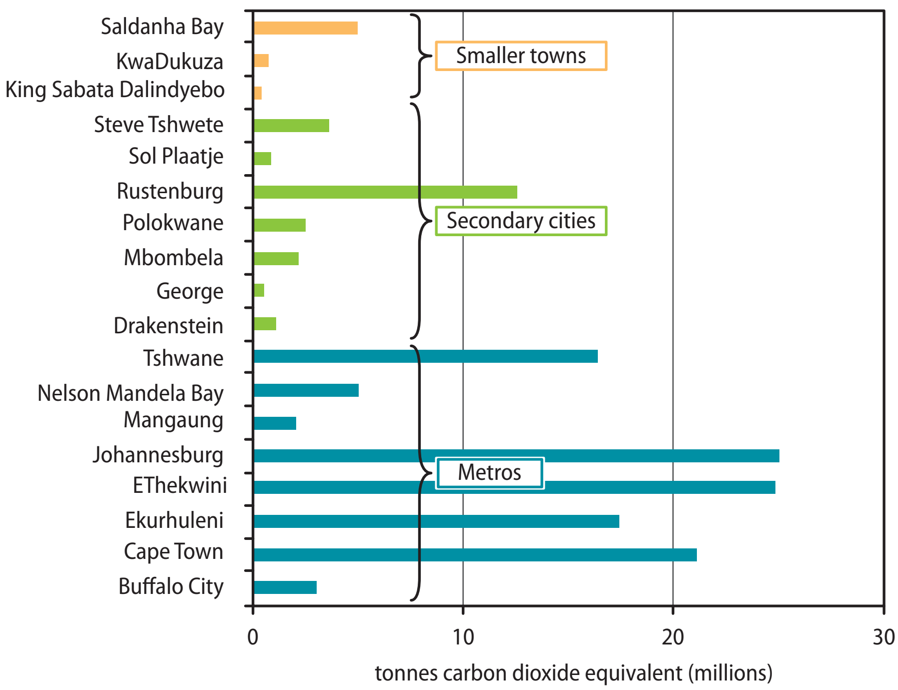


Figure 19: Energy-related emissions as a share of national (2012)



Note: EThekwini appears to have higher emissions than other metros with an international airport (Cape Town and Ekurhuleni), which is probably because eThekwini recently completed a detailed GHG inventory that includes data on marine, aviation and jet fuel emissions, data that may not be captured in the other metros.

Figure 20: Energy-related emissions of the study cities (2012)

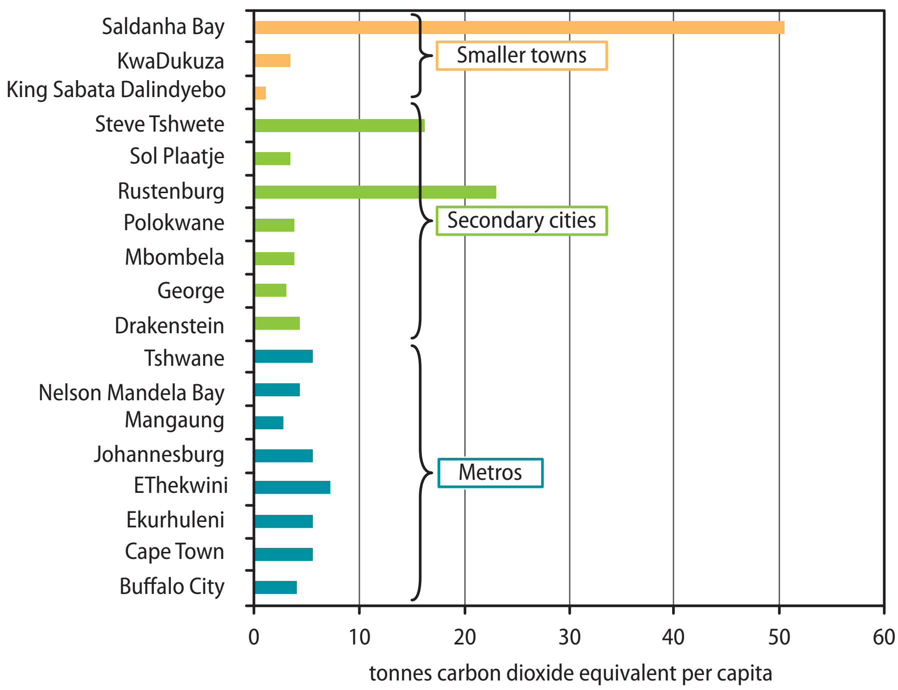


Figure 21: Energy-related emissions per capita in the study cities (2012)

by global standards and closer to the global fair share of two tonnes of CO_2e per person (Stern, 2009). Such a figure may reflect underdevelopment and poverty, but also presents an opportunity to ensure that the required future development supports low-carbon emissions.

Given the predicted urban growth in the coming decades, a unique window of opportunity exists to develop cities according to sustainable planning and development principles, which will reduce carbon emissions. The metros and secondary cities will be important partners in reducing emissions, as illustrated in Figure 22, which maps the trend in per capita emissions (indexed to the year 2000) based on metro data from this study and the national GHG inventory of 2010.

In Figure 22, aviation and marine fuel is included in the national trend but not in the metro trend. The curves are shown relative to the national peak-plateau-decline carbon intentions, which have been reworked to represent the per capita trends (also indexed to the year 2000). It can be seen that, compared to the national trend, the metro per capita emissions and carbon intensity (carbon/GVA) are on the decline. This decline is more likely to be as a result of the steep electricity price increases since 2008 rather than of energy efficiency and renewable energy programmes. However, these efficiency and renewable energy programmes are critical for a sustainable future, and their role is growing fast (in keeping with international trends).

Cities will need to continue to pursue efficient and renewable options, as cities can achieve the 'required by science' carbon trajectory with strong sustainable energy interventions. As Figure 23 shows, the optimum energy future includes efficiency and renewable energy interventions and has a lower cost than Business as Usual. In fact, national government is unlikely to be able to achieve their peak-plateau-decline ambitions without strong support from such forward-thinking cities.

The three main areas of intervention that are necessary for a sustainable city are: (1) energy efficiency, (2) transport efficiency (based on a modal shift to public transport) and (3) renewable energy provision. In particular, both renewable energy options and energy efficiency have to be scaled up significantly. The implementation of efficiency measures generally sits squarely in a city's domain, but (like

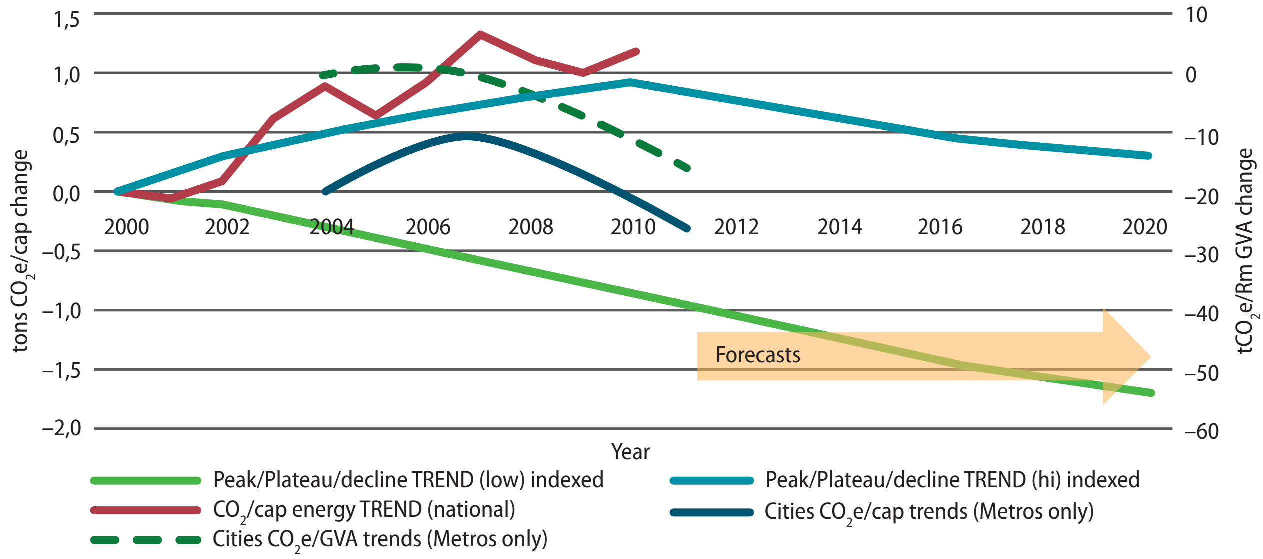
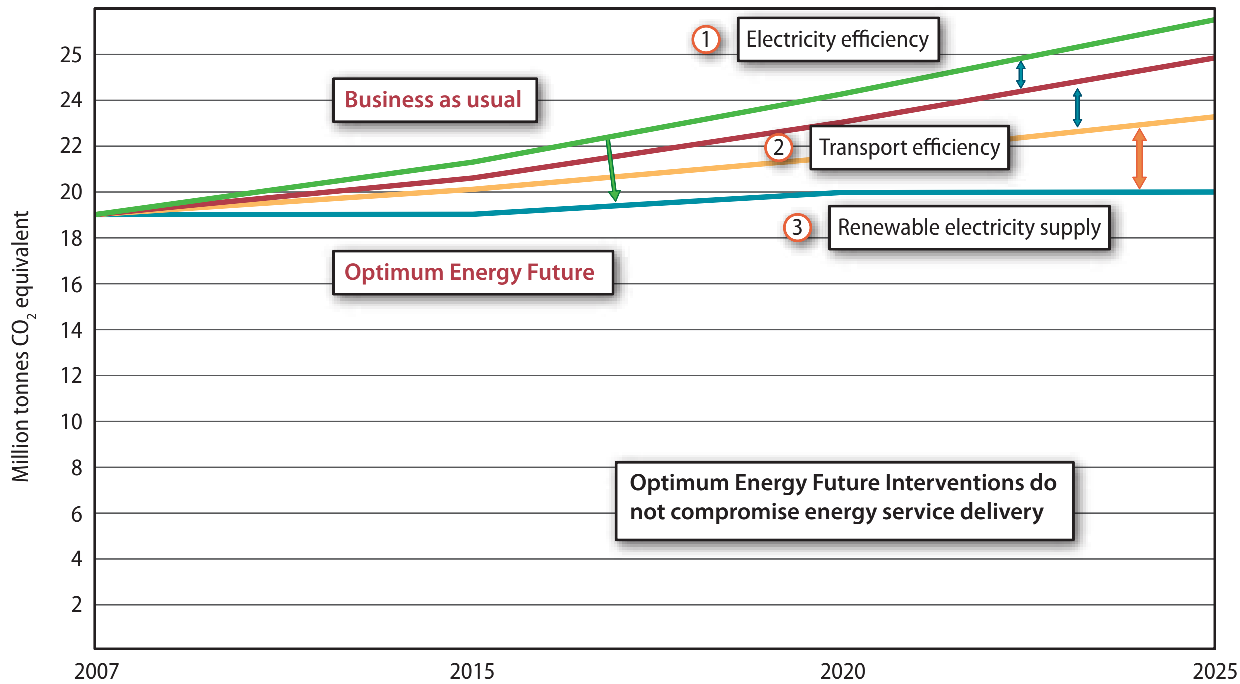


Figure 22: Trends in CO_2 per capita (indexed to 2000)



Source: Annexure B: Technical Report for Energy Scenarios for Cape Town: Exploring the implications of different energy futures for the City of Cape Town up to 2050 by SEA, 2011

Figure 23: Optimum Energy Future

most large supply options) the implementation of large-scale renewable programmes tends to be handled by the national generation system, which is guided by the Integrated Resource Plan (IRP) for Electricity (DOE, 2013b). In the past, cities generated some of their own electricity, and a few municipalities continue to do so (e.g. Johannesburg through the Kelvin power station). However, for large-scale electricity generation, municipalities must apply for a generation license. In light of Eskom's outages, own generation is perhaps a way forward for cities.

Many cities are working on lowering emissions and implementing efficiency measures, yet considerable work needs to be done to further change and cement the shifts in city energy consumption. The implications of **not** pursuing a low-carbon growth path for a city should be reason enough to justify bold leadership decisions in the municipality, in other spheres of government and indeed in all sectors of society. Adopting a Business as Usual approach will have overall negative effects on the city's future economy, society and environment, and are symptoms of an unsustainable approach to city development.

The transition to a low-carbon city must become an imperative for all metros and smaller cities in the country in order to ensure a sustainable future for all. This vision must go beyond short-term municipal budget constraints, immediate consumer wants, and short-sighted political agendas. Interventions aimed at creating more sustainable cities are explored in the following sections of the chapter.

The City of Cape Town and eThekwini are exploring ways of pursuing a low-carbon development path. To this end, SEA undertook energy and emissions scenarios modelling for both metro areas. The findings were:

- Business as Usual scenarios, which include no significant changes from current energy use and growth trends, result in higher energy consumption (by 60–75%) and carbon emissions (by 35–50%) by 2030 when compared to current levels.
- Scenarios that include aggressive energy efficiency measures across all sectors (including the built environment and transport), as well as the rollout of SSEG, result in increased energy consumption (of 25–50%) and emissions (of 10–30%) by 2030.[18] It is interesting to note that these new emissions pathways still fall short of the Cabinet-endorsed peak-plateau-decline emissions path, as set out in the national Long-Term Mitigation Scenarios.

18 It was found that the models are sensitive to economic drivers. This reflects real-world experience when it comes to electricity sales and the economy. In the past, the two have been closely linked. A lack of electricity, due to load-shedding, is having a large negative impact on the national economy currently. This accounts for the wide range in the results.

5.2 RENEWABLE ENERGY

Since democracy, there has been a substantial shift in energy policy in South Africa, influenced also by international climate change imperatives. Historically, the energy sector in South Africa focused almost entirely on the supply side of energy and on energy security, with little attention being given to demand side and sustainability issues – where was energy being used, by whom, for what and how these needs could be met in a manner that would promote social, economic and environmental sustainability.

Sustainability issues began to be brought into government policy with the White Paper on Energy Policy of the Republic of South Africa (DME, 1998) and the National Energy Act (2008). These policies required that the country address energy poverty, energy security, development and environmental issues.

Centralised electricity planning has meant that renewable energy (RE), and in particular RE generation, has generally not been the focus of local government in South Africa. However, this is changing, as a result of the recent international RE price decreases, local electricity price rises, climate change pressures, and the confidence instilled by the national Renewable Energy Independent Power Producer Procurement Programme (REIPPPP 2011), one of the largest in the world.

Although energy use in South Africa's cities continues to be based principally on fossil fuel, with electricity derived mainly from coal-fired power stations, local small-scale RE generation is starting to become financially and technically viable. Thus contributing to low-carbon development and local economic growth and sustainability. In addition, RE provides a potential for job-creation, an important developmental goal for the country (NPC, 2011).

In addition to small-scale embedded generation (SSEG) at the municipal level, municipalities themselves have potential RE resources, including landfill gas, sewage methane and micro-hydro on water distribution systems. Biofuels are also an important component of a low-carbon energy trajectory for urban areas, but the promotion of liquid fuel mix changes largely rests with national government, not local government. These renewable energy options are explored in more detail below.

Small-scale embedded generation (SSEG)

SSEG provides a real opportunity for individual households and companies to generate their own electricity through renewable means. National government has signalled its support for this by relaxing the Electricity Regulation Act of 2007 to allow feed-in into the grid. The cost of installing rooftop PV systems is decreasing, and the cost of the electricity generated from these systems is approaching domestic and commercial electricity tariffs. This has given rise to a burgeoning interest among South African electricity customers to install rooftop PV systems, as a way to reduce their electricity bill and supplement their consumption. As Table 1 shows, the PV installations in South Africa currently have a total peak capacity of approximately 10MW.

Table 1: Photovoltaic installations in progress in South Africa

Project	Location	Province	Capacity (kWp)	When completed
Cronimet Chrome Mining SA (pty) Ltd, Diesel-PV Hybrid	Thabazimbi	Limpopo	1,000	Nov 2012
Belgotex's factory	Pietermaritzburg Natal	KwaZulu-Natal	1,000	2013
Black River Park	Cape Town	Western Cape	700	2013
Eskom Kendal PV (groundmounted, fixed)	Eskom's Kendal coal-fires power station	Mpumalanga	620	Nov 2011
Eskom Lethabo PV (groundmounted, 1-axis tracking)	Eskom's Lethabo coal-fired power station	Free State	575	Nov 2011
Rooibos Storage Facilities	Clanwilliam	Western Cape	511	2014
Ceres Koelkamers	Ceres	Western Cape	505	2013
Vodacome Century City	Cape Town	Western Cape	500	2012
Eskom Rosherville PV Eskom's R&D site	Rosherville	Gauteng	400	2014
Eskom Megawatt Park Carport PV	Sunninghill, Johannesburg	Gauteng	398	Nov 2011
Eskom Megawatt Park Rooftop PV	Sunninghill, Johannesburg	Gauteng	358	Dec 2013
Bosco Factory PV Plant	Edenvale	Gauteng	304	2013
Pick n Pay Distribution Centre	Philippe, Cape town	Western Cape	300	2013
Kriel Mine	Kriel	Mpumulanga	240	Aug 2013
Dube Trade Port	Durban	KwaZulu-Natal	220	2011
Vrede en Lust Wine Farm	Franschoek	Western Cape	218	2013
Novo Packhouse	Paarl	Western Cape	200	Unknown
Leeupan Solar PV project	OR Tambo Precinct, Wattville	Gauteng	200	2012
Pick n Pay Distribution Centre	Longsmeadow, Johannesburg	Gauteng	150	2011
Villera Winefarms	Stellenbosch, Cape Town	Western Cape	132	2011
Standard Bank PV Installation	Kingsmead, Durban	KwaZulu-Natal	105	Unknown
Pick n Pay Store	Hurlingham, Johannesburg	Western Cape	100	2010
Lelifontein Wine Cellar and Grootfontein Admin Offices	Stellenbosch	Western Cape	88	2013

Local government distributors and Eskom have recently initiated frameworks to allow small generators to feed into the grid in a way that is feasible for both the distributor and small-scale generator (largely PV and wind technologies). However, the regulatory system remains unclear regarding the need for licensing of small generators (between 100kW and 1MW).

Municipal electricity distributors are bound by strict regulations to ensure that the distribution grid's power, quality and safety standards are maintained. In the absence of workable frameworks for connecting to the grid, experience has shown that SSEG systems are often installed without official approval. Such installations pose potential safety and quality concerns. Some municipalities are already developing procedures and technical standards with the National Energy Regulator (NERSA) to guide the many applications being received. (See Appendix 2 for the differentiated approaches adopted by municipalities with regard to the integration of SSEG.)

As municipalities begin to explore their role in the wheeling[19] of power between generators and willing buyers (greater than 100kW), they require clear guidance. In particular on how to engage with private renewable energy generators wanting to 'wheel' power through their municipal grids and how to cost the 'rental' of the grid by the seller and buyer, so that the full cost is taken into account without the taxpayer subsidising electricity costs for private entities. NERSA guidelines on this are currently under discussion and development.

The large-scale adoption of SSEG has potentially significant financial impacts on municipal revenue. Under the current local government fiscal framework, municipalities largely rely on local revenue to deliver on their constitutional service delivery mandate. Income from electricity distribution is a key contributor to municipal revenue without which municipalities will not be able to meet their obligations (SALGA, 2011). In order to avert the potential adverse impact on municipal revenue, appropriate tariffs will need to be developed. Initial work around a 'netfit' (net feed-in tariff) model, in which municipalities could be reimbursed for the portion lost through SSEG, is underway (Bowen, 2014).

Over time the effects of SSEG proliferation on municipal electricity revenues will need to be monitored. Given the many different approaches and tariffs in place (see Appendix 2) or waiting approval, tariff setting will largely be a lesson-sharing and lesson-learnt process, thus facilitating a degree of experimentation and innovation, through which best practices will emerge.

19 'Wheeling' refers to the transportation of electric power over transmission lines.

Municipal own renewable energy generation

Municipalities are demonstrating their strong commitment by installing their own RE generation, such as landfill gas, sewage methane and micro-hydro on water distribution systems (Table 2). Several municipalities are looking at the feasibility or the implementation of landfill gas and sewage methane projects. Landfill gas electricity generation has the potential to be an economically feasible supply option. However, experience shows that implementation and ongoing operations are challenging and require thorough investigation before being pursued by individual municipalities. Sewage methane electricity generation is usually for on-site electricity requirement. Micro-hydro installations, sometimes embedded in the water supply network of municipalities, can also be viable in certain circumstances. The eThekwini Municipality has undertaken a feasibility analysis of micro-hydro potential within the municipality's water distribution network.

As Table 2 shows, a number of municipalities are pursuing their own small-scale renewable energy generation:

- *Landfill gas to electricity:* Ekurhuleni has budget allocations for an additional 1MW per year, while the City of Johannesburg has plans for 18MW.
- *Wastewater gas to electricity:* the City of Johannesburg plans to ramp up current production to 4.5MW.
- *PV systems:* Ekurhuleni is issuing a tender for two 150kWp PV systems on municipal buildings, and eThekwini is intending to install around 500kWp in the next two years. Cape Town has installed a 10kWp and 20kWp PV system on its buildings, and is awarding a tender for another 80kWp system. The Gauteng government announced a programme to install an ambitious 500MW of rooftop PV on its buildings, starting in 2013/14, at a cost of around R7-billion. However, due to its size, this project would require approvals from NERSA and local electricity distributors before proceeding. The City of Johannesburg also has rooftop PV plans, but the quantities are unknown at time of publication.
- *Biogas to electricity:* the City of Tshwane expects production at its Bronkhorstpruit facility to come online in early 2015.

Table 2: Municipal (led or supported) local renewable development (MWh/yr), 2005–2017

Municipality and RE project engagement	Year				
	2005	2008	2011	2014	2017 (in pipeline)
City of Cape Town: PPA (wind)			7770	7770	7770
City of Cape Town: rooftop PV				15	135
Ekurhuleni Metro: PV array				350	350
Ekurhuleni Metro: Landfill gas to electricity				7135	21405
Ekurhuleni Metro: rooftop PV				46	46
EThekwini Metro: Landfill gas to electricity		6000	45000	45000	45000
City of Johannesburg: wastewater gas to electricity				2331	4662
City of Johannesburg: landfill gas to electricity					150000
City of Johannesburg: rooftop PV					
Nelson Mandela Bay Metro: wheeling agreement (wind)				5000	5000
City of Tshwane: wheeling agreement (biowaste gas to elec)					35000
Approx. Total MWh/year	**0**	**6000**	**52770**	**67647**	**269368**

Notes: Private rooftop PV has been excluded, but is likely to grow with producers remaining net grid electricity consumers.

Table 3: Renewable energy developments in three metros

Project	Coega wind farm (Nelson Mandela Bay)	Landfill gas to electricity project (City of Johannesburg)	Bronkhorstspruit biogas Project (City of Tshwane
Source of power	Wind power at Coega IDZ	Five landfill sites in Johannesburg	Beefcor feedlot, Bronkhorstspruit
Electricity generation capacity	1.8 MW	18.6 MW	4 MW
Business model	Private RE development supported by a municipal Power Purchase Agreement (PPA) and wheeling agreement	Build, own, operate and transfer model	Private developer, limited recourse finance transaction.[20]
Funding of project	Electrawinds Africa	Municipal budgets	Bio2Watt, Industrial Development Corporation (IDC), and various donor/ funding agencies
Buyer of electricity generated	BHP Billiton headquarters	Eskom	BMW
Type of agreement	PPA between BHP Billiton and Amatola Green Power (AGP), and AGP and Electrawinds'. Coega IDZ has a wheeling agreement with AGP and the municipality.	REIPPPP	PPA via wheeling agreements with City of Tshwane and Eskom
Capital cost/MWh	R28 million	R13.4 million	R27 million
No. of middle-income households that could be powered by electricity generated from the project	833	25 000	5833

20 A limited recourse finance transaction is a debt in which the creditor has limited claims on the loan in the event of default.

Table 3 gives details of RE developments in three metros (Nelson Mandela Bay, City of Johannesburg and City of Tshwane). These examples show the different approaches being adopted, which hopefully will facilitate a degree of experimentation and innovation, through which best practices will emerge.

The way forward

KwaZulu-Natal, the Eastern Cape and the Western Cape have identified a range of small-scale RE projects that could be developed by municipalities and are developing support activities. However, whether municipalities can themselves be Independent Power Producers within the REIPPPP requires clarification and needs to be taken forward by both national and local government.

RE has the potential to form a significant component of local energy supply, and many municipalities have introduced RE interventions. However, as electricity generation is centrally controlled by Eskom, the upscaling of RE technologies requires all parties (government, Eskom and municipal electricity distributors) to develop frameworks and regulations, which will allow small generators to connect to and feed into the grid in a way that is feasible for both the electricity distributor and generator.

5.3 ENERGY EFFICIENCY

It is internationally recognised that saving one unit is cheaper than producing one unit of energy. Energy efficiency is the quickest, cheapest and most direct way of addressing the climate change imperative, high electricity costs and the electricity supply constraints facing the country. The importance of energy efficiency has been highlighted at the global level, by the World Energy Council, and at the national level through various policies, particularly the national Energy Efficiency Strategy (DME, 2005, 2008, 2011) and further reinforced in the State of the Nation Address (The Presidency, 2015).

Energy efficiency has far-reaching benefits in terms of financial savings, economic efficiencies, job creation, reduced demand and (indirectly) lower carbon emissions. Yet, despite these benefits, energy efficiency remains underutilised in South Africa's energy portfolio. This is a combination of the upfront capital costs, which have acted as major barriers, and the anticipated reduced municipal income from electricity sales, as a result of improved electricity efficiency. For municipalities, there is an inherent tension between generating income through electricity sales and being an efficient energy service provider.

As metros are the largest electricity consumers (Figure 24), they should be encouraging energy efficiency, electricity savings and energy switching. The residential, commercial and industrial (built environment) sectors in South African municipalities rely heavily on (coal-based) electricity to meet energy needs and therefore contribute substantially to GHG emissions. South Africa has also had, historically, very cheap electricity, which resulted in entrenched inefficiency in electricity consumption.

Energy efficiency appears to be slowly gaining traction in the country, and the focus here is on efficiency in the electricity sector.

Energy efficiency in municipalities

Municipalities can promote energy efficiency by developing and implementing projects to improve the energy efficiency of their own municipal operations (SACN, 2014). In leading by example, they will motivate the residential, commercial and industrial sectors to follow suit. Municipalities can also save costs by improving the energy efficiency of their facilities and daily operations. Delaying the implementation of energy efficiency improvement due to high upfront costs also carries costs because of continuing high operating costs due to inefficient energy use.

In parallel with national energy efficiency policy development, local government policy and initiatives have advanced considerably. Most cities are undertaking a range of energy efficiency interventions, including public building audits and lighting retrofits. These are financed through the national DOE's Energy Efficiency Demand Side Management (EEDSM) Programme. This programme has been a catalyst for energy efficiency within municipalities, and covers street lights, traffic lighting, building lighting, heating, ventilation and air conditioning systems, and (lately) water pumps in the water and wastewater treatment plants. Some of the larger cities and metros have also undertaken energy efficiency campaigns and established forums to promote implementation.

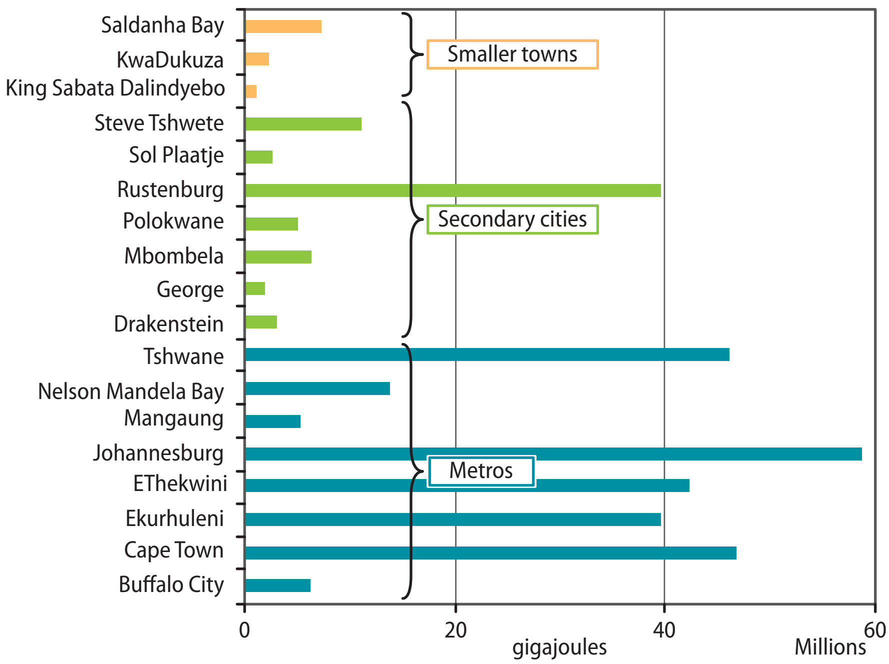


Figure 24: Electricity consumption in study cities (2012)

Local government's own operations may account for only about 2% of total municipal electricity consumption but are a potential gold mine for efficiency implementation (Table 4). Improving the energy efficiency of streetlights, traffic lights, water pumps and buildings can be readily implemented and result in savings. For many municipalities, savings of more than R10-million per year can be made (SACN, 2014), resulting in significant benefit to municipal revenues. Payback times for interventions are also often reasonable.

Table 4: Significant energy efficiency opportunities in municipal operations

Municipality	Sector	Baseline Energy Consumption (GJ/a)	EE measure penetration (%)	Potential Electricity Savings (MWh/a)	Potential Energy Savings (GJ/a)	Carbon Emissions Reduction	Financial Saving (ZAR)
Buffalo City	Buildings & facilities	–	–	–	–	–	–
	Street lighting	19,307	19%	2,084	7,501	R 2 146	R 1 145 976
	Traffic lighting	1,686	100%	–	–	–	–
	Wastewater treatment	21,711	7%	2,078	7,482	R 1 143 062	
	Petrol (ℓ)	–	0%	–	–	–	–
	Diesel (ℓ)	–	–	–	–	–	–
Cape Town	Buildings & facilities	968,682	11%	42,484	152,942	R 43 758	R 23 366 033
	Street lighting	355,134	59%	24,106	86,783	R 24 830	R 13 258 490
	Traffic lighting	42,767	100%	–	–	–	–
	Bulk water supply & wastewater treatement	390,223	0%	51,039	183,742	R 52 570	R 28 071 624
	Petrol (ℓ)	206,256	0%	1,929,881	66,002	R 13 583	R 61 484 548
	Diesel (ℓ)	404,934	0%	3,401,017	129,579		
Ekurhuleni	Buildings & facilities	235,057	10%	10,429	37,544	R 10 738	R 5 733 625
	Street lighting	–	–	–	–	–	–
	Traffic lighting	–	–	–	–	–	–
	Bulk water supply & wastewater treatement	213,096	0%	12,634	45,484	R 13 014	R 6 948 957
	Petrol (ℓ)	366,250	0%	3,426,901	117,200	R 19 862	R 90 996 825
	Diesel (ℓ)	531,293	0%	4,462,306	170,014	–	R –
EThekwini	Buildings & facilities	692,076	10%	30,694	110,498	R 31 614	R 16 881 467
	Street lighting	535,120	23%	47,116	169,618	R 48 529	R 25 913 788
	Traffic lighting	22,430	100%	–	–	–	–
	Bulk water supply	175,55	–	15,445	55,603	–	–
	Wastewater treatment	83,066	0%	–	–	R 15 909	R 8 494 964
	Petrol (ℓ)	152,707	0%	1,428,837	48,866	R 11 203	R 50 419 556
	Diesel (ℓ)	350,380	0%	2,942,825	112,122	–	R –
Johannesburg	Buildings & facilities	103,334	10%	4,835	17,406	R 4 980	R 2 659 029
	Street lighting	22,866	–	–	–	–	–
	Traffic lighting	–	–	–	–	–	–
	Bulk water supply & waste water treatment	1,308	0%	38,700	139,320	R 39 861	R 21 285 000
	Petrol (ℓ)	14,268	0%	133,505	4,566	R 1 174	R 5 252 817
	Diesel (ℓ)	38,333	0%	321,957	12,267	–	–
Mangaung	Buildings & facilities	92,710	10%	4,112	14,803	R 4 325	R 2 261 429
	Street lighting	142,165	20%	–	–	–	–
	Traffic lighting	–	–	–	–	–	–
	Bulk water supply & wastewater treatment	36,473	0%	26,139	94,100	R 26 923	R 14 376 440
	Petrol (ℓ)	30,780	0%	288,000	9,850	R 1 693	R 7 751 040
	Diesel (ℓ)	45,720	0%	384,000	14,630	–	–

Municipality	Sector	Baseline Energy Consumption (GJ/a)	EE measure penetration (%)	Potential Electricity Savings (MWh/a)	Potential Energy Savings (GJ/a)	Carbon Emissions Reduction	Financial Saving (ZAR)
Msunduzi	Buildings & facilities	22,723	10%	1,008	3,629	R 1 038	R 554 266
	Street lighting	4,269	–	–	–	–	–
	Traffic lighting	–	–	–	–	–	–
	Water & wastewater treatment	Umgeni Water	–	–	–	–	–
	Petrol (ℓ)	4	0%	348	12	R 26	R 111 415
	Diesel (ℓ)	1,109	0%	9,315	355	–	–
Nelson Mandela Bay	Buildings & facilities	18,458	10%	819	2,948	R 843	R 450 238
	Street lighting	42,268	20%	4,068	14,646	R 4 190	R2 237 601
	Traffic lighting	–	100%	–	–	–	–
	Bulk water supply	95,144	0%	10,846	39,046	R 11 172	R 5 965 368
	Wasterwater treatment	86,465	–	–	–	–	–
	Petrol (ℓ)	–	–	–	–	–	–
	Diesel (ℓ)	–	–	–	–	–	–
Tswane	Buildings & facilities	173,754	40%	5,137	18,493	R 5 291	R 2 825 530
	Street lighting	32,572	25%	2,860	10,298	R 2 946	R 1 573 267
	Traffic lighting	4,666	37%	1,090	3,924	R 1 122	R 599 229
	Bulk water supply & wastewater treatment	171,662	0%	10,252	36,907	R 10 560	R 5 638 633
	Petrol (ℓ)	75,001	0%	701,762	24,000	R 8 675	R 38 311 331
	Diesel (ℓ)	311,989	0%	2,620,382	99,837	–	–

Source: SACN (2014)

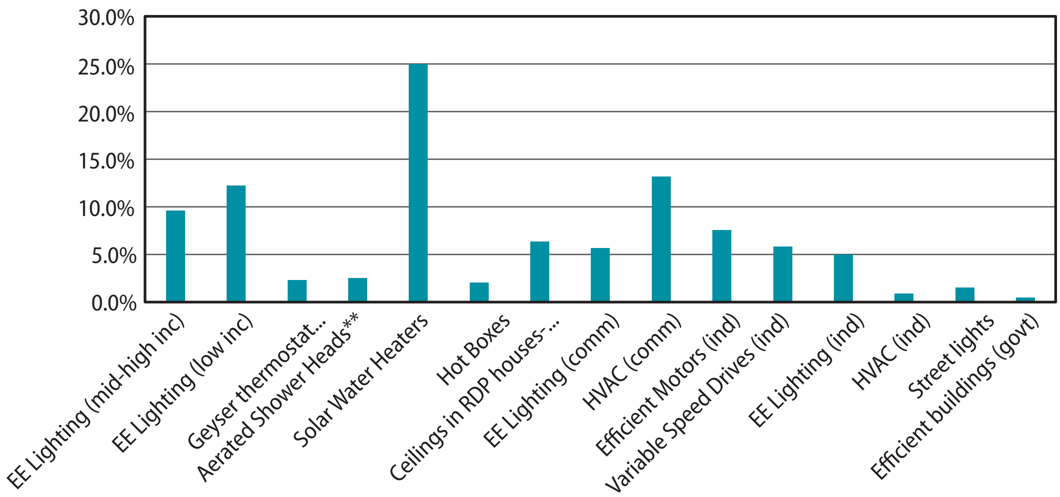
Energy efficiency in residential and commercial sectors

Research[21] and modelling indicates that, for all cities, significant energy efficiency opportunities lie in the residential (mid- to-high-income households) and commercial sectors (SEA, 2014a). As Figure 25 shows, the interventions with the greatest impact – saving 20% on electricity costs – are solar water heaters (SWH) and efficient lighting for the residential sector. Energy efficient water heating, through the use of SWH, is the 'lowest hanging fruit' and can reduce substantially residential energy consumption. However, progress has been slow at the national scale. National government introduced a SWH rebate to promote the uptake within the residential sector, and since 2008, about 85 000 high-pressure SWHs have been installed in mid- to high-income households. Although approximately 330 000 low-pressure units were installed in low-income housing between 2010 and 2012, this is far off government's target of one million SWHs installed by 2014.[22]

The next greatest impact is from heating, ventilation and cooling (HVAC) and lighting for the commercial sector and efficient motors for the industrial sector. Industry energy efficiency opportunities – although more difficult to generalise – are significant, particularly in the more industrial cities.

The way forward

It is essential that the country acknowledges energy efficiency as an important energy resource capable of yielding energy and demand savings. Power outages are expected to continue for the next few years, and so energy efficiency should be vigorously pursued by all tiers of government, industry and private individuals. Many cities are working on lowering emissions and implementing efficiency measures, yet much work is needed to change and cement these shifts and institutionalise efficiency into national and local government processes. The key challenge to achieving greater energy efficiency within all sectors is to take efficiency to scale.



Source: SEA (2014b)

Figure 25: Energy efficiency savings by intervention for a typical metro

21 This draws on over 15 years of peer-reviewed project work conducted by SEA and based on Eskom M&V figures. Most recent calculations presented here are derived from recently completed REEEP-funded project exploring the impact of energy efficiency and renewable energy on municipal revenue.

22 http://www.engineeringnews.co.za/print-version/industry-body-says-transfer-of-solar-geyser-scheme-to-doe-may-spur-recovery-2015-01-09

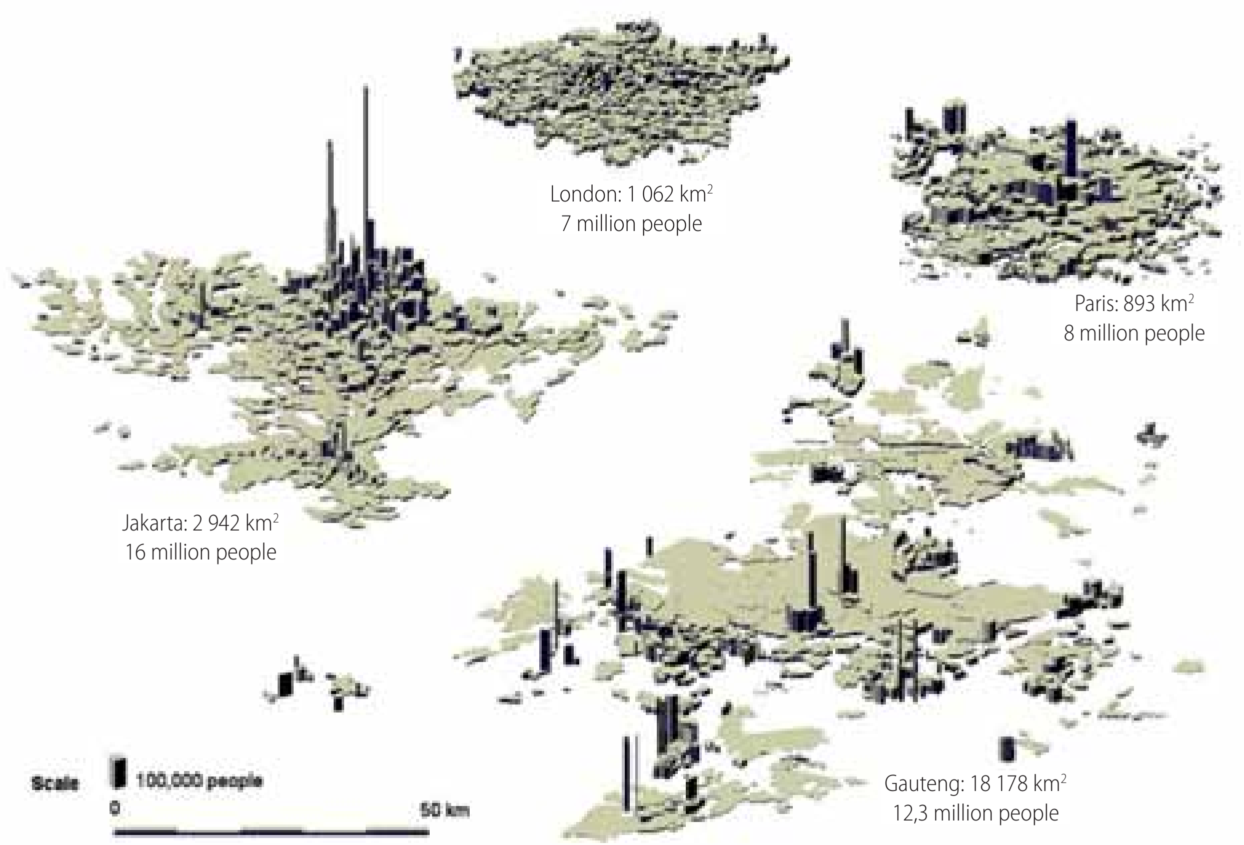
5.4 MOBILITY AND URBAN FORM

The urban spatial form – and its influence on mobility – plays a crucial role in the productivity of city economies and the long-term financial soundness of city governments. It also has a significant influence on the welfare of urban residents, patterns of human interaction, social inclusion and efficient use of resources in a city, particularly transport and distribution of services.

South Africa's sprawling, low-density cities and towns are shaped by the apartheid legacy of racial segregation, poverty and exclusion from social and economic opportunities' (DCOG, 2014a). Since the advent of democracy in 1994, government has invested heavily in low-cost housing and infrastructure. However, these developments have not reversed, but have unintentionally reinforced the apartheid spatial form, as pressure to provide houses and services led to developments on the outskirts of cities, where land is cheaper. Figure 26 compares the spatial distribution of population in Gauteng and three other cities, and clearly shows Gauteng's relatively low density.

A study found that the average car trip in Tshwane is twice as long and the average public transport trip is three times as long, compared to cities such as Moscow, London, Tokyo and Singapore. The low density of the city and 'displaced urbanisation' as a result of apartheid spatial planning explain these findings (SACN, 2011: 58).

Spatial distribution of population in Gauteng (2011 census) compared to Jakarta, London and Paris



Source: DOT (2011)

Figure 26: Spatial distribution of population in Gauteng, Jakarta, London and Paris

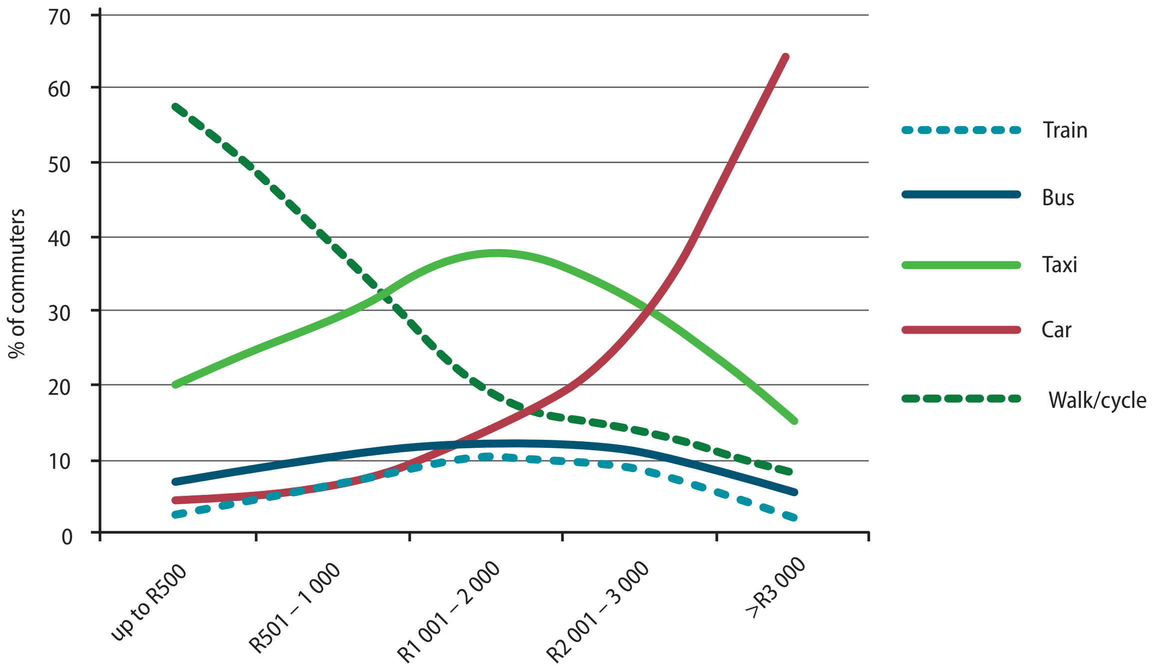
South Africa's cities are therefore energy-inefficient, with high transport energy demands and expenditure, and a widespread dependence on private vehicles. Transport is typically responsible for at least half of South Africa's total energy use in urban areas, and around one-third of urban GHG emissions (SEA, 2015). Together, the 18 cities covered in this report account for over half of national transport fuels.

Historically, transport planning in South Africa was designed largely for private vehicles, following the North American city development model of the past century and a focus on creating western road layouts.[23] Public funding continues to prioritise road transport and is not proportionally supportive of public transport modes (FFC, 2011; DBSA, 2008), despite the fact that majority of poor South Africans depend on public transport/walking (Figure 27); only 26% of South Africans own a car.

Compared to public transport or non-motorised transport (NMT), private vehicles are both resource and space inefficient, as illustrated in Figures 28 and 29.

Private vehicles consume most of the transport energy in metros (Figure 30), and yet passenger numbers are low compared to public transport (Figure 31). This is important in terms of resource use and the spatial configuration of South African cities.

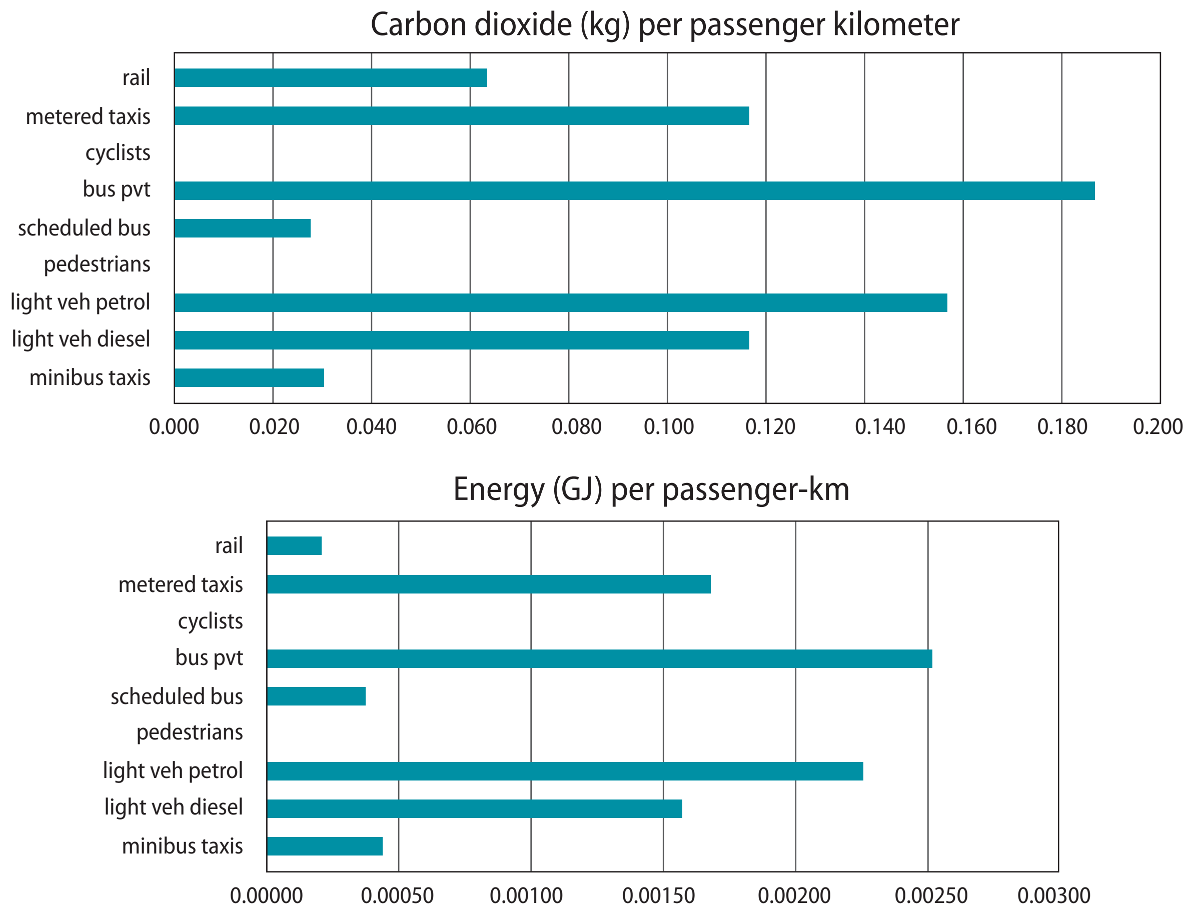
Changing the transport and spatial profile of urban areas is a slow and often expensive undertaking, and achieving modal shifts to public transport is not straightforward (Venter et al., 2013; SACN, 2013). The current trends are not promising: the percentage of urban households that own cars increased to 32.6% in 2013 from 22.9 % in 2003 (Figure 32), with associated urban congestion problems, and spending by households on transport more than doubled between 1995/6 and 2005/6 – from 4% to 10.6% (DOT, 2013, 2014). Shifting usage from private to public transport takes decades of holding a consistent policy trajectory (with associated budget allocations), which often conflicts with short-term political gain. While urban areas have changed their planning approach over the past decade (SEA, 2011), there is still a long way to go to achieve efficient and sustainable urban mobility systems (SACN, 2013).



Source: DOT (2013)

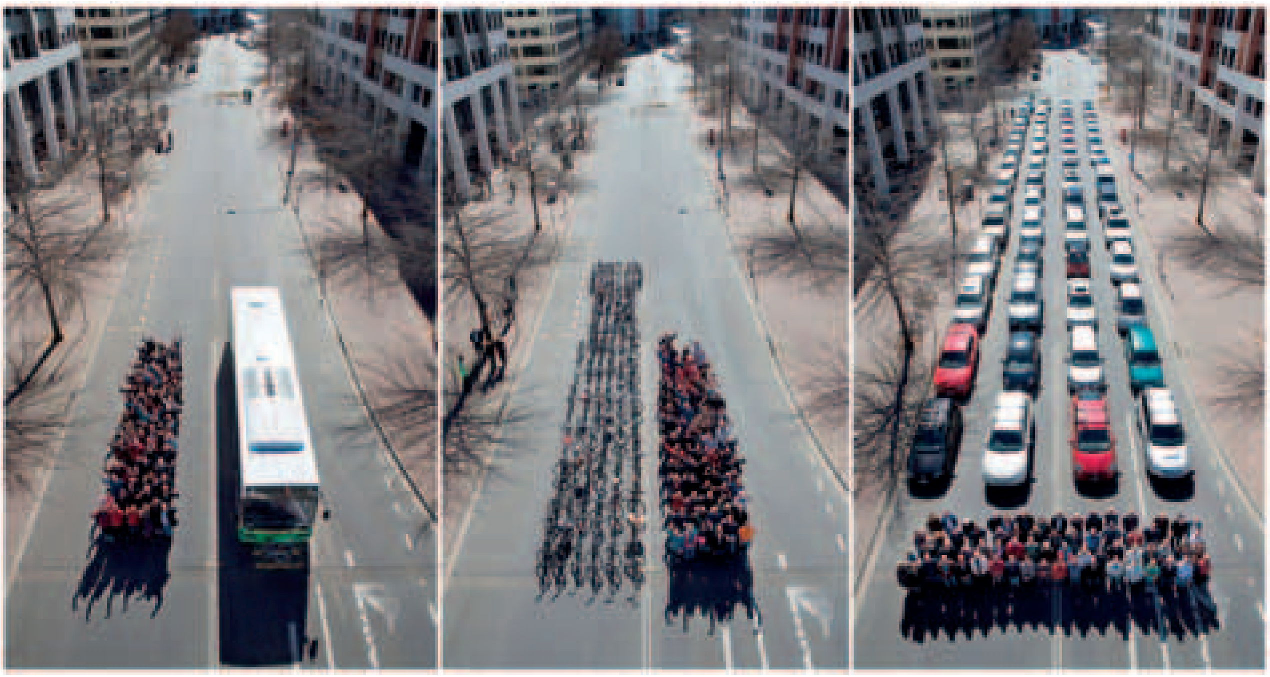
Figure 27: Transport mode by income group

23 L. Kane, presentation at CPD course on Sustainable Urban Energy Development., 2012



Source: SEA, 2014

Figure 28: Typical energy and carbon emissions for different transport options



Source: Cycling Promotion Fund, www.cyclingpromotion.com.au

Figure 29: Space requirements of different transport modes

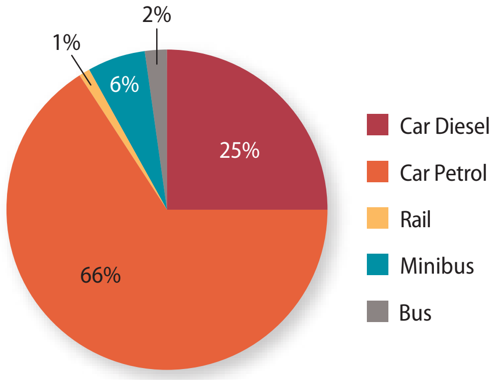


Figure 30: Metro passenger transport (energy consumption)

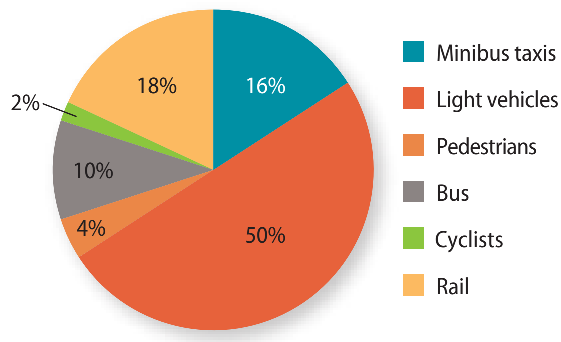
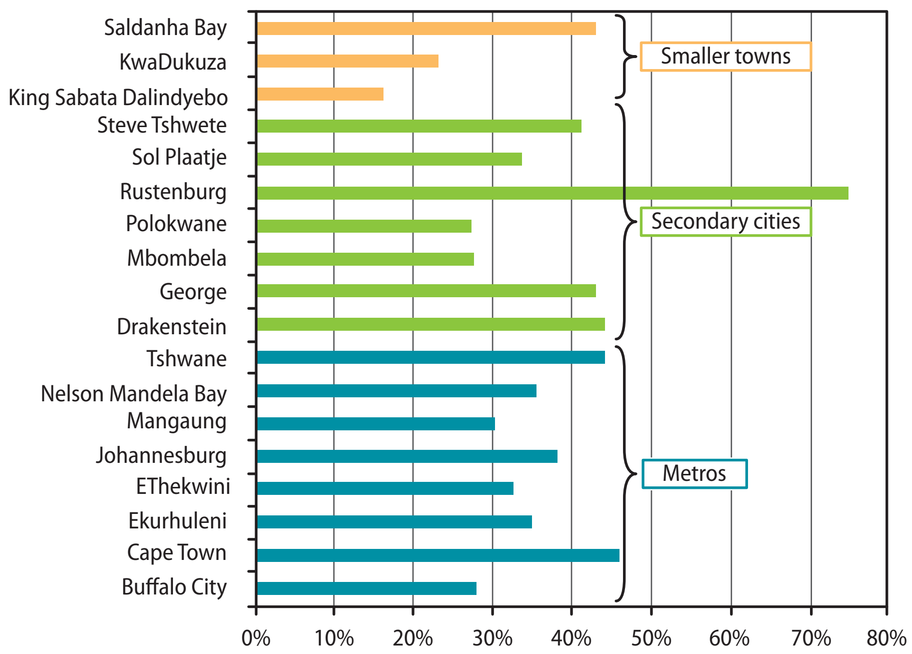


Figure 31: Metro passenger transport (passenger numbers)



Source: Data from DOT (2013)

Figure 32: Car ownership in urban areas

Reasons for the slow shift from private to public transport include the lack of institutional coordination within local government and lack of alignment between local, provincial and national government. Inadequate coordination between local government spatial planners and transport departments has been widespread and still persists in many urban centres (DOT, 2010; SACN, 2013). Furthermore, transport-related mandates are spread across different spheres of government, which makes integrated transport planning difficult and inefficient. For example, urban rail is a national government function, while most bus services are provincially controlled. In addition, different spheres of government are responsible for different categories of roads, even within an urban municipal boundary.

There are clear links between the density of the settlement and the cost of providing public transport. For this reason it is not feasible to develop a decent public transport system in a low-density city. Without decent public transport, energy use and emissions from private vehicles remain high and the poor are not mobile.

Low-density cities involve expensive service provision, with low volumes of rate paying households to support city revenue required to cover service level. The cost per capita of providing services and infrastructure relating to water, electricity connections, sewage and solid waste removal and roads places financial strain on already cash-strapped cities. A spatial form that has not transformed will be prohibitively costly in terms of service delivery. Furthermore, unlike commercial/industrial or mid- to-high-income residential growth, providing services to low-income areas will contribute little to the city revenue base. Therefore, cities will be required to deliver costly services, with relatively less budget.

The spatial status quo, whereby the poor are housed on cheap but poorly located land, has not changed significantly over the past decade. Entrenched land markets, inappropriate political interference and vested interests are influential in retarding urban spatial reform and can trump more democratic intentions. This is reflected in the public participation processes around spatial development frameworks (SDFs), which typically rally strong responses from professionals and ratepayer associations representing the interests of the wealthy, but the voice of the poor is weak.[24]

The Integrated Urban Development Framework (DCOG, 2014a) represents a step towards a rational and coordinated approach to spatial and mobility issues in South Africa's towns and cities. Sustainable transport efforts need to be supported by spatial planning interventions such as urban densification, potentially along corridors (major connecting routes within an area), and the firm holding of appropriate zoning schemes and the urban edge[25] (Wolpe et al., 2012). The larger municipalities all produce integrated transport plans (ITPs) and SDFs, which include corridor densification, infill low-income developments, mixed-use zoning to reduce travel needs and the promotion of integrated public transport.

Sustainable transport seeks to improve (i) efficiency in the transport systems (leading to reduced costs and lower GHG emissions) by moving people from private vehicles to public transport, as well as (ii) the mobility of the poor, thereby improving their welfare, given that poor settlements generally occupy land far from employment opportunities and urban amenities (Maphakela et al., 2013).

Some examples of sustainable transport initiatives

- In Johannesburg, sustainable spatial development is being promoted by mandatory criteria for new developments that lead to improved access to public transport and concentration of development in priority zones and corridors (CoJ, 2008).
- Johannesburg, eThekwini and Cape Town have bus rapid transit (BRT) schemes in place, and a number of other urban areas are planning such interventions.[26]
- Cape Town has a progressive SDF and supportive Densification and Urban Edge policies. However, coordination with transport planning is weak, and political decisions have at times blatantly frustrated the intentions of these documents.
- Several urban areas have introduced 'Park and Ride' facilities around key public transport hubs.
- Gauteng province has the high-speed 'Gautrain' linking Johannesburg, Ekurhuleni and Tshwane.

24 For example of the 1805 registered comments on Cape Town's 2010 SDF, under 4% directly represented the interests of the poor, who could not pay expensive consultants to engage with the SDF as wealthier stakeholders did.

25 Urban edge refers to a demarcation boundary and interrelated policy which serves to manage, direct and control the outer margins of urban expansion of a city or town, relaxed urban edge works against densification (http://carnegie3.org.za/docs/papers/227_Wolpe_Energising%20Urban%20South%20Africa%20-%20poverty,%20sustainability%20and%20future%20cities.pdf)

26 Although it is too early for comprehensive evaluations to have emerged, some observers consider that BRT is inappropriate for all but very specific routes in the largest metros (e.g. Grey and Behrens, 2013).

It is important to note that the minibus taxi industry is the most important form of public transport in the country, carrying 65% of urban passengers to their destinations (Fobosi, 2013). The minibus taxi industry in South Africa arose out of the lack of decent public transport for the poor and experienced huge growth from the mid-1980s to the mid-1990s. Government has instituted regulations to promote safety and has incentivised vehicle efficiency in this industry, but much still needs to be achieved in this area (DOT, 2010).

The way forward

To improve access and mobility in South African cities, the current transport system needs to be transformed, restructured and improved. An effective and affordable public transport system is key to reducing a city's dependence on fossil fuels and lowering the carbon footprint, in addition to having important social benefits. However, the cost of an upgraded public transport system is high, and cities may struggle to find sufficient funds.

Important factors to accelerate change in the mobility and urban form in South African urban areas include:

- Clear holding of principles of densification, mixed use zoning and infill low-income development in SDFs.
- Improved integration of public transport modes in transport planning.
- Improved walkability of destinations to encourage public transport.
- Improved coordination between municipal transport and spatial planning departments.
- Greater political commitment and consistency to spatial transformation, and reduced political interference.
- Rationalised transport planning and implementation mandates between local, provincial and national government, with associated budgetary reallocations.
- Financial support from national government to fund expensive public transport infrastructure.

Addressing these factors is central to urban sustainability because of the important role of transport and spatial systems in promoting the welfare of citizens, improving economic efficiency and moving to an appropriate environmental profile.

5.5 ENERGY ACCESS AND AFFORDABILITY

Households require energy for essential services such as lighting, cooking and space heating. Lack of choice in 'accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services' is the way in which energy poverty manifests itself (UNDP, 2000: 44). Within the urban context, energy poverty is especially prevalent in informal dwellings (households living on formal properties in backyard shacks, often in overcrowded conditions) and informal settlements (usually situated on unproclaimed land not zoned for residential development). Approximately 13.6% of the national population in South Africa live in informal settlements, of which 8% reside in the largest cities (metros) of the country. The majority of informal settlements are situated on the periphery of cities and do not always have formal access to Eskom or municipal distributed electricity. Many of these households therefore use unsafe and dirty fuels, such as candles, paraffin and firewood, to meet their energy needs. These alternatives to formal electricity are harmful and costly, not only to the households but also to the state, through energy-related fires, health burdens and theft. Those that have access to electricity often receive it through illegal connections that sometimes involve private sellers overcharging their customers.

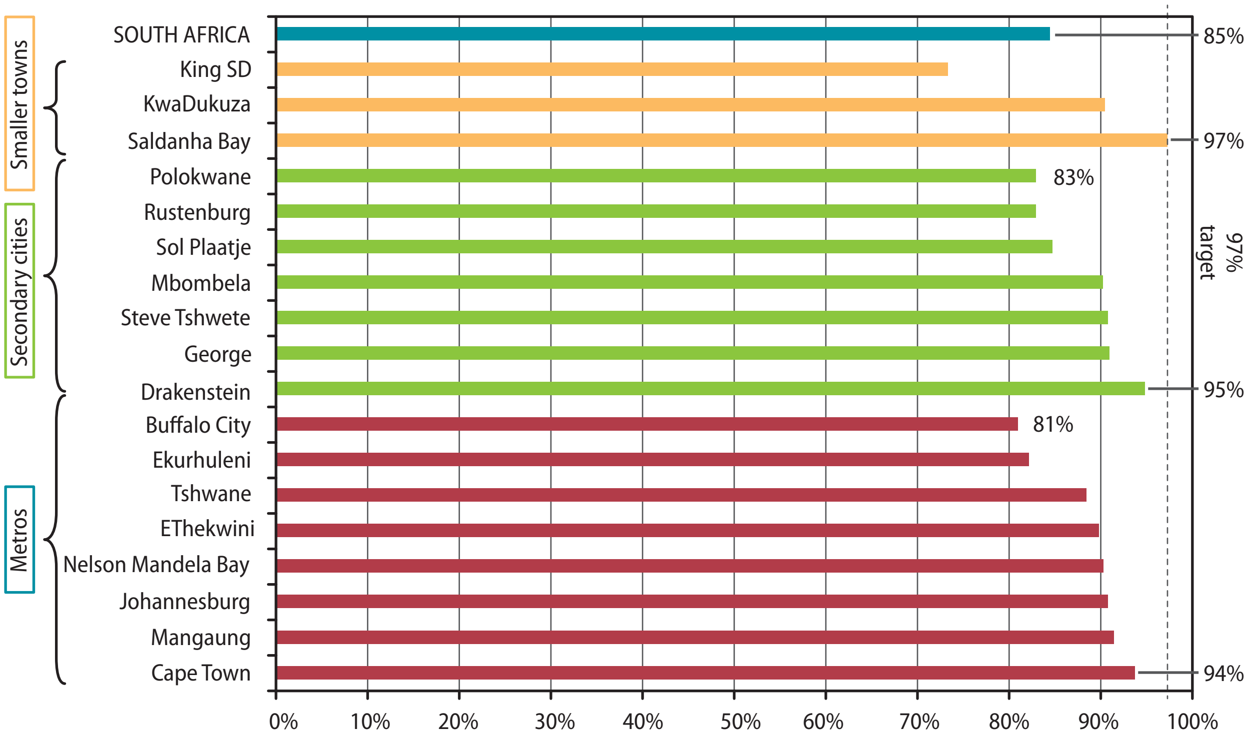
A survey of energy-related behaviour and perceptions in South Africa found that 43% of South Africans are energy poor, as they spend more than 10% of their income on energy needs (DOE, 2013c). Over the last 10 years, household energy use patterns show an increased uptake in electricity particularly for lighting and cooking (Stats SA, 2011). However, despite being electrified, poor households continue to use multiple fuels because of affordability constraints. Almost seven million households continue to rely largely on unsafe, unhealthy with fuels such as paraffin, coal and firewood, when they cannot afford to buy electricity.

Universal electricity access

The United Nations declared 2014–2024 the Decade of Sustainable Energy for All, emphasising the importance of energy for sustainable development and attaining the post-2015 development goals (SE4ALL, 2013). The South African government's target is universal access or sustainable energy access for 97% of all households by 2025 (DOE, 2013b), through grid connections (90%) and high-quality off-grid solar systems (7%).

Between 1994 and 2012, household electrification dramatically increased, from 36% to 87%, or 5.7 million households, mainly in urban centres (DOE, 2013c), a significant milestone for South Africa and unprecedented internationally. In 2011, 85% of South African households had access to electricity for lighting.[27] Figure 33 shows the percentage of households with access to electricity for lighting and how close the 18 towns and cities are to achieving the universal access target of 97%. The percentage of households that still need to be electrified range from 3% (Cape Town) to 24% (King Sabata Dalinyebo).

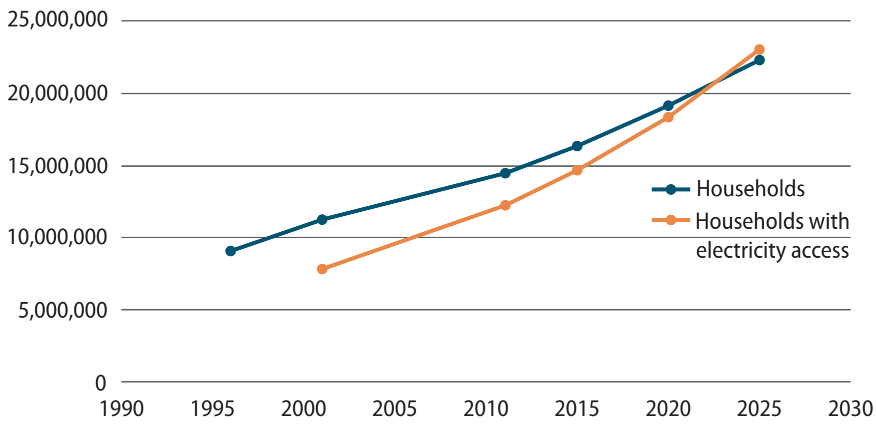
When assessing progress, the starting backlog, average growth in number of households and electrification rates must be taken into consideration. Historically, some municipalities have had a larger electrification and housing backlog than others.



Source: Stats SA (2011)

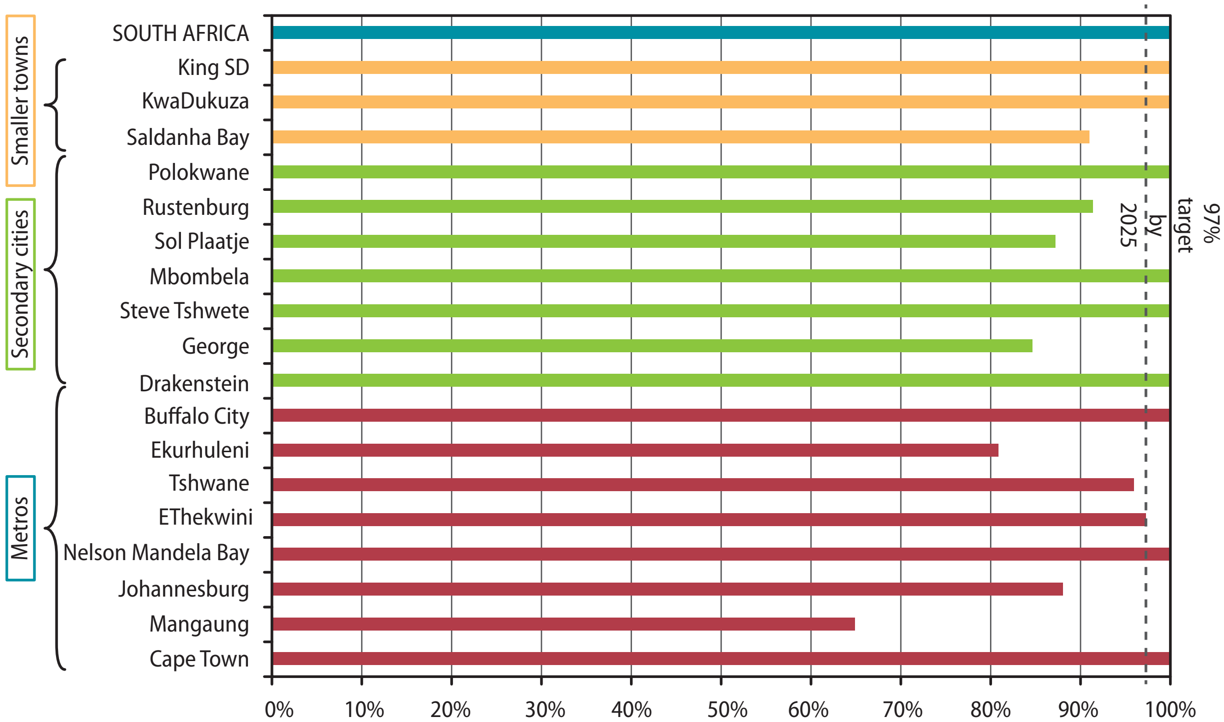
Figure 33: Share of households using electricity for lighting (2011)

27 Lighting is used as a proxy for access to electricity and should not be confused with electrification. Lighting is usually the first thing a household will run on electricity. If a household is using another fuel, such as candles or paraffin, for lighting, it is doubtful that the household is electrified. However, this does not indicate whether a household is electrified legally, as there is usually a disconnect between the 'electrification' figures and electrification backlog data.



Sources: Sustainable Energy Africa; StatsSA Census (1996, 2001, 2011)

Figure 34: Projected growth for South Africa under Business as Usual



Sources: Sustainable Energy Africa; StatsSA Census (1996, 2001, 2011)

Figure 35: Projected electricity access by 2025 under Business as Usual

Figure 34 shows that, if present population growth and electrification rates continue under business as usual (BAU), the universal access target of 97% could be achieved by the year 2021 on average in South Africa.

However, averages can be misleading, as Figure 35 shows. Based on current growth rates, only 10 of the 18 cities included in this report are likely to achieve the 97% universal access target by 2025. This is largely due to population growth outpacing electrification rates and implies that lagging municipalities need to upscale their electrification programmes beyond the household growth rates.

South Africa's approach to energy for all households has two important components: (i) the number of households with an electricity connection, either through the national grid or alternative safe sources such as solar panels; and (ii) the affordability of that electricity for optimal service benefit. Since 1994, huge strides have been made through universal access to electricity, Free Basic Electricity (FBE) and Free Basic Alternative Energy (FBAE).

Free Basic Electricity (FBE)

Subsidising the poor has been an essential part of the government's strategy to promote sustainable development. Government introduced FBE, so poor households can afford electricity for their basic energy needs (e.g. lighting, cooking and cell phone charging) once they are connected. FBE allows indigent households up to 100kWh of free electricity per month.

FBE implementation rates differ widely across municipalities and access to FBE does not reach all indigent households due to different selection criteria used (e.g. based on electricity consumption per month or on voluntary registration of indigent households) and lack of resources in smaller municipalities. In the absence of clear data, this study compares the number of grants delivered by a municipality to the number of indigent households.[28] In all instances the number of indigent households exceeds the number grant recipients, indicating the 'maximum possible' number of indigent households that could be receiving the grant. This is clearly illustrated in Figure 36, which shows the maximum percentage of poor households receiving FBE in the respective study cities. The average 'maximum' number of households receiving the FBE grant is 35% in the metros and 42% in the secondary cities. These low percentages are clearly pointing to a major service delivery failure relating to poverty alleviation.

Free Basic Alternative Energy (FBAE)

In 2007 national government introduced a Free Basic Alternative Energy (i.e. not just electricity) policy, in recognition that FBE excluded non-electrified households and that universal electricity access would not be achieved

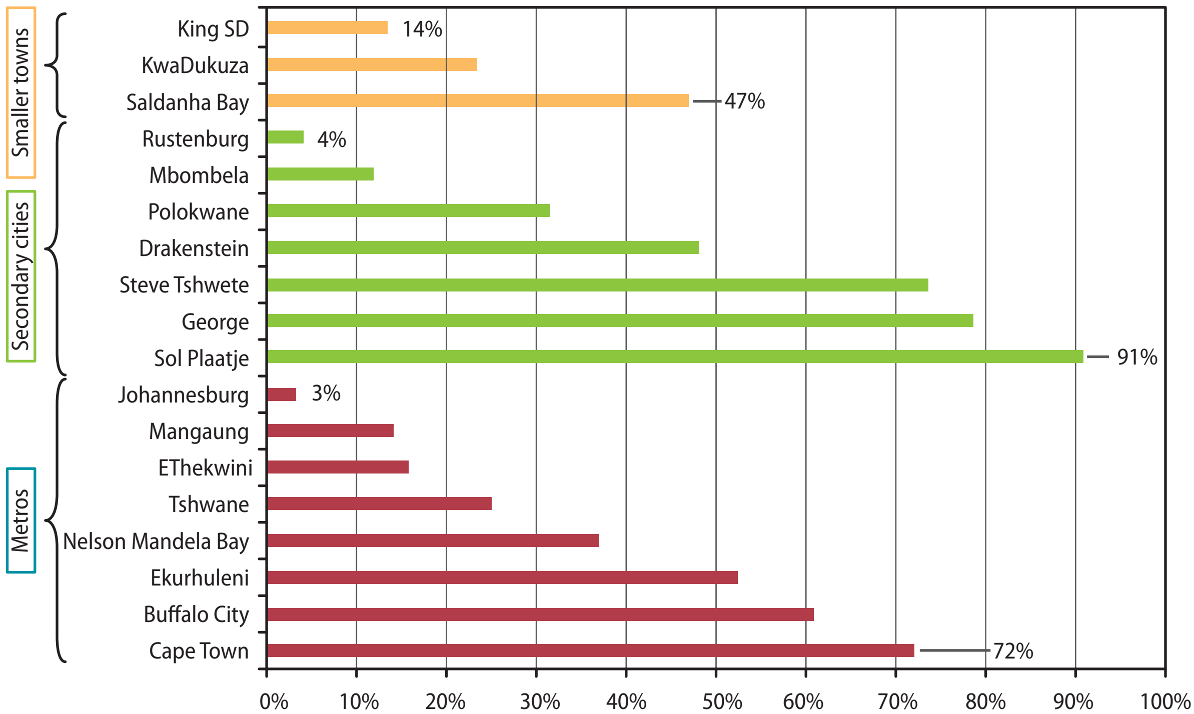


Figure 36: Potential maximum share of indigent households accessing FBE

28 Households receiving less than R3200/month according to StatsSA (2011)

in the near future. The intention was to support indigent households by providing them with the equivalent of R56.29 per month of alternative fuels/technology such as paraffin, LPG and others deemed appropriate by the municipality. To date, the number of households receiving FBAE is small and restricted to rural areas.

Inclining Block Tariff (IBT)

In 2010, the National Energy Regulator of South Africa (NERSA) approved the IBT, which allows for electricity to be billed on a sliding scale of consumption. The intention was to cushion low-income and low-use electrified households from the sharp electricity price increases and encourage efficient use of electricity in high income households. Eskom and only 30% of municipalities have implemented IBT, while the rest continue to use a flat billing system.

The way forward

Government has made enormous inroads in addressing the challenges of urban energy poverty. Since 1994, many progressive pro-poor policies and strategies have been implemented, but two decades later substantial challenges persist in delivering effective energy services to the poor.

A large part of the answer lies in the institutional and governance challenges facing the country. Deepened engagement with civil society and communities about energy poverty and decision-making is also urgently needed, especially as active community participation in municipal affairs and decision-making is a key objective of developmental local government as defined by the Constitution.

What needs to be done to tackle the challenges posed by informal settlements and energy poverty is:

- To build capacity at city level, to improve the implementation efficiencies of electrification programmes and subsidies.
- To undertake research into best practices among municipalities and monitor delivery, to improve FBE and FBAE access to indigent households and establish greater levels of consistency in the targeting approach.
- To integrate informality issues into local and national policy.
- To align the spheres of government for improved coordination

It is acknowledged that a systematic and comprehensive review of policy, implementation and its efficacy will assist in bringing the kinds of transformation and development that the country is working towards.



6

CITY GOVERNANCE AND IMPLEMENTATION

WELL-FUNCTIONING CITIES DO NOT COME ABOUT BY ACCIDENT, BUT REQUIRE GOOD INFRASTRUCTURE AND ENVIRONMENTAL SUSTAINABILITY, AND NEED TO BE INCLUSIVE. TO ACHIEVE THIS REQUIRES QUALITY LEADERSHIP AND MANAGEMENT. IN OTHER WORDS, 'GOOD GOVERNANCE IS AT THE HEART OF THE EFFECTIVE FUNCTIONING OF MUNICIPALITIES' (DCOG, 2014b: 10).

The National Development Plan (NPC, 2012) and the draft Integrated Urban Development Framework (DCOG, 2014a) both talk to the issues of effective governance and strong leadership, the lack of coordination and alignment among the spheres of government and the need for better integration and planning. This chapter explores the governance challenges and successes within the arena of urban sustainable energy development.

Sustainable energy development at the municipal level was first explored in South Africa in the late 1990s, when the White Paper on Energy Policy (1998) and the White Paper on Local Government (1998) were published. Local government was identified as a key platform for redistribution, predominantly through equitable service delivery. This brought about the integration of new energy planning approaches – moving away from focusing only on the supply of energy and considering the energy demand needs from an equitable and environmentally sound perspective. Municipalities no longer simply manage electricity distribution (their historical mandate), but bring sustainable energy development into governance structures. New national policy directions introduced after 1994 required a whole new level of collaboration with local government, as this is where much of the implementation and development must happen. More recently, the external environment is bringing about bottom-up changes from citizenry, such as greater energy efficiency and rooftop PV generation. Thus, local government has to adjust to this systemic shift while coping with the day-to-day pressure to deliver on existing service delivery mandates.

Sustainable energy development is challenging, as it does not speak directly to the immediate needs and priorities of residents. Climate change is not a priority for municipalities or citizens on a day-to-day basis, yet mitigating disastrous levels of climate change is critical for our survival. The economic benefits – through greater efficiency and (in the medium to longer term) cheaper energy sources – are not instantaneous. Therefore, the transition to sustainable energy requires a high degree of leadership, innovation and partnership.

Sustainable energy policy, institutional capacity development and project implementation have grown exponentially in South African cities. However, the excitement of this sizeable shift must be tempered by the often-felt frustration of municipal officials and the still limited impact on the business as usual energy consumption and global emissions. Municipal officials believe strongly that municipalities of all sizes must lead by example in the move towards sustainability and energy efficiency. However, the reality is that without dedicated funding from national government, this type of work is unlikely to be given priority where it matters – in budget allocations.[29] This, surely, is the path of change: messy and contradictory and possessing few short-cuts. The ingredients for change are there: leading municipalities are developing strong political support for sustainable energy and directing capacity (staffing and budget allocations) to this end; diverse experiments and innovations are happening, a space for lessons-sharing is in place; courses and curriculums for new skills and 're-skilling' of current professionals and officials are underway; and partnerships are developing among municipalities, provincial and national government, NGOs, universities and other stakeholders. Nevertheless, much work remains to be done.

Municipalities are large bureaucracies, with complex legal frameworks and systems of accountability, a close interface with citizens and vulnerability to political interference. Systemic change must recognise, work with and address the following challenges:

- Nothing can happen in a municipality without a policy direction or mandate. Data is required to fuel policy development and a process must be undertaken for this to be politically adopted.
- Capacity is required (job descriptions developed, advertised, budget for new positions authorised, applications assessed, interviews undertaken and appointments made) in order to conceptualise new projects, to do the feasibility studies relating to new projects, to develop the business plans and to submit budgets.
- Procurement documentation (with new technical specifications) has to be developed, bid adjudication processes undergone, and contracts for implementation drawn up (often requiring very new approaches that require legal and financial expertise) and managed.
- The impact of new directions and projects must be evaluated. Impacts could introduce risks to municipal revenue or to social development, which would need to be assessed and managed.

Some of the key components of urban governance taking place within the study cities are described below.

6.1 DEVELOPING STRATEGIES AND COLLECTING DATA

During 2000–2003, the first local-level energy data collection and energy strategy was developed in Cape Town. In November 2003, Sustainable Energy Africa (SEA), the South African Cities Network (SACN) and the City of Cape Town successfully hosted the City Energy Strategies Conference.[30] The conference was attended by high-level national and local decision-makers and resulted in the Cities Energy Declaration, which challenged cities to set course on a more sustainable energy path. Since then, an extraordinary expansion of local level data collection and energy strategy development has occurred (Figure 37). South Africa may well be one of the leading countries globally with regard to levels of local level energy data collection, collation and analysis.

29 This statement is made based on the input of municipal officials in the consultation process towards the SALGA-led EE and RE Strategy, undertaken across all nine provinces, as well as inputs made by municipal officials towards a case study on the DOE EEDSM programme.

30 This was done in association with the International Council for Local Environmental Initiatives (ICLEI) and SALGA, and endorsed by UNEP.

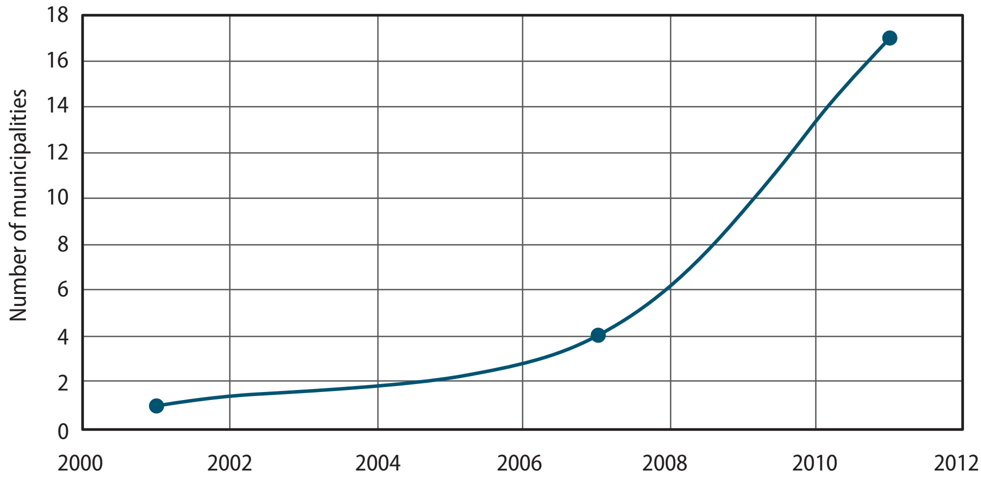


Figure 37: Expansion of energy and climate change mitigation strategies among municipalities (2000–2012)

The pursuit of local level energy data has been vigorous and, each time such work is undertaken, the level of understanding among role-players and of the data sources increases. Despite enormous progress, data collection remains a challenge: many municipalities still do not routinely collect data on electricity consumption within their own facilities and operations, and many do not have the necessary equipment in place.

In 2014, a SALGA-led national Local Government Energy Efficiency and Renewable Energy Strategy was developed. It provides guidance to municipalities and supports coordination among external support organisations (including provincial and national government) and stakeholders. Many of the study cities have also developed their own energy and climate change strategies.

6.2 GROWING CAPACITY AND SHARING LEARNING

Many municipalities have created energy units, located in their electricity or environmental departments, or as a standalone unit, such as the Sustainability Unit in the City of Tshwane. In addition to this dedicated capacity, many metros have two or three interns every year (funded internally or through the national DOE EEDSM programme) or graduate trainees. A number of tertiary institutions offer courses that enable the 'reskilling' of emerging and current urban professionals and municipal officials. For example, since 2008 the UCT Engineering Faculty has run a continuing professional development (CPD) course on urban energy in conjunction with SEA.[31] Figure 38 shows the exponential growth in staff dedicated to sustainable energy management in four leading metros: eThekwini, Cape Town, Ekurhuleni and Tshwane.

The development of sustainable energy projects has also resulted in the building of new capacity in other service delivery departments. In Ekurhuleni, eThekwini and Johannesburg, waste department officials are involved in methane gas harvesting and gas-to-electricity generation initiatives. In Cape Town, public lighting retrofit has drawn in officials from the roads department and led to city-owned building managers being trained in energy management. To manage this type of work, new inter-departmental committees have been established, such as in Polokwane, where a growing group of staff from all relevant departments meet regularly to discuss sustainable energy development.

31 First run through the Sustainability Institute, Stellenbosch University, in 2005.

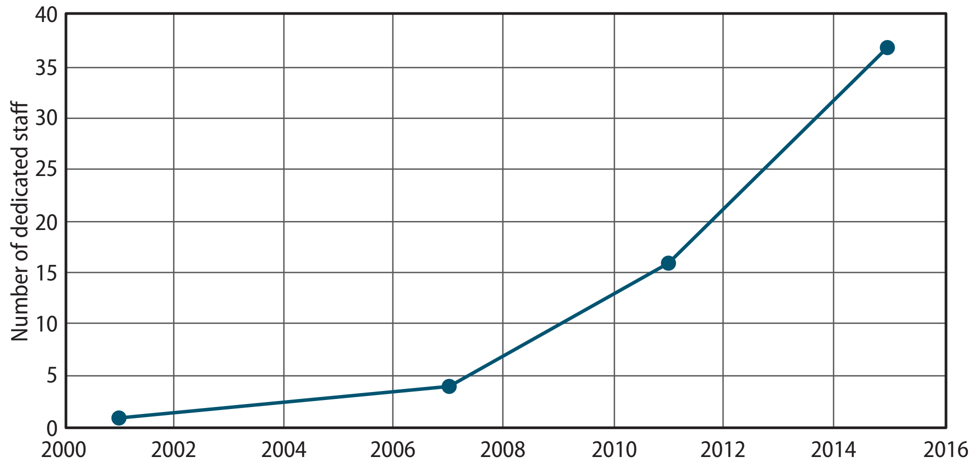


Figure 38: Sustainable energy management capacity in four leading metros (2001–2012)

Nevertheless, in spite of the additional capacity, this work is in addition to existing mandates, creating a burden for many municipal officials. Some confusion about the local government's 'mandate' for urban energy is understandable, as it represents a new approach to all service delivery and brings additional project work. It does not neatly sit in one department, as sustainable energy is not only about electricity but also involves transport, housing, environment, spatial planning, etc.

Since 2003, an urban energy learning network has provided a space for municipal officials to come together and share lessons and information. From an initial grouping of pioneering energy 'drivers' within municipalities, a network within SEA's SEED programme has developed and expanded to include a range of municipalities, a cross-section of departments and a core of closely collaborating partners. Today the space is coordinated by SEA, SALGA and SACN, working closely with ICLEI-Africa.

In 2014, a national website for urban energy issues (www.cityenergy.org.za) was developed and is co-hosted by SEA and SALGA. The site contains a repository of all documents – data, policy, research, guides – relating to urban energy matters and is collated along municipal lines. Municipalities are free to forward all of their documents for uploading, making this an important site of learning exchange and for documenting key developments across all cities and towns.

A number of other forums, through the Association of Municipal Electricity Undertakings (AMEU) and the DOE (particularly relating to the EEDSM programme), also provide important spaces for officials to come together and share their experience.

Universities and NGOs are valuable partners for municipalities. Some examples of partnerships between universities and cities include the African Centre for Cities and the City of Cape Town (climate change research), the University of Johannesburg and Gauteng metros (the Enerkey programme), and the University of Limpopo (Statistical Department) and Polokwane Municipality (household energy research). Universities, such as the University of Pretoria and Cape Peninsula Technikon, have also provided monitoring and verification expertise. NGOs can often bring additional resources through funded projects, such as SEA's ongoing City Energy Support Unit, SALGA's SDC-funded energy efficiency municipal pilot projects and the ICLEI Urban-LEDs project.

Lastly, provinces are important partners for local government. In the Eastern Cape, the provincial government has developed an extensive directory of renewable and energy efficiency projects, while the Western Cape

Government has a comprehensive energy and emissions database, an Energy and Climate Mitigation Strategy and supports selected local municipalities to develop local strategies. Gauteng has an Energy and Climate Strategy and an Energy Office, while KwaZulu-Natal co-hosts a regional, knowledge-sharing Sustainable Energy Forum.

6.3 ENCOURAGING ENERGY EFFICIENCY AND RENEWABLE ENERGY

As seen in Chapter 5, cities are at the forefront of the move to sustainable urban energy. Municipalities are supporting energy efficiency measures, including retrofitting old buildings, encouraging new 'green buildings' and implementing renewable energy projects.

A growing number of municipalities are undertaking their own, internal efficiency retrofits, through the national DOE EEDSM programme, which began in 2009 and is now in its second three-year funding phase. The programme funds the implementation of municipal efficiency measures and has, in response to municipal needs, expanded from public lighting to building and wastewater treatment pump retrofits. Substantial retrofits and related savings have been realised,[32] although no detailed analysis of the cost-benefits has been published.[33] Further savings could be achieved by, for example, replacing outdated and inefficient equipment with energy efficient alternatives. In principle such changes would reduce both the running costs and the carbon footprint of the municipality (thereby meeting both national and local priorities). However, in practice the financial saving is often very small (and only down-the-line) relative to the required human resource capacity and upfront capital outlay. Nevertheless, the programme is extremely important for the country and could benefit from a greater alignment to policy and clear, strategic direction, particularly given the failure (or at best great difficulty) of complex energy service company performance contracting at the municipal level.[34]

The municipal mandate includes building approval and regulation, and so municipalities are responsible for enforcing the new SANS 10400-ZA building regulations, which were passed in 2011 and extended in 2013 to include government-delivered, low-income housing (SABS, 2011). New buildings must comply with the energy efficiency requirements set out in the SANS 204:2008 document. Metros, such as Tshwane, Johannesburg and Cape Town, have taken this further and developed local 'additional' green building guidelines for developments (e.g. City of Johannesburg, 2008).

The regulations resulted in additional work for municipal officials, as the requirements are complex and the key performance indicators include the quantity of plans passed. The response from municipalities to these regulations has been varied: in the City of Cape Town[35] initial resistance from municipal officials gave way to increased job satisfaction and interest; in Polokwane, the building approval officer is adamant that the regulations will be applied to the sizeable public hospital and private developments awaiting approval;[36] in some smaller municipalities the cry is that the requirements require a degree of technical skill for which the staff are not qualified.[37]

32 According to data directly from municipal monitoring and verification reports. However, municipalities also mention that implementation has not been extremely efficient and that the programme may have a relatively high cost per kWh saving. A better understanding of this could greatly enhance policy direction or programme development/ support work.

33 It should be noted that, despite enormous progress, data collection remains a challenge. Many municipalities still do not routinely collect data on electricity consumption within their own facilities and operations, and many do not have necessary equipment in place.

34 The notable failure here was the Clinton Foundation's attempts to procure a large, international ESCO to undertake the retrofit of the City of Johannesburg's major municipal buildings. The City of Cape Town has undertaken performance contracting, however, the contracting model is fairly complex.

35 Roux et al. (2013).

36 Personal communication, Polokwane municipal official, January 2015.

37 Personal communication, Sol Plaatje Municipality, 2013.

The new regulations may require all new buildings to have efficient water heating, but this does not address the issue of existing high-energy-consuming electric geysers. In response, and helped by national government's rebate for solar water heaters (SWHs), some municipalities are promoting SWHs. For example, the City of Cape Town has initiated a SWH endorsement programme, whereby city-endorsed service providers offer installations and financing. This helps overcome householders' concerns about reliable services and high, upfront capital costs. The City of Johannesburg, through City Power, is using electricity revenue to roll out SWHs among low-income communities, as a way of reducing demand during peak times: low-income households without geysers commonly heat water by boiling a kettle, which uses a lot of electricity during peak periods.

Renewable energy is the arena in which most recent developments have taken place. Larger metros have embarked on using their waste (waste water and solid waste) 'assets' for gas-to-electricity projects, and their rooftops for PV development. The motivation behind these projects is not purely economic, but also as a way to develop new skills sets, improve waste management, and provide visible leadership in new, sustainable directions. The acceleration of project development mirrors the acceleration of capacity among municipal officials and service providers to engage in new technologies and business models (Figure 39).

Municipalities are also looking at how to encourage local, private renewable energy projects by developing application guidelines and procedures relating to small-scale embedded generation (SSEG) (less than 100kW). The larger metros have developed procedures and are now accepting SSEG applications and a number of municipalities have been involved in the finalisation of the NERSA NRS 097-2-1 SSEG guidelines. Municipalities are also exploring their role in the wheeling of power between generators and willing buyers (greater than 100kW). NERSA guidelines on this are currently under discussion and development.

Ekurhuleni, eThekwini and Cape Town all have a target of 10–15% renewable energy within the next 10+ years. Ekurhuleni has an ambitious plan to develop 260MW of renewable energy capacity within the metro area. It is interesting that municipalities all have slightly different approaches to local renewable energy development, thus facilitating a degree of experimentation and innovation, through which best practices will emerge.

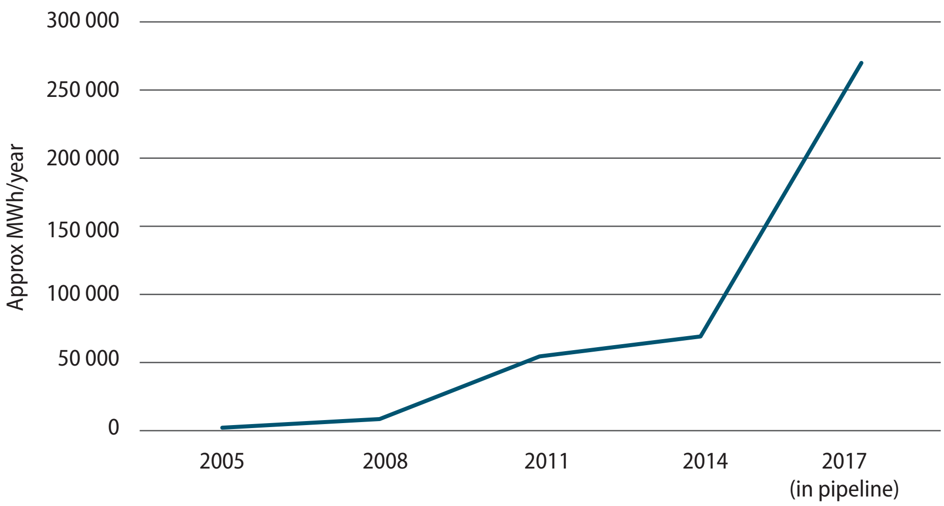
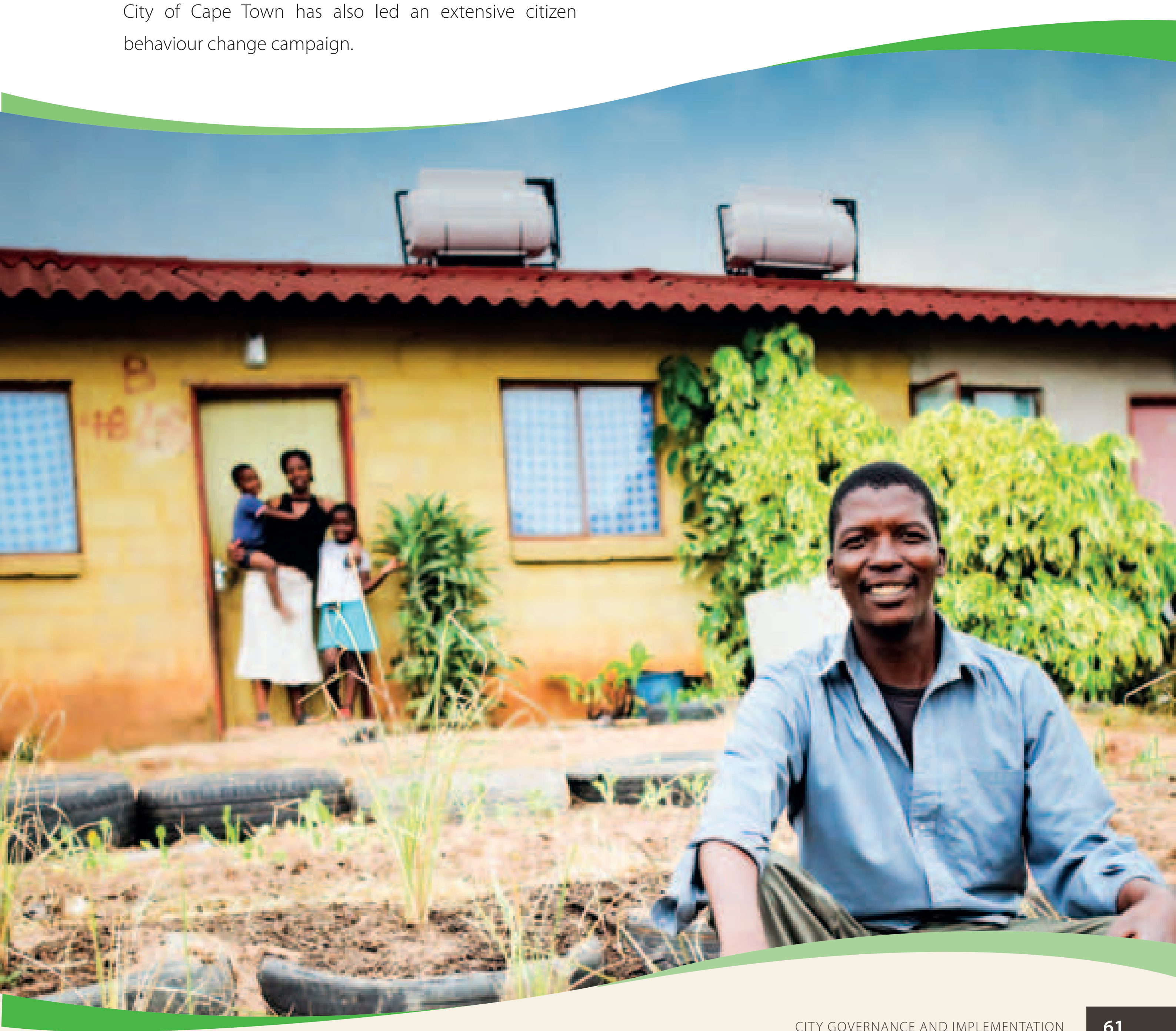


Figure 39: Municipal (led or assisted) local renewable energy development (2005–2017)

6.4 ENGAGING WITH COMMUNITIES

In any municipality, residents and businesses consume most energy. Therefore, to achieve any change in usage patterns, local level energy management must be concerned with citizen engagement and participation. Some innovations made by municipalities include electricity departments liaising closely with their top electricity consuming customers (both through forums and real-time metering technologies) and commercial energy forums (in Cape Town and KwaZulu-Natal) where trust can be developed and information conveyed. The City of Cape Town has also led an extensive citizen behaviour change campaign.

The Joe Slovo national sustainable housing development programme illustrates the importance of community engagement for successful project outcomes. Joe Slovo is one of the sustainable housing developments being pioneered in a number of locations around the country. Led by the national and provincial departments of human settlements, the project demonstrates that more sustainable, 'infill' housing development is possible within existing budgets, provided the monitoring processes are thorough. The benefits for residents are improved quality of life, lower energy and transport costs, greater access to social and economic opportunities and



a lower carbon footprint overall.[38] The lesson is that developers (local, provincial, national, contractors) need to improve their own understanding of household needs, and enable residents to understand, accept and be aware of the benefits of sustainable development. This goes beyond the household electricity safety awareness that accompanies electrification rollout projects.

A major challenge of the next era will be to govern cities and towns that are truly inclusive and sustainable. The City of Johannesburg's 'Corridors of Freedom' initiative is undertaking exactly this sort of radical transformation of urban space. Strategic nodes will be connected by public transport corridors along which will be mixed income housing, schools, offices, community facilities, cultural centres, parks, public squares, clinics and libraries.'[39]

The City of Cape Town is developing a new and exciting policy: an Integrated Household Energy Services Strategy. While the City convenes the policy development process, the policy itself will be the product of a broad stakeholder group. The intention is to look at energy service delivery from a whole-city perspective (the 'sum of ways'), identifying how the collective can improve the delivery of energy services to households, thus moving away from the notion of the city (government) being the only agency empowered to respond to citizen needs.

6.5 THE WAY FORWARD

Enormous expansion in sustainable energy management has taken place within South African metros and is spreading to secondary cities and towns. The indicators show that change is often fairly invisible in the early years but can be exponential. This is a very exciting and dynamic space.

National policy is all too often playing catch-up with local developments. Clarity on many policy issues is vital, for example generation for 'own consumption', regulations relating to grid use and issues/concerns around the privatisation of aspects of distribution. Sustainable energy development can be further enhanced through concerted work from national government to address capacity shortages and potential revenue impacts. Appropriate tariffs need to be developed in order to counter the threat to municipal revenue from efficiency measures and renewable energy development, in particular large scale adoption of SSEG (notably rooftop PV). Research[40] has found that municipalities could see a drop in electricity sales of 10–20% over 10 years, which would affect their income from the sale of electricity. Therefore, national government needs to work with local government to tackle the revenue problem. Funds for staff, and the inclusion of local SSEG into the REIPPPP are some ways through which this could happen.

The next new frontier for this work will be to move the work and approaches from a marginal concept of emissions reduction to the heart of the city's planning engine: squarely promoting an urban infrastructure, economy and form that accelerates integration and access to social and economic resources while ensuring sustainability and developing a local 'green' economy.[41] In support of this, the sustainable energy goals need to be translated (and continually communicated) into what matters for people, what they care about: liveability, children's safety and jobs, which all point to the need for good governance.

38 Sustainable Energy Africa, Joe Slovo, Cape Town: Sustainable Low-Income Settlement Densification in Well-Located Areas

39 City of Johannesburg, Corridors of Freedom (Pienaar, 2014)

40 See Appendix 3 for overview on Report on Municipal Revenue Impact from Energy Efficiency and Renewable Energy (2013–2014).

41 This has been the trajectory of Portland, Oregon. This city, through early engagements with Portland officials, has influenced South African city energy development. It is also the first, and possibly only, city to have reduced GHG emissions to below 1990 levels.

7

CONCLUSION

OVER THE PAST DECADE, URBAN DATA AVAILABILITY HAS IMPROVED, AND CITIES ARE IMPLEMENTING SUSTAINABLE ENERGY INITIATIVES, ALTHOUGH THESE ARE OFTEN IN EARLY STAGES OF DEVELOPMENT.

The energy and emissions profiles of cities have changed slightly for reasons outlined in this report. However, much remains to be done in order to move to a sustainable urban energy profile in support of the national goals of improving welfare, supporting economic activity and reducing carbon emissions to acceptable levels. Challenges include the institutionalising of sustainable energy work in municipal practice, associated capacity development in local government, and greater coordination and support from national government for the local level.

The major cities of South Africa are clearly doing much in the arena of sustainable energy, but further work is required. The 10 trends that have emerged from this report are:

1. Energy consumption has increased in absolute terms, which is to be expected for a developing country and is linked to a growing population and economy.

2. Electricity consumption has been decreasing since 2007, in response to the electricity supply crisis and high price increases. While price increases do lead to behaviour changes, which is good for improved efficiency, they are detrimental for the poor in terms of affordability. The downward trend may also be in part because of the introduction of sustainable energy interventions.

3. The energy intensity of the economy appears to be steadily improving. This is generally positive, in keeping with international trends and necessary for global competitive participation. Although the data does not provide conclusive evidence of the drivers of this improvement, some cities are showing a small shift away from energy-intensive manufacturing and industrial sectors towards the financial and services sectors which are less energy intensive. The other driver is very likely to be the electricity price increases.

4. Carbon emissions per capita and per GVA are decreasing in metros despite increases nationally. The reason for this is that the national profile includes large energy-intensive industries such as Sasol and aluminum smelters. A significant driver is the decrease in electricity use, due to the effects of price escalation and blackouts. To a lesser extent sustainable energy interventions have contributed to this trend, as many

metros are supporting the peak-plateau-decline climate mitigation intentions of national government.

5. The electrification and housing programmes have been successful in providing access to energy and addressing energy poverty, an issue high on the local and national government agenda. However, challenges remain in terms of reaching universal access, building thermally efficient houses for the poor close to work and amenities, and enabling the poor to afford safe energy sources.

6. Renewable energy use is still in its infancy, and its contributions are negligible compared to Eskom-supplied electricity. Nevertheless, much is happening at local level, despite cities not having a clear mandate to generate electricity. Municipalities are likely to do more, especially given the electricity crisis, through biogas and waste-to-electricity projects and small-scale solar PV rooftop generation. The application of small-scale embedded PV in particular is expected to accelerate in the next few years. NERSA and municipalities are engaged in improving the regulatory framework relating to embedded generation.

7. Energy efficiency in the private and public sectors is improving. In many urban areas, energy efficiency measures in local government facilities have resulted in financial savings, while many municipalities are promoting efficiency measures in the commercial and residential sectors. The steep electricity price increases since 2009 have led to greater electricity efficiencies in the private sector and in residential properties, often benefitting from the Eskom Demand-Side Management programme. The recently introduced national building standards, which require energy efficiency in new buildings (including government delivered low-income housing), are expected to significantly improve the energy performance of buildings – when enforced. Despite these improvements, more savings could be realised.

8. The transport sector is the dominant energy-consuming sector in most cities across the country. In spite of several important public transport interventions, urban transport is still characterised by inefficient, congested roads and a dependence on private vehicles. While the Gautrain, BRT systems and other public transport interventions are positive developments, overall trends are still towards private vehicle use with associated increases in congestion, and higher real expenditure on transport by households.

9. Since 1994, the development of South African cities has largely reinforced the apartheid spatial form of sprawling, low-density urban spaces, with inefficient and expensive transport systems and reduced access to urban amenities for many households. While a few urban areas have progressive Spatial Development Frameworks or regulations, in general the urban form is not becoming more efficient, in part because of strong vested interests and political interference.

10. The concept of sustainable energy governance has expanded in local government, with many metros and secondary cities developing sustainable energy strategies. A national, SALGA-led EE and RE strategy has been developed for local government. In keeping with this strategic direction, many municipalities are looking at improving service delivery, such as through building efficiency, BRT and waste-to-energy facilities. However, without external support, most municipalities struggle to attend to longer-term, sustainability projects because of the pressing demands of day-to-day service delivery.

It is evident that, if managed well, cities provide an opportunity for a better life for all. To achieve this will require further investment in cities, a drive to change the urban energy and carbon profile, and greater coordination and cooperation between the spheres of government and private sector.

Urban Energy Statistics

8

THE CITY DATA PICTURE

8.1 HOW TO INTERPRET CITY ENERGY DATA

EThekwini (as well as other municipalities for comparisons) is used as an example of how to interpret energy- and emissions-related graphs for a municipality.

Energy by fuel for entire municipal area

As explained in the Chapter 2, certain assumptions regarding the different fuel types were made.

- **Diesel** use at Eskom's Ankerlig power plant, based in the Cape Town municipal area, was subtracted from Cape Town's diesel use figure to avoid double-counting (the fuel is used to generate electricity, which is accounted for in the electricity use data).
- **LPG** is used in the industrial sector (space and process heating, and certain machinery needs), the commercial sector (refrigeration, water heating and cooking) and the residential sector (cooking, and space and water heating).[42]
- **Natural gas** is used solely as a feedstock for the production of synthetic fuels.[43] Synthetic fuels are already included in the liquid fuel figures. To avoid double counting, natural gas is excluded from the pie charts.
- **Heavy furnace oil** (HFO), which is also known as heavy fuel oil or residual fuel oil is used in the industrial sector (e.g. boilers).
- **Jet fuel** use at Eskom's Acacia power plant (also situated within the Cape Town municipal boundaries) was subtracted from total jet fuel use.

Figure 40 shows that international marine fuel makes up the largest proportion (26%) of fuel consumed in eThekwini, which is understandable given Durban's large port/maritime sector. The port of Durban is now the busiest port in South Africa and the third busiest container port in the Southern Hemisphere.[44] In Cape Town, international marine fuel represents just 5% of total fuel consumption, reflecting the smaller port (Figure 41). However, Cape Town consumes a larger percentage of aviation fuel[45] (7%) than eThekwini (1%), which is to be expected, as the total number of flights to and from Cape Town is almost double that to and from Durban.[46]

42 Source: http://www.parallaxonline.net/LPGpricing.html

43 Source: Department of Energy (http://www.energy.gov.za/files/naturalgas_frame.html)

44 Source: http://en.wikipedia.org/wiki/Durban#Sea

45 Jet fuel is generally used by large commercial aeroplanes, while aviation gasoline is more often used in smaller, private aircraft.

46 Source: Airports Company of South Africa (2012/13 figures)

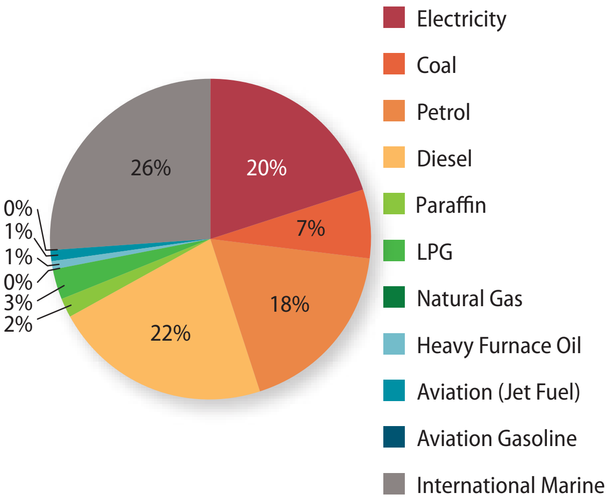


Figure 40: Energy consumption by fuel type in eThekwini

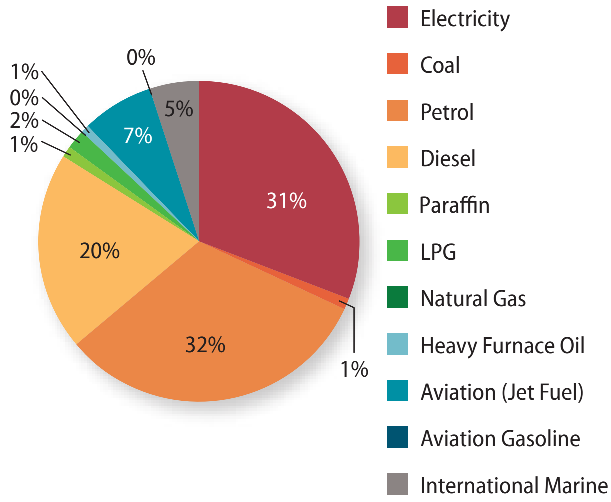


Figure 41: Energy consumption by fuel type in Cape Town

Energy by sector for entire municipal area

- Electricity is largely used by any sector with buildings, e.g. the residential, industrial and commercial sectors. The transport sector does not use much electricity, except sometimes for rail.
- Coal is assumed to be used largely by the industrial sector, as obtaining data on who uses coal (especially at municipal level) is very difficult.
- Aviation gasoline, international marine fuel, petrol and diesel consumption is assigned to the transport sector.
- Paraffin use is assigned entirely to the residential sector due to uncertainty about where to apportion the 30% of paraffin not consumed by households (according to a 2003 National Treasury Report, households consume over 70% of paraffin).
- LPG is split 25% residential, 25% commercial and 50% industrial use, based on LPG allocations in the Cape Town LTMS work.
- Natural gas is excluded from the pie charts.
- HFO is used in the industrial sector.

The transport sector consumes over two-thirds of energy in eThekwini (67%) and Cape Town (65%), reflecting the lack of density and sprawling nature of South African cities (Figures 42 and 43). This spatial form results in long commuting distances, which is very inefficient and explains the large amounts of energy being consumed by the transport sector. The transport sector may represent an even greater proportion of energy consumption in smaller municipalities, especially those that are situated on national highways. This is because of cars and trucks filling up with petrol or diesel before continuing on their journey.

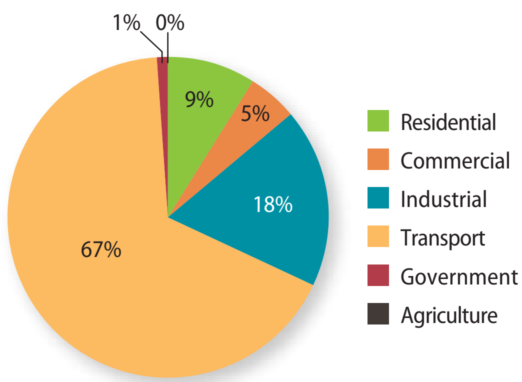


Figure 42: Energy consumption by sector in eThekwini

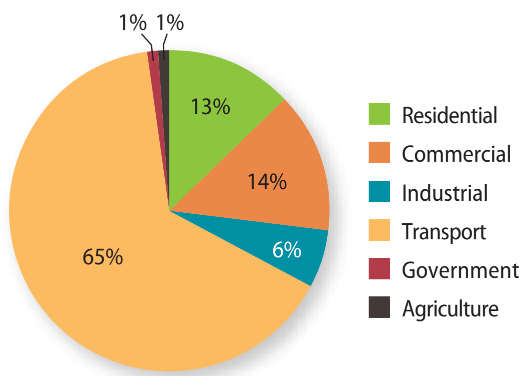


Figure 43: Energy consumption by sector in Cape Town

Municipalities with large, energy-intensive industries (e.g. mine or an aluminium smelter) are the exception to this pattern of transport sector-dominated energy consumption. In this case, energy consumption by the industrial sector is substantial and may dominate. An example is Rustenburg (Figure 44), where the industrial sector consumes 75% of all energy, which is not surprising given that Rustenburg is home to the two largest platinum mines in the world and the world's largest platinum refinery, which processes around 70% of the world's platinum.[47]

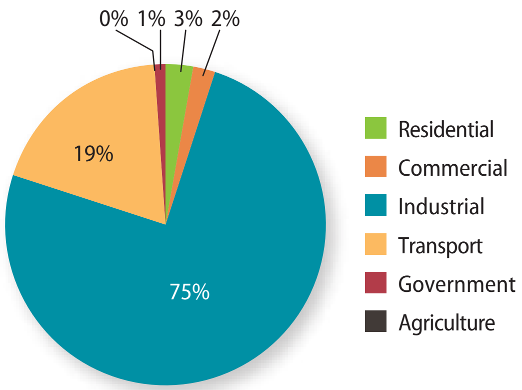


Figure 44: Energy consumption by sector in Rustenburg

As Figures 42 and 43 show, the second-largest energy-consuming sector is the industrial sector (18%) in eThekwini and the commercial (14%) and residential (13%) sectors in Cape Town. This indicates that, compared to Cape Town, eThekwini has a relatively large industrial sector, which is the case.

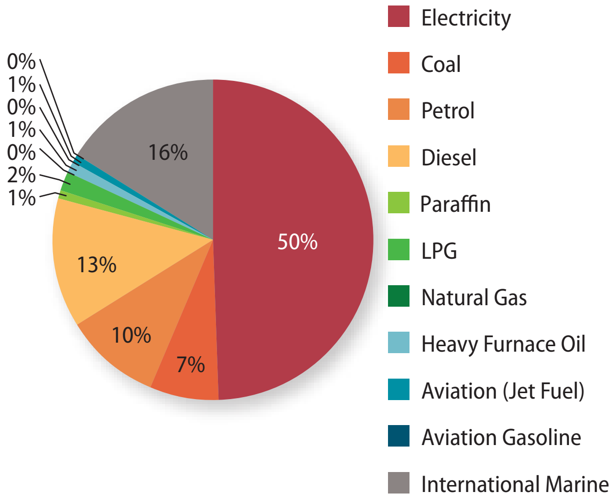


Figure 45: Emissions by fuel in eThekwini

Emissions by fuel for entire municipal area

In eThekwini, electricity accounts for 20% of energy consumption (Figure 40) but for 50% of emissions (Figure 45). This is because certain fuels, e.g. electricity, create more GHG emissions per unit of energy. Electricity is very 'dirty' in this regard, producing a high amount of emissions per unit energy, because 90% of South Africa's electricity is produced by coal-fired power plants (as opposed to renewables, nuclear or hydro).[48]

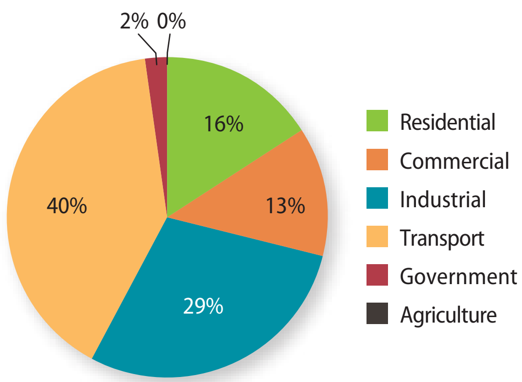


Figure 46: Emissions by sector in eThekwini

Emissions by sector for entire municipal area

Any sector that uses electricity will produce disproportionately more emissions than sectors not using electricity, due to the carbon-intense way that South Africa produces electricity. The transport sector largely uses liquid fuel (petrol, diesel, etc.), not electricity, which is why it only produces 40% of the metro area's emissions (Figure 46) despite being responsible for 67% of energy consumption Figure 42).

47 Source: http://en.wikipedia.org/wiki/Rustenburg

48 IRP 2010 Policy Adjusted Scenario

Emissions and energy consumption in local government

Figure 48 shows the energy consumption and emissions produced by the eThekwini Municipality's offices and facilities, vehicle fleet, street and traffic lighting, and waste water treatment works (WWTW). Fugitive emissions[49] (e.g. methane gas produced by WWTW) are not included.

The energy consumed and emissions produced across all municipalities vary widely. This may not be due to actual energy consumption patterns, but a reflection of energy data availability, e.g. buildings may share the same meter as a WWTW, in which case this data may be amalgamated.

Buildings (55%), lighting (27%) and WWTW (7%) contribute disproportionately to the emissions produced by local government, because these sub-sectors largely consume electricity. In contrast, the vehicle fleet produces proportionally less emissions (11%) when considering its energy consumption (34%). Therefore, if eThekwini wishes to address its internal energy use, the focus should be on buildings and the vehicle fleet (the two largest energy consumers). However, if the municipality wants to reduce emissions, the focus needs to be on buildings and street and traffic lighting (the largest contributors to local government emissions).

49 'emissions of gases or vapors from pressurized equipment due to leaks and other unintended or irregular releases of gases, mostly from industrial activities.' http://en.wikipedia.org/wiki/Fugitive_emissions.

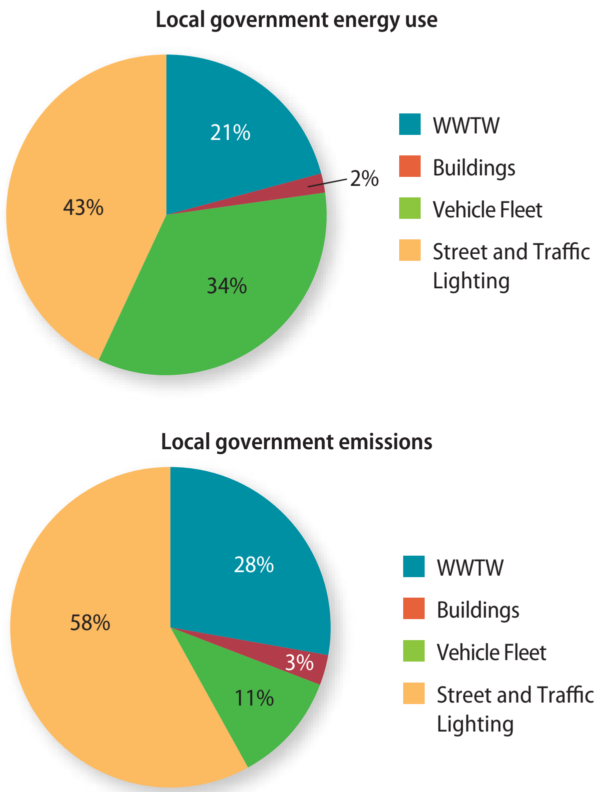


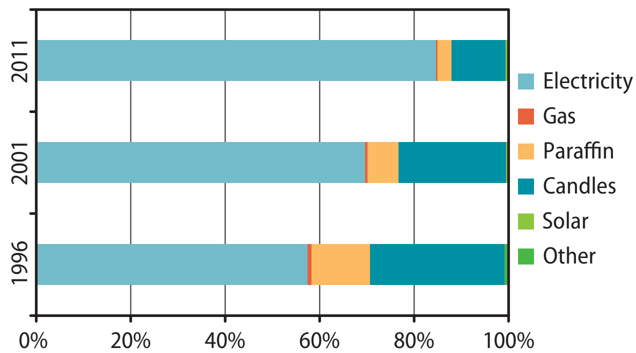
Figure 47: EThekwini local government energy consumption and emissions

Fuel use by end-use in households

Here low-income households are defined as households with a monthly income of less than R3200. All the data is sourced from the national census (Stats SA, 2001, 2011).

Fuel use for lighting is a good proxy for household electrification, as lighting is usually the first thing a household will run on electricity. If a household is using another fuel, such as candles or paraffin, for lighting, it is doubtful that the household is electrified. However, this does not indicate whether a household is electrified legally, as there is usually a disconnect between the 'electrification' figures and electrification backlog data.

The increase in households using electricity for lighting is a reflection of the government's electrification drive since 1994. This nationwide trend is visible throughout the municipalities included in this report.



Sources: StatsSA Censuses 1996, 2001 and 2011

Figure 48: Main fuel used for lighting nationally (1996–2011)

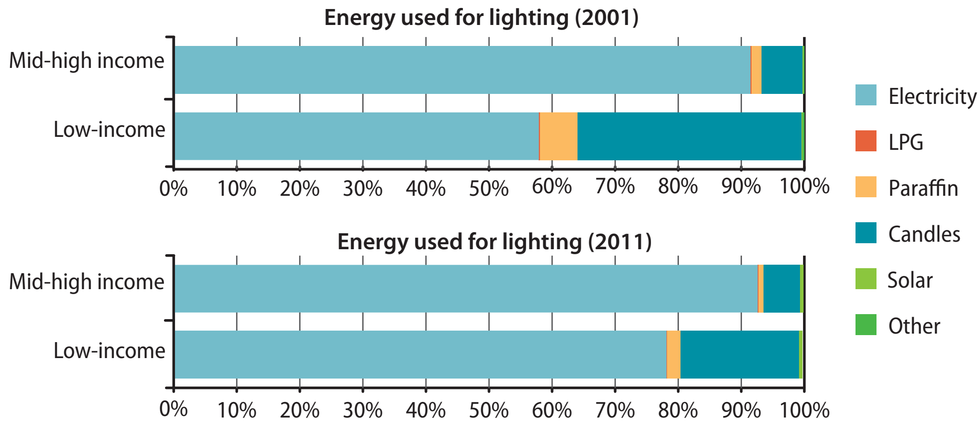


Figure 49: Main fuel used for lighting in eThekwini (2001 and 2011)

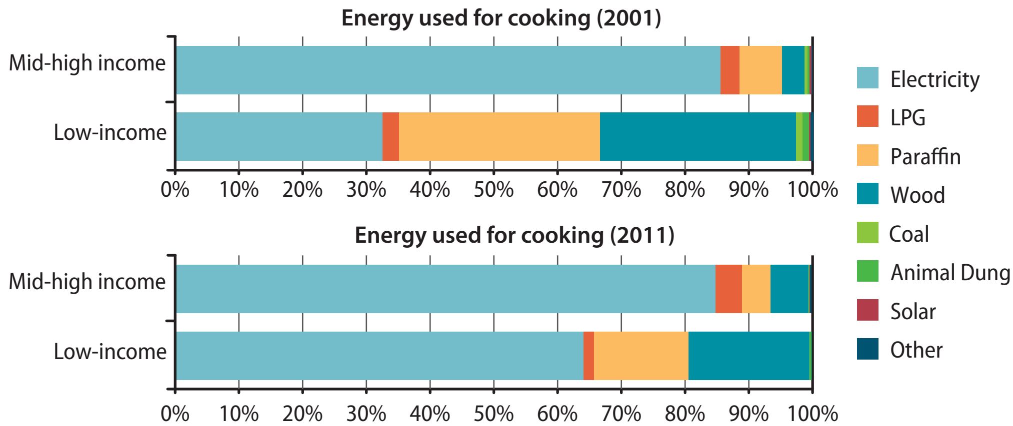
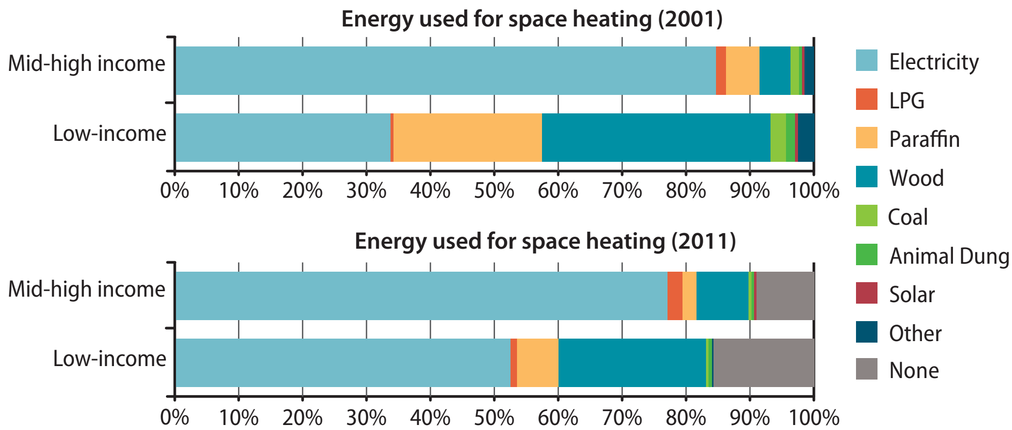


Figure 50: Main fuel used for cooking in eThekwini (2001 and 2011)



Note: *The "Other" category was split into "Other" and "None" in the 2011 Census.*

Figure 51: Main fuel used for space heating in eThekwini (2001 and 2011)

Mid- to high-income households are more likely to use electricity for lighting (and therefore be electrified), but the proportion of low-income households that are electrified has increased between 2001 and 2011. However, electrified households will not necessarily use electricity for cooking, as shown in Figure 50.

Only electricity, LPG and solar are considered to be 'clean' fuels. Other fuels, such as paraffin, coal, animal dung and wood, carry various health risks, including respiratory diseases (from bad air quality when burning these fuels), poisoning (from accidental ingestion of paraffin by children) and fire (from open flames). The use of these alternative 'dirty' fuels is also indicative of energy poverty, i.e. the households cannot afford to use the safer fuel options.

An electrified low-income household may sometimes use alternative fuel sources for cooking because these alternative sources of fuel are either cheaper or perceived to be cheaper than cooking with electricity. The main type of fuel used as an alternative to electricity for cooking is generally paraffin, but may differ depending on area characteristics. In municipalities close to coal mines, such as in Mpumalanga, the use of coal for cooking and/or space heating is more prominent.

However, between 2001 and 2011 low-income households appear to shift to using electricity for cooking, largely at the expense of paraffin. In 2001, 72% of low-income households were using electricity for lighting, but only 62% were using electricity for cooking. As Figures 49 and 50 show, in 2011, 85% of low-income households were using electricity for lighting, and 81% were using electricity for cooking (a difference of 4 percentage points compared to 10 percentage points in 2001). This may be due to the relatively steep price increase for paraffin between 2001 and 2011, when the paraffin nominal price increased by an average of 11.3% annually.[50] Electricity prices have increased steeply recently, which may reverse this trend.

Between 2001 and 2011, mid- to high-income households showed a small shift from electricity to LPG use for cooking (Figure 51). This may have been in response to price signals (relative cost of cooking with electricity vs. LPG) or to households wishing to be able to cook when electricity is unavailable (nation-wide load-shedding was implemented for the first time in 2008).

Over the past decade, the proportion of low-income households using electricity for space heating also increased, at the expense of other 'dirty' fuels (paraffin, coal, animal dung).

8.2 INDIVIDUAL CITIES DATA

The detailed data for the metros, secondary cities and small towns follow on pages 72–107.

50 Source of cost: Department of Energy website, Statistics: http://www.energy.gov.za/files/energyStats_frame.html



BUFFALO CITY

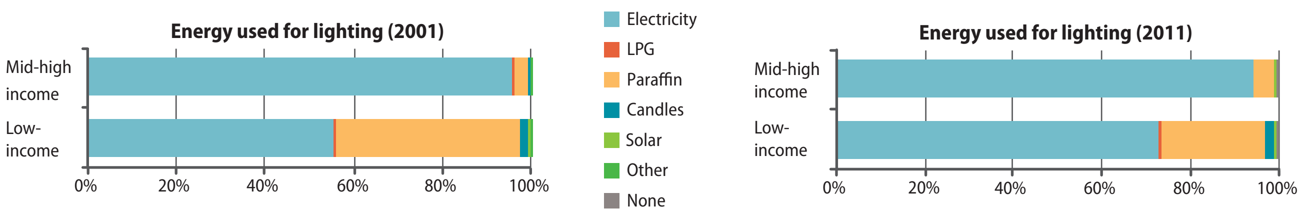
KEY INDICATORS

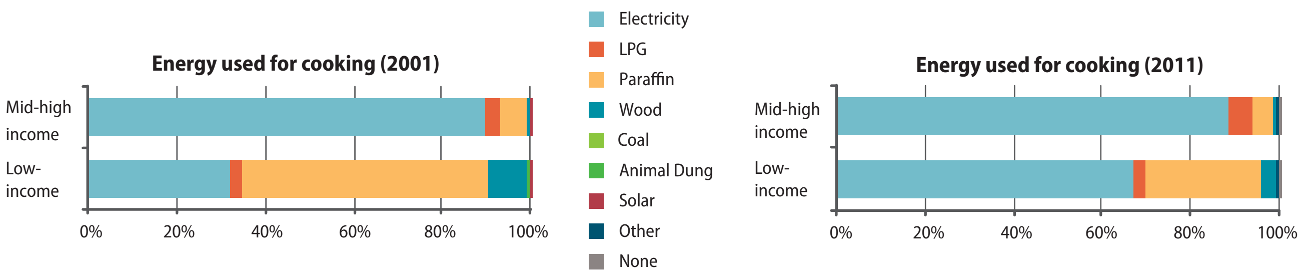
Energy and emissions overview	Value	Year
Energy per capita (GJ)	30,4	2011
Energy per GVA (GJ/R millions)	741,4	2011
GHG per capita (tonnes CO_2e)	4,0	2011
GHG per GVA (tCO_2e/R millions)	97,5	2011

General	Value	Year	Value	Year
Population density (people/km^2)	300	2011	280	2001
Population growth (% p.a.)	0,7%	2001–2011		
Umemployment (narrow)	35%	2011	14%	2001
Umemployment (broad)	45%	2011	56%	2001
Informal households (%)	22%	2011	29%	2001
Indigent households (<R3 200/month)	43%	2011		
Households that own a car (%)	28%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	81%	2011	63%	2001
Households using safe/clean energy for cooking (%)	78%	2011	46%	2001
Households using safe/clean energy for heating (%)	44%	2011	37%	2001
No. of households without formal electricity connection	1 500	2011/12		
Potential maximum share of indigent households accessing FBE (%)	61%	2011		

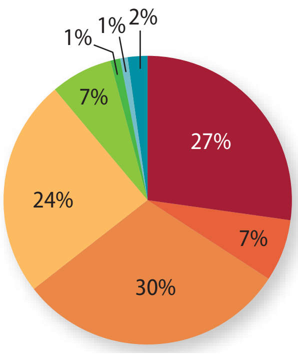
BUFFALO CITY HOUSEHOLD ENERGY USE

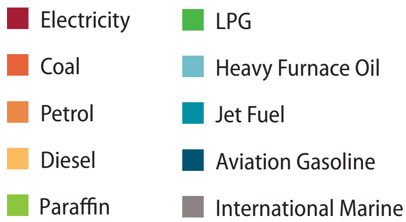




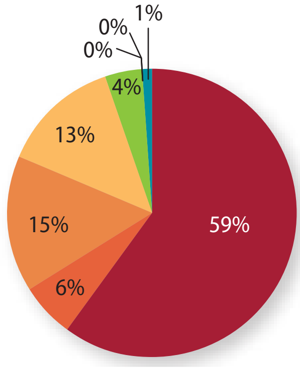
ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

Energy by fuel





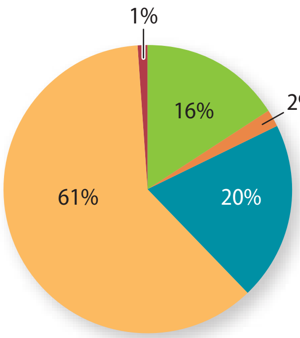
Emissions by fuel

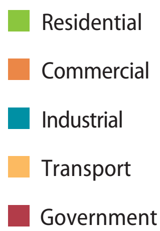


ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

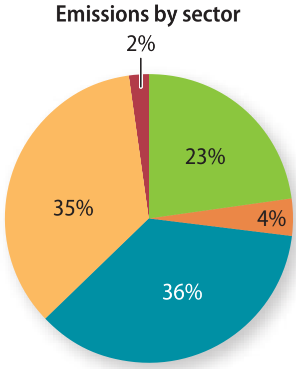
Sector	GJ	tCO_2e
Residential	3 444 628	601 887
Commercial	357 419	91 582
Industrial	4 417 947	932 962
Transport	12 989 378	892 765
Government	175 191	47 639
Agriculture	–	–
Losses	1 580 890	452 310
TOTAL	**22 965 453**	**3 019 145**

Energy by sector





Emissions by sector

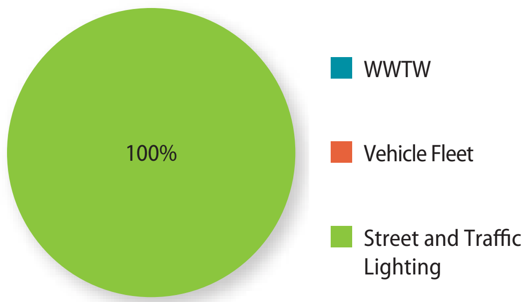


LOCAL GOVERNMENT

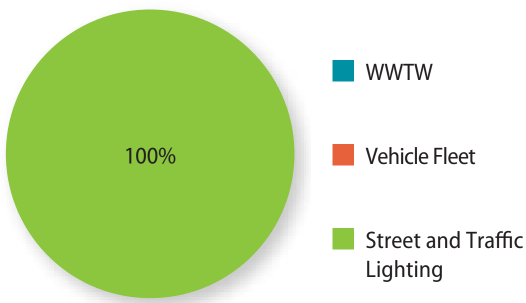
Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	548	–	–	548
WWTW	–	–	–	–
Buildings	548	–	–	548
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	130	–	–	130
TOTAL	**1 226**	**–**	**–**	**1 226**

Emissions (tCO_2e)	Electricity	Liquid Fuel	Coal	tCO_2e
Buildings and Facilities	157	–	–	157
WWTW	–	–	–	–
Buildings	157	–	–	157
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	37	–	–	37
TOTAL	**351**	**–**	**–**	**351**

Local government energy use



Local government emissions



CAPE TOWN

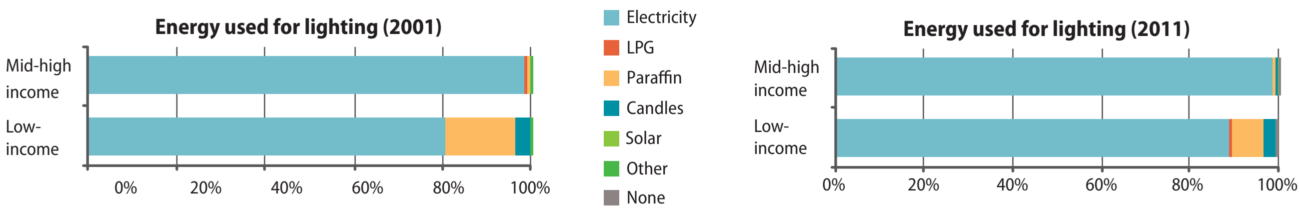
KEY INDICATORS

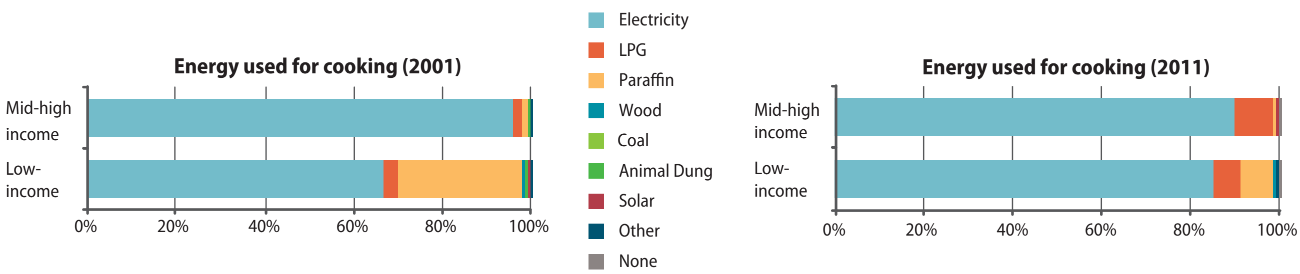
Energy and emissions overview	Value	Year
Energy per capita (GJ)	41,4	2012
Energy per GVA (GJ/R millions)	800,9	2012
GHG per capita (tonnes CO_2e)	5,5	2012
GHG per GVA (tCO_2e/R millions)	107,4	2012

General	Value	Year	Value	Year
Population density (people/km²)	1 569	2011	1 183	2001
Population growth (% p.a.)	2,9%	2001–2012		
Umemployment (narrow)	24%	2011	29%	2001
Umemployment (broad)	31%	2011	32%	2001
Informal households (%)	20%	2011	19%	2001
Indigent households (<R3 200/month)	47%	2011		
Households that own a car (%)	46%	2011		

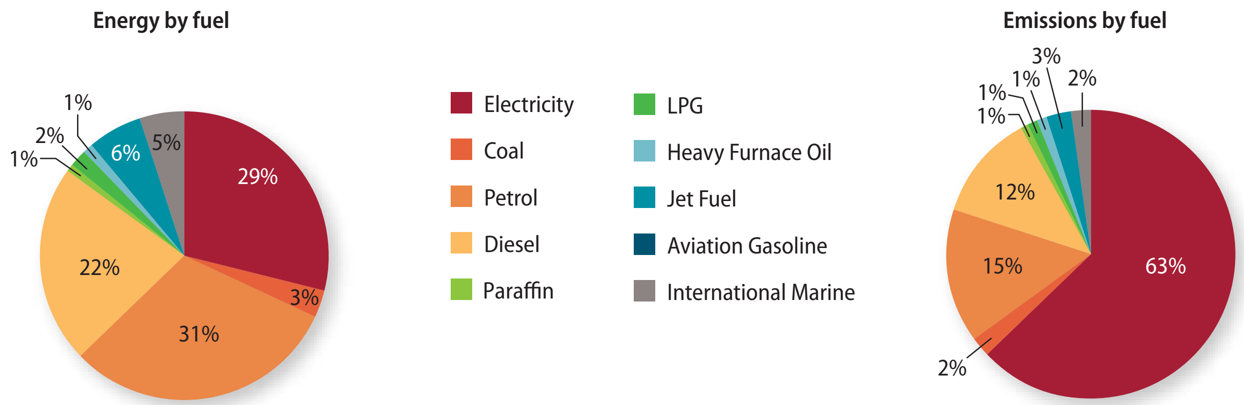
Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	94%	2011	89%	2001
Households using safe/clean energy for cooking (%)	95%	2011	83%	2001
Households using safe/clean energy for heating (%)	67%	2011	76%	2001
No. of households without formal electricity connection	No data	2012		
Potential maximum share of indigent households accessing FBE (%)	72%	2011/12		

CAPE TOWN HOUSEHOLD ENERGY USE



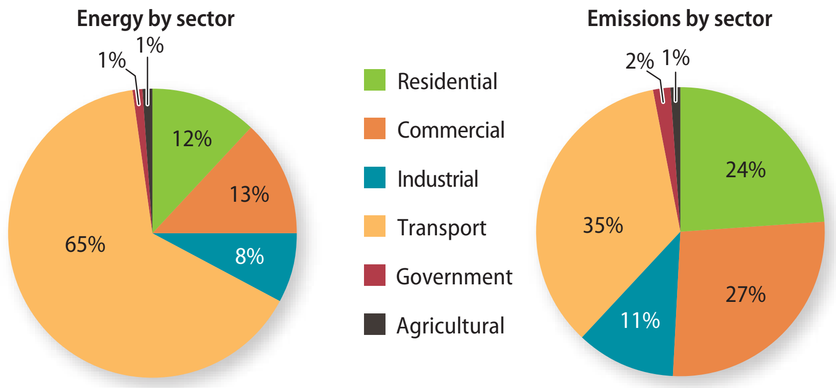


ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)



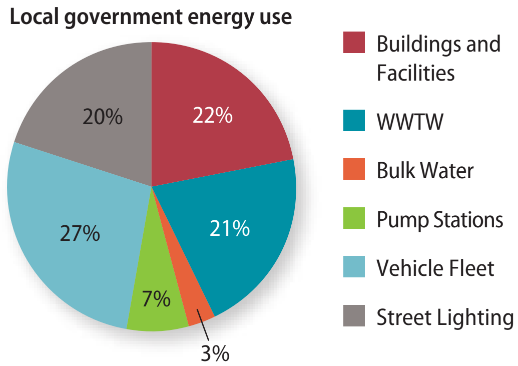
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

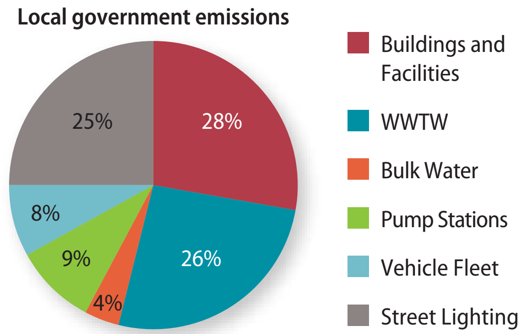
Sector	GJ	tCO_2e
Residential	18 353 781	4 752 490
Commercial	20 043 476	5 495 718
Industrial	12 542 036	2 261 431
Transport	100 988 653	6 974 396
Government	2 204 190	503 635
Agriculture	760 895	217 630
Losses	3 792 024	1 076 937
TOTAL	**158 685 055**	**21 282 238**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	486 414	–	–	486 414
WWTW	452 761	–	–	452 761
Bulk Water	68 543	–	–	68 543
Pump Stations	159 935	–	–	159 935
Vehicle Fleet	–	586 070	–	586 070
Street and Traffic Lighting	444 459	–	–	444 459
TOTAL	**1 612 113**	**586 070**	**–**	**2 198 183**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	139 168	–	–	139 168
WWTW	129 540	–	–	129 540
Bulk Water	19 611	–	–	19 611
Pump Stations	45 759	–	–	45 759
Vehicle Fleet	–	40 673	–	40 673
Street and Traffic Lighting	127 165	–	–	127 165
TOTAL	**461 243**	**40 673**	**–**	**501 917**





DRAKENSTEIN

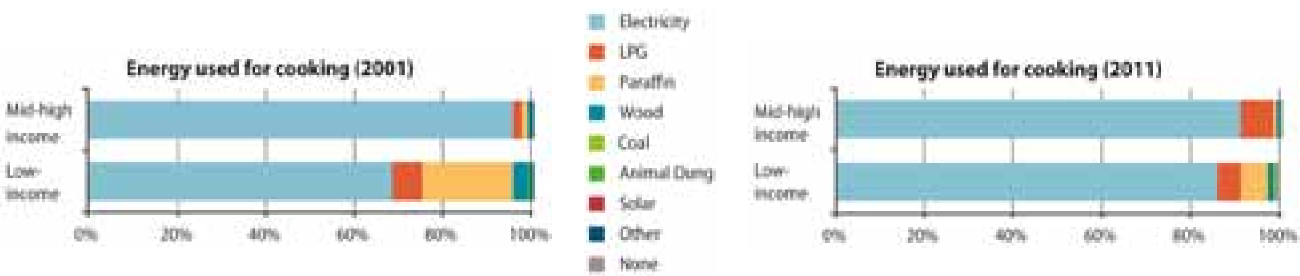
KEY INDICATORS

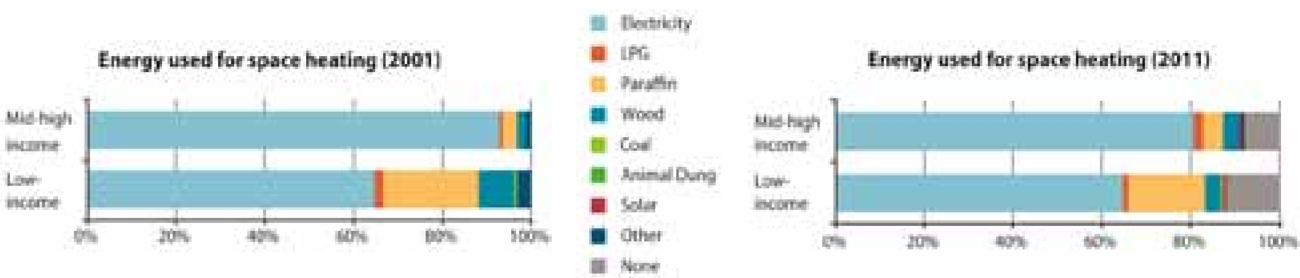
Energy and emissions overview	Value	Year
Energy per capita (GJ)	25,4	2012
Energy per GVA (GJ/R millions)	785,4	2012
GHG per capita (tonnes CO_2e)	4,4	2012
GHG per GVA (tCO_2e/R millions)	136,0	2012

General	Value	Year	Value	Year
Population density (people/km^2)	163	2011	126	2001
Population growth (% p.a.)	2,6%	2001–2011		
Umemployment (narrow)	18%	2011	23%	2001
Umemployment (broad)	27%	2011	25%	2001
Informal households (%)	13%	2011	16%	2001
Indigent households (<R3 200/month)	64%	2011		
Households that own a car (%)	44%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	95%	2011	87%	2001
Households using safe/clean energy for cooking (%)	95%	2011	84%	2001
Households using safe/clean energy for heating (%)	75%	2011	77%	2001
No. of households without formal electricity connection	No data	2012		
Potential maximum share of indigent households accessing FBE (%)	48%	2012		

DRAKENSTEIN HOUSEHOLD ENERGY USE

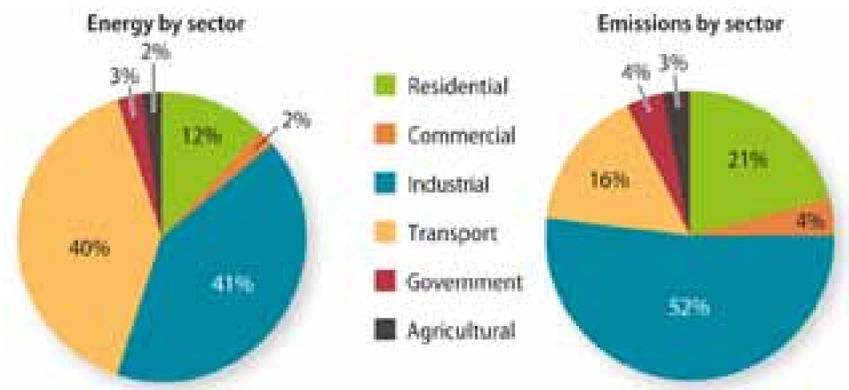




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA EXCLUDED)

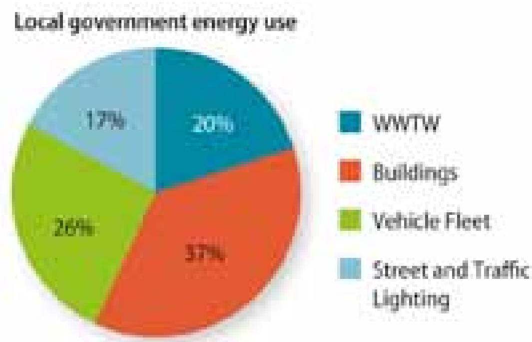
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

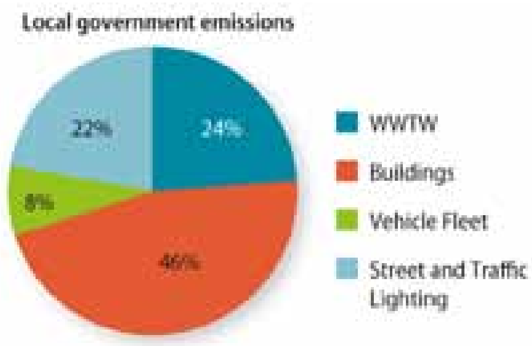
Sector	GJ	tCO_2e
Residential	750 876	214 354
Commercial	150 767	43 134
Industrial	2 496 341	536 983
Transport	2 444 910	166 772
Government	164 100	37 556
Agriculture	127 268	36 413
Losses	237 347	67 907
TOTAL	**6 371 607**	**1 103 120**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	92 564	–	–	92 564
WWTW	32 118	–	–	32 118
Buildings	60 446	–	–	60 446
Vehicle Fleet	–	43 241	–	43 241
Street and Traffic Lighting	28 294	–	–	28 294
TOTAL	**213 423**	**43 241**	**–**	**256 664**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	26 484	–	–	26 484
WWTW	9 189	–	–	9 189
Buildings	17 294	–	–	17 294
Vehicle Fleet	–	2 977	–	2 977
Street and Traffic Lighting	8 095	–	–	8 095
TOTAL	**61 063**	**2 977**	**–**	**64 040**





EKURHULENI

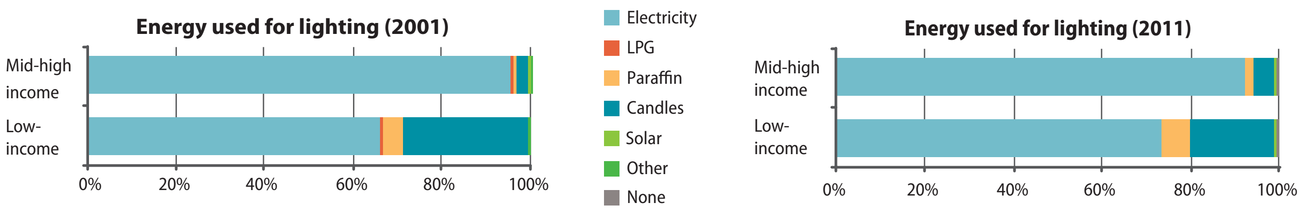
KEY INDICATORS

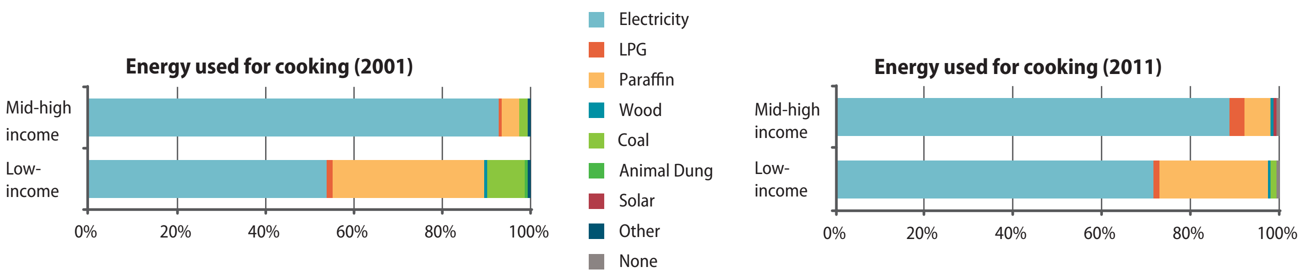
Energy and emissions overview	Value	Year
Energy per capita (GJ)	39,9	2011
Energy per GVA (GJ/R millions)	1 153,1	2011
GHG per capita (tonnes CO_2e)	5,5	2011
GHG per GVA (tCO_2e/R millions)	159,3	2011

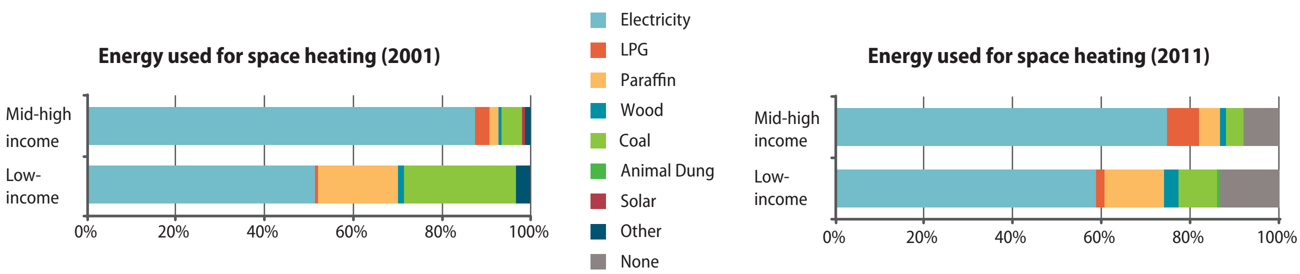
General	Value	Year	Value	Year
Population density (people/km²)	1 609	2011	1 257	2001
Population growth (% p.a.)	2,5%	2001–2011		
Umemployment (narrow)	29%	2011	10%	2001
Umemployment (broad)	35%	2011	44%	2001
Informal households (%)	21%	2011	29%	2001
Indigent households (<R3 200/month)	55%	2011		
Households that own a car (%)	35%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	82%	2011	75%	2001
Households using safe/clean energy for cooking (%)	82%	2011	67%	2001
Households using safe/clean energy for heating (%)	70%	2011	63%	2001
No. of households without formal electricity connection	285 000	2012		
Potential maximum share of indigent households accessing FBE (%)	52%	2014		

EKURHULENI HOUSEHOLD ENERGY USE



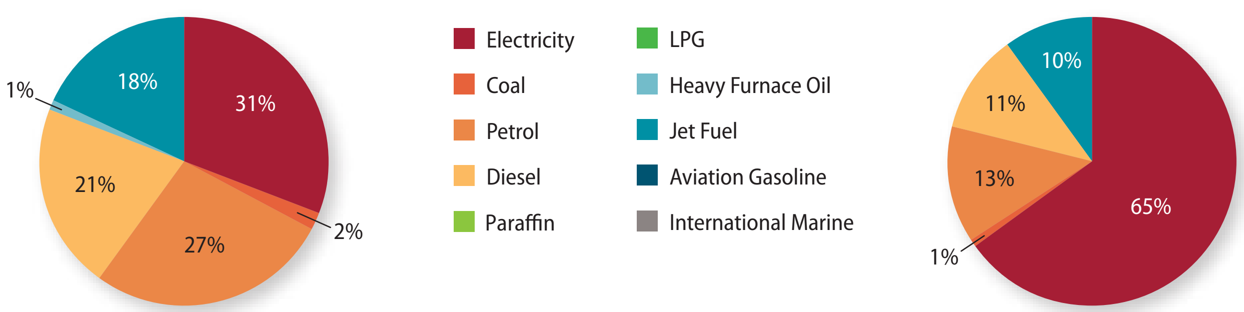




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

Energy by fuel

Emissions by fuel

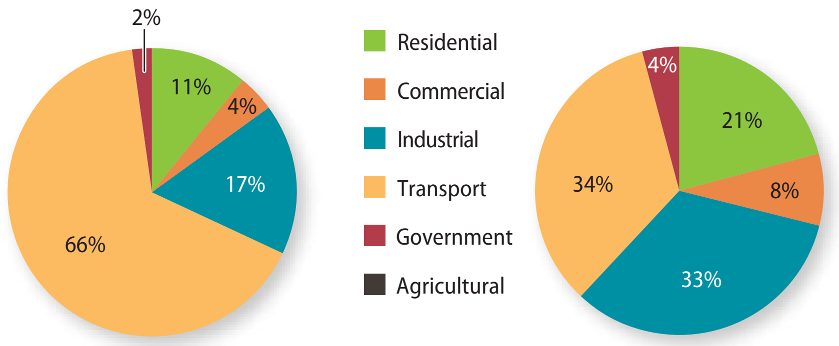


ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

Sector	GJ	tCO_2e
Residential	13 671 860	3 569 459
Commercial	4 479 483	1 253 091
Industrial	21 356 238	5 597 726
Transport	82 298 271	5 746 053
Government	2 724 806	714 004
Agriculture	6	2
Losses	2 158 878	617 679
TOTAL	**126 689 542**	**17 498 014**

Energy by sector

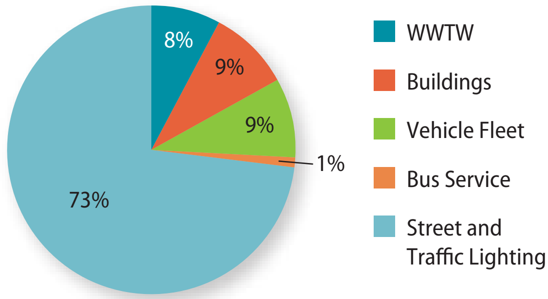
Emissions by sector



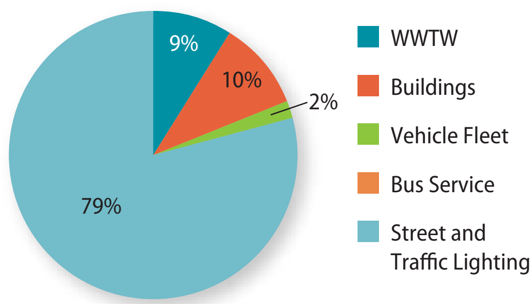
LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	446 611	–	–	446 611
WWTW	211 554	–	–	211 554
Buildings	235 057	–	–	235 057
Vehicle Fleet	–	248 362	–	248 362
Bus Service	–	21 801	–	21 801
Street and Traffic Lighting	1 964 293	–	–	1 964 293
TOTAL	**2 857 514**	**270 162**	**–**	**3 127 677**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	127 780	–	–	127 780
WWTW	60 528	–	–	60 528
Buildings	67 252	–	–	67 252
Vehicle Fleet	–	17 613	–	17 613
Bus Service	–	1 546	–	1 546
Street and Traffic Lighting	562 006	–	–	562 006
TOTAL	**817 567**	**19 160**	**–**	**836 726**

Local government energy use



Local government emissions



ETHEKWINI

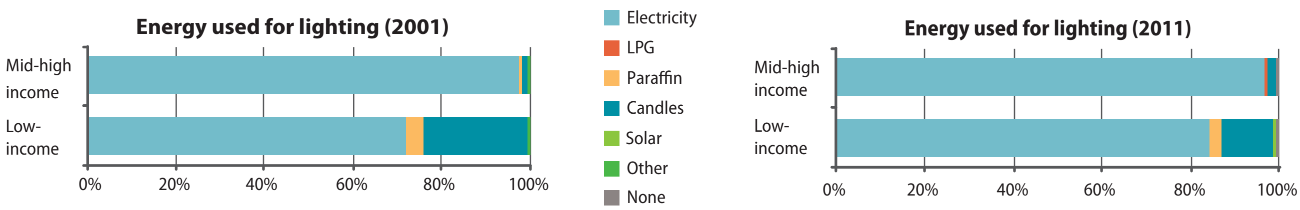
KEY INDICATORS

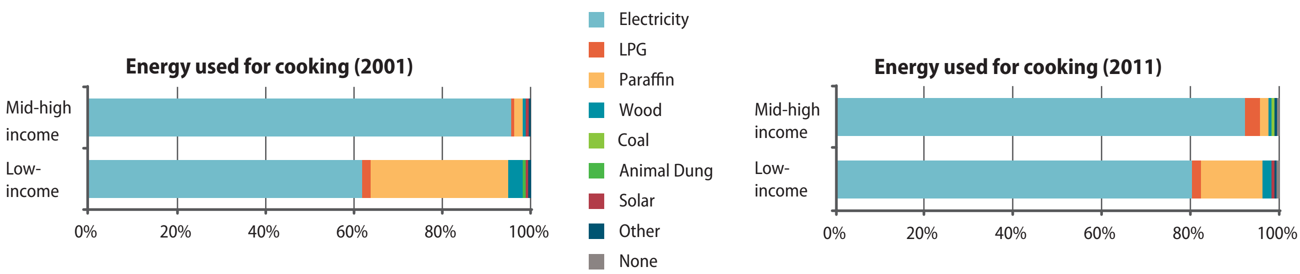
Energy and emissions overview	**Value**	**Year**
Energy per capita (GJ)	61,1	2011
Energy per GVA (GJ/R millions)	1 151,3	2011
GHG per capita (tonnes CO_2e)	7,3	2011
GHG per GVA (tCO_2e/R millions)	137,0	2011

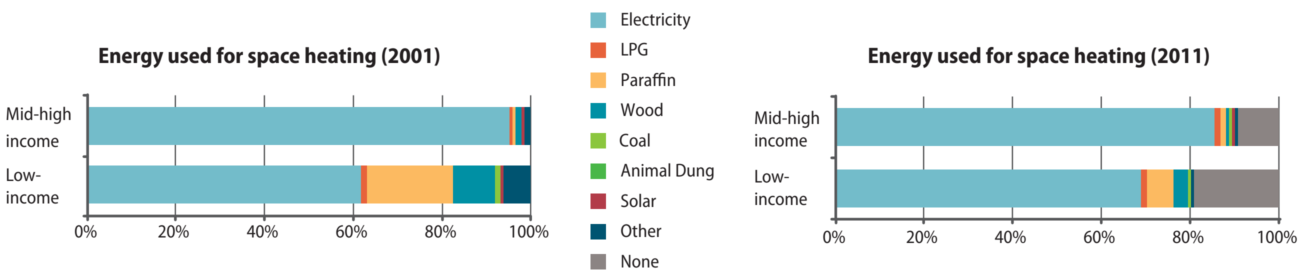
General	**Value**	**Year**	**Value**	**Year**
Population density (people/km²)	1 502	2011	1 348	2001
Population growth (% p.a.)	1,1%	2001–2011		
Umemployment (narrow)	30%	2011	9%	2001
Umemployment (broad)	40%	2011	46%	2001
Informal households (%)	16%	2011	19%	2001
Indigent households (<R3 200/month)	59%	2011		
Households that own a car (%)	33%	2011		

Energy Poverty	**Value**	**Year**	**Value**	**Year**
Electrified households, lighting as proxy (%)	90%	2011	80%	2001
Households using safe/clean energy for cooking (%)	89%	2011	74%	2001
Households using safe/clean energy for heating (%)	78%	2011	73%	2001
No. of households without formal electricity connection	96 971	2011		
Potential maximum share of indigent households accessing FBE (%)	16%	2011		

ETHEKWINI HOUSEHOLD ENERGY USE

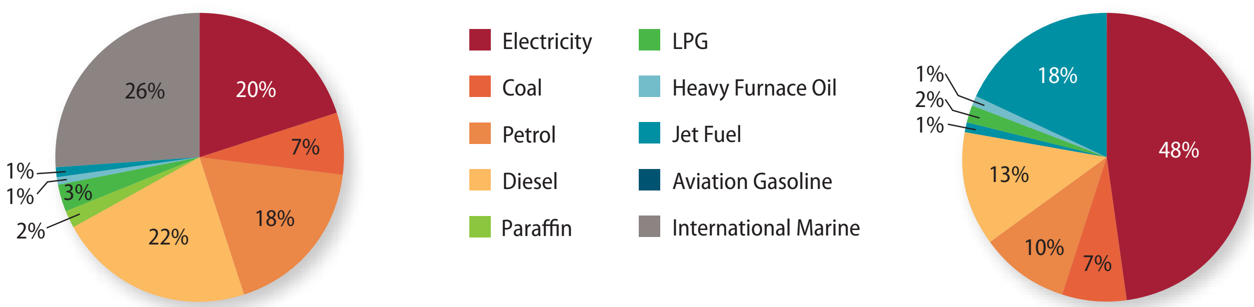






ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

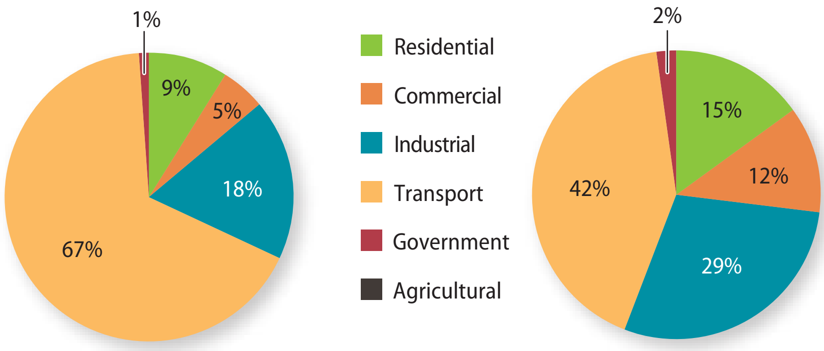
Energy by fuel | **Emissions by fuel**



ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

Sector	GJ	tCO_2e
Residential	17 934 080	3 831 139
Commercial	11 663 702	2 995 323
Industrial	37 895 172	7 069 124
Transport	139 023 928	10 221 450
Government	2 050 057	429 913
Agriculture	–	–
Losses	1 651 893	472 625
TOTAL	**210 218 833**	**25 019 574**

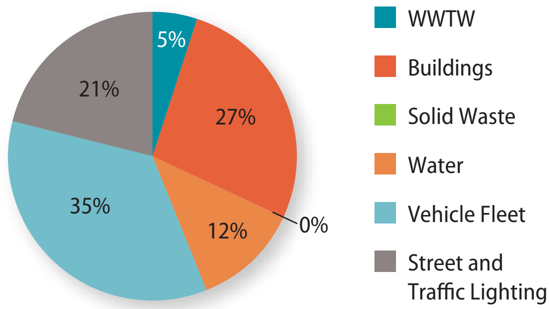
Energy by sector | **Emissions by sector**



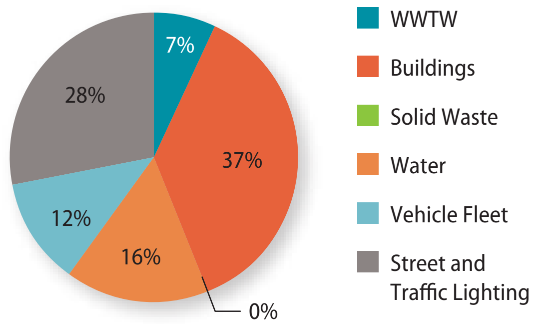
LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	900 056	21 008	–	921 064
WWTW	108 892	–	–	108 892
Buildings	548 549	–	–	548 549
Solid Waste	6 129	–	–	6 129
Water	236 486	–	–	236 486
Vehicle Fleet	–	725 020	–	725 020
Street and Traffic Lighting	424 981	–	–	424 981
TOTAL	**2 225 093**	**746 028**	**–**	**2 971 121**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	257 516	1 499	–	259 015
WWTW	31 155	–	–	31 155
Buildings	156 946	–	–	156 946
Solid Waste	1 754	–	–	1 754
Water	67 661	–	–	67 661
Vehicle Fleet	–	50 805	–	50 805
Street and Traffic Lighting	121 592	–	–	121 592
TOTAL	**636 624**	**52 304**	**–**	**688 927**

Local government energy use



Local government emissions



GEORGE

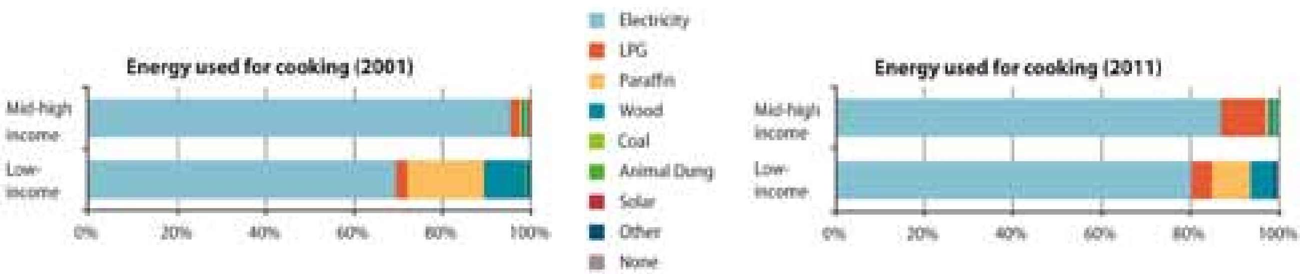
KEY INDICATORS

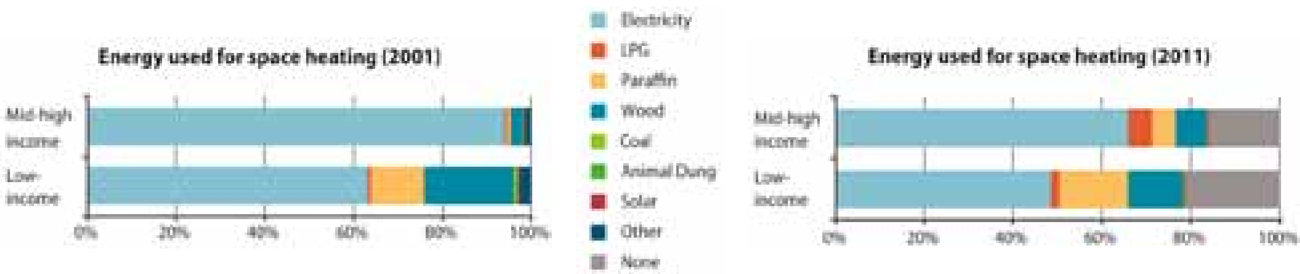
Energy and emissions overview	Value	Year
Energy per capita (GJ)	15,6	2012
Energy per GVA (GJ/R millions)	512,1	2012
GHG per capita (tonnes CO_2e)	3,0	2012
GHG per GVA (tCO_2e/R millions)	99,7	2012

General	Value	Year	Value	Year
Population density (people/km^2)	37	2011	29	2001
Population growth (% p.a.)	2,6%	2001–2011		
Umemployment (narrow)	21%	2011	28%	2001
Umemployment (broad)	30%	2011	30%	2001
Informal households (%)	14%	2011	15%	2001
Indigent households (<R3 200/month)	37%	2011		
Households that own a car (%)	43%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	91%	2011	87%	2001
Households using safe/clean energy for cooking (%)	91%	2011	81%	2001
Households using safe/clean energy for heating (%)	61%	2011	74%	2001
No. of households without formal electricity connection	No data	2012		
Potential maximum share of indigent households accessing FBE (%)	79%	2012		

GEORGE HOUSEHOLD ENERGY USE

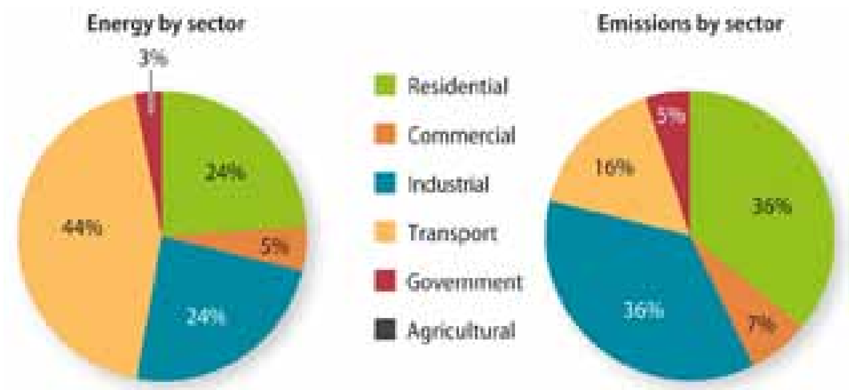




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

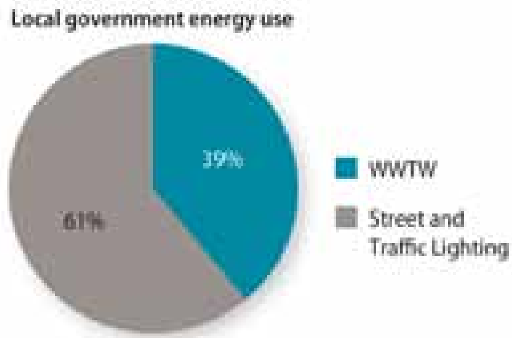
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

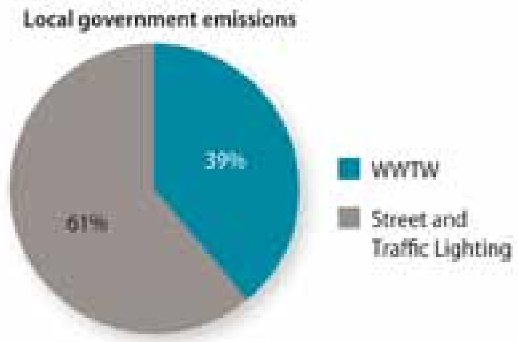
Sector	GJ	tCO_2e
Residential	669 120	190 938
Commercial	132 928	37 566
Industrial	686 676	194 775
Transport	1 263 644	87 973
Government	86 844	24 847
Agriculture	7 286	2 085
Losses	174 536	49 937
TOTAL	**3 021 035**	**588 120**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	34 110	–	–	34 110
WWTW	34 110	–	–	34 110
Buildings	–	–	–	–
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	52 734	–	–	52 734
TOTAL	**120 954**	**–**	**–**	**120 954**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	9 759	–	–	9 759
WWTW	9 759	–	–	9 759
Buildings	–	–	–	–
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	15 088	–	–	15 088
TOTAL	**34 606**	**–**	**–**	**34 606**





JOHANNESBURG

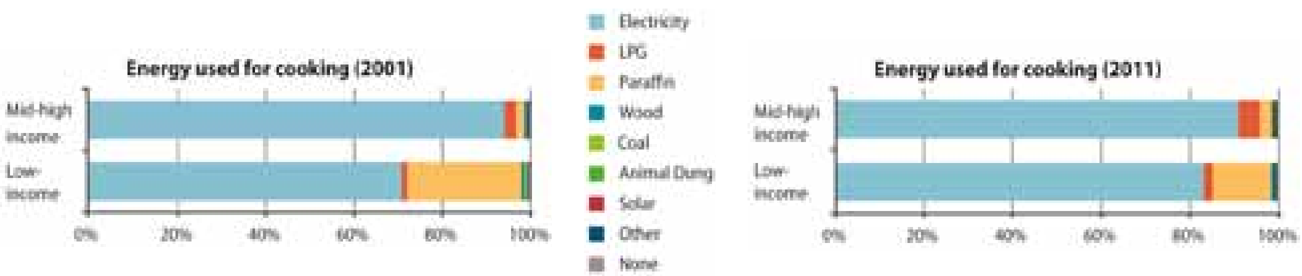
KEY INDICATORS

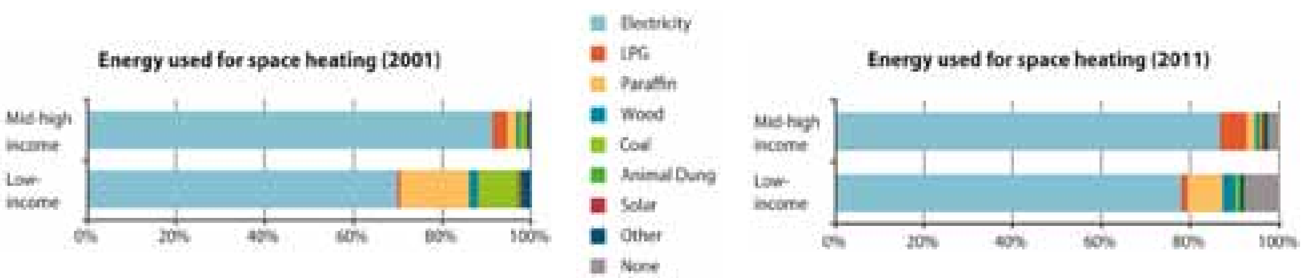
Energy and emissions overview	Value	Year
Energy per capita (GJ)	39,6	2011
Energy per GVA (GJ/R millions)	614,6	2011
GHG per capita (tonnes CO_2e)	5,7	2011
GHG per GVA (tCO_2e/R millions)	88,0	2011

General	Value	Year	Value	Year
Population density (people/km²)	2 696	2011	1 961	2001
Population growth (% p.a.)	3,2%	2001–2011		
Umemployment (narrow)	25%	2011	7%	2001
Umemployment (broad)	31%	2011	40%	2001
Informal households (%)	17%	2011	21%	2001
Indigent households (<R3 200/month)	52%	2011		
Households that own a car (%)	38%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	91%	2011	85%	2001
Households using safe/clean energy for cooking (%)	91%	2011	81%	2001
Households using safe/clean energy for heating (%)	86%	2011	79%	2001
No. of households without formal electricity connection	26 393	2011		
Potential maximum share of indigent households accessing FBE (%)	3%	2011/12		

JOHANNESBURG HOUSEHOLD ENERGY USE

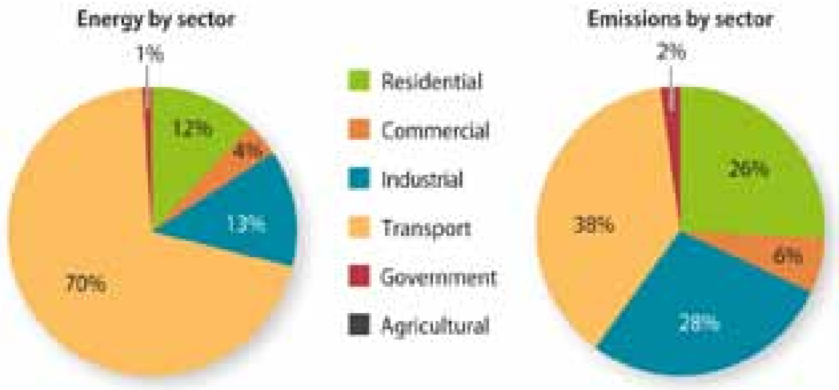




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

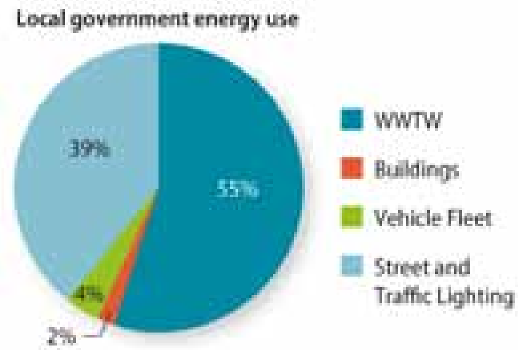
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

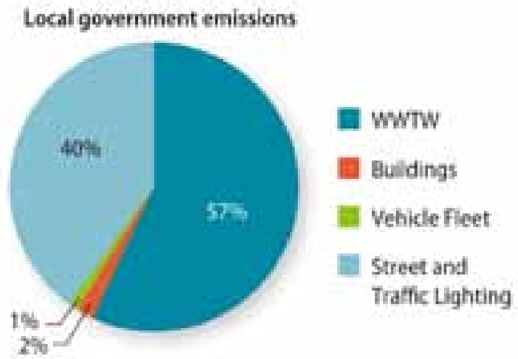
Sector	GJ	tCO_2e
Residential	18 537 957	5 236 066
Commercial	7 269 160	1 289 301
Industrial	20 109 492	5 641 357
Transport	111 247 068	7 692 684
Government	1 242 041	334 038
Agriculture	4 061	1 162
Losses	17 310 885	4 952 837
TOTAL	**175 720 664**	**25 147 445**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	–	–	–	–
WWTW	648 000	–	–	648 000
Buildings	25 920	–	–	25 920
Vehicle Fleet	–	52 601	–	52 601
Street and Traffic Lighting	457 200	–	–	457 200
TOTAL	**1 131 120**	**52 601**	**–**	**1 183 721**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	–	–	–	–
WWTW	185 400	–	–	185 400
Buildings	7 416	–	–	7 416
Vehicle Fleet	–	3 668	–	3 668
Street and Traffic Lighting	130 810	–	–	130 810
TOTAL	**323 626**	**3 668**	**–**	**327 294**





KING SABATA DALINDYEBO

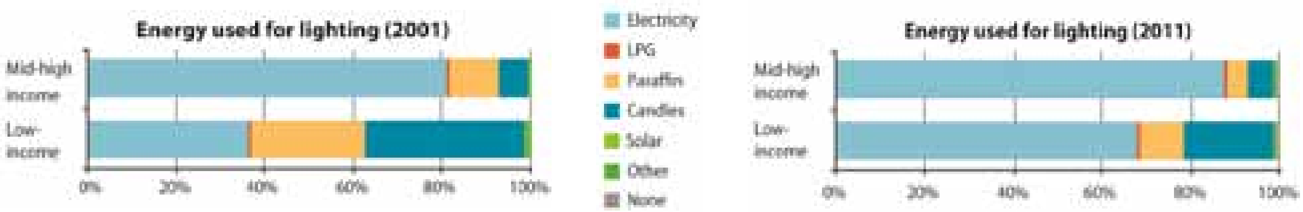
KEY INDICATORS

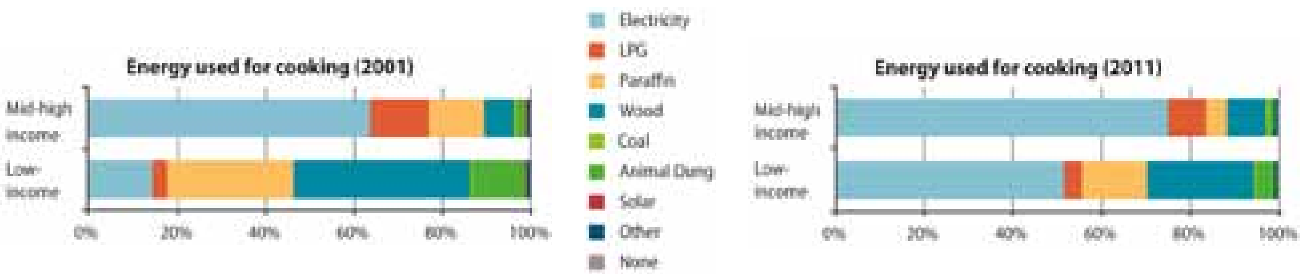
Energy and emissions overview	**Value**	**Year**
Energy per capita (GJ)	10,3	2011
Energy per GVA (GJ/R millions)	584,9	2011
GHG per capita (tonnes CO_2e)	1,2	2011
GHG per GVA (tCO_2e/R millions)	66,6	2011

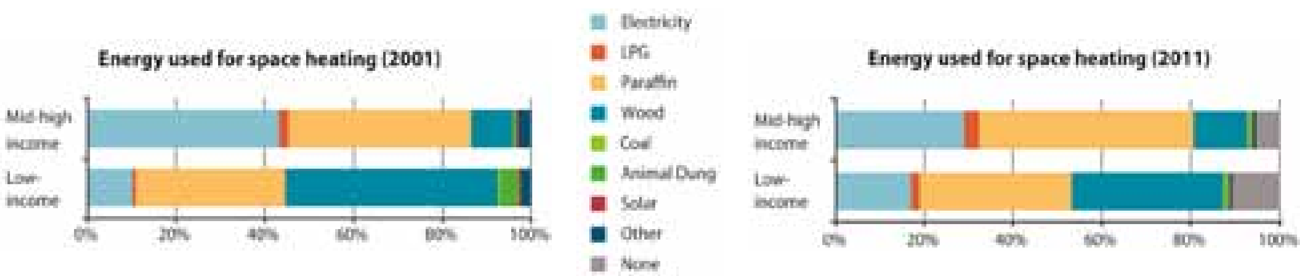
General	**Value**	**Year**	**Value**	**Year**
Population density (people/km^2)	149	2011	138	2001
Population growth (% p.a.)	0,8%	2001–2011		
Umemployment (narrow)	38%	2011	57%	2001
Umemployment (broad)	54%	2011	64%	2001
Informal households (%)	2%	2011	5%	2001
Indigent households (<R3 200/month)	53%	2011		
Households that own a car (%)	16%	2011		

Energy Poverty	**Value**	**Year**	**Value**	**Year**
Electrified households, lighting as proxy (%)	73%	2011	42%	2001
Households using safe/clean energy for cooking (%)	63%	2011	25%	2001
Households using safe/clean energy for heating (%)	22%	2011	15%	2001
No. of households without formal electricity connection	31 467	2007		
Potential maximum share of indigent households accessing FBE (%)	14%	2011		

KING SABATA DALINDYEBO HOUSEHOLD ENERGY USE



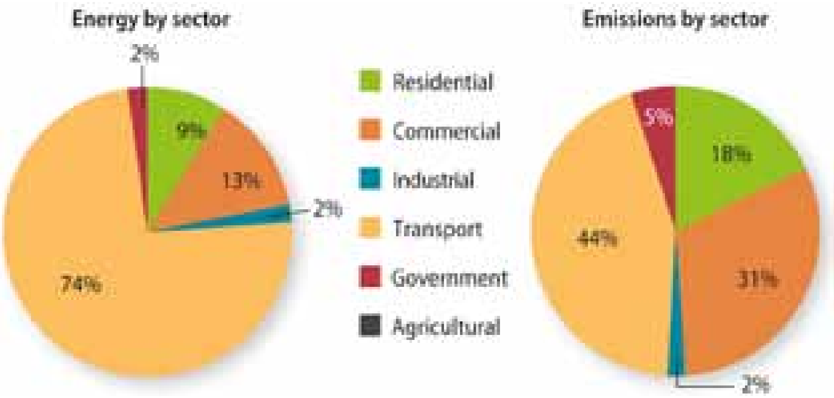




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

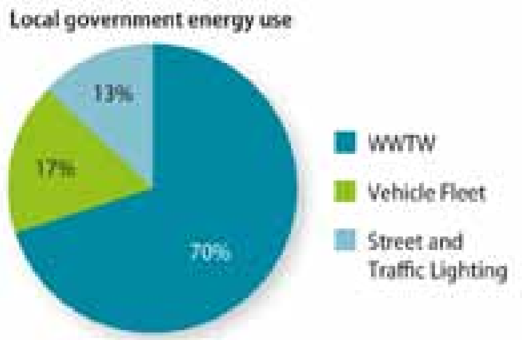
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

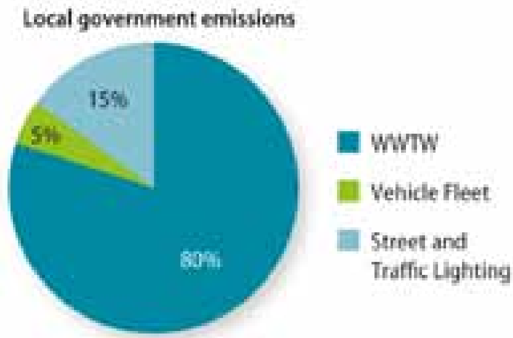
Sector	GJ	tCO_2e
Residential	422 004	91 595
Commercial	588 288	164 254
Industrial	99 793	8 581
Transport	3 388 853	230 564
Government	109 111	25 147
Agriculture	–	–
Losses	24 690	7 064
TOTAL	**4 632 739**	**527 205**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	66 028	–	–	66 028
WWTW	66 028	–	–	66 028
Vehicle Fleet	–	16 526	–	16 526
Street and Traffic Lighting	11 977	–	–	11 977
TOTAL	**144 032**	**16 526**	**–**	**160 558**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	18 891	–	–	18 891
WWTW	18 891	–	–	18 891
Vehicle Fleet	–	1 143	–	1 143
Street and Traffic Lighting	3 427	–	–	3 427
TOTAL	**41 209**	**1 143**	**–**	**42 352**





KWADUKUZA

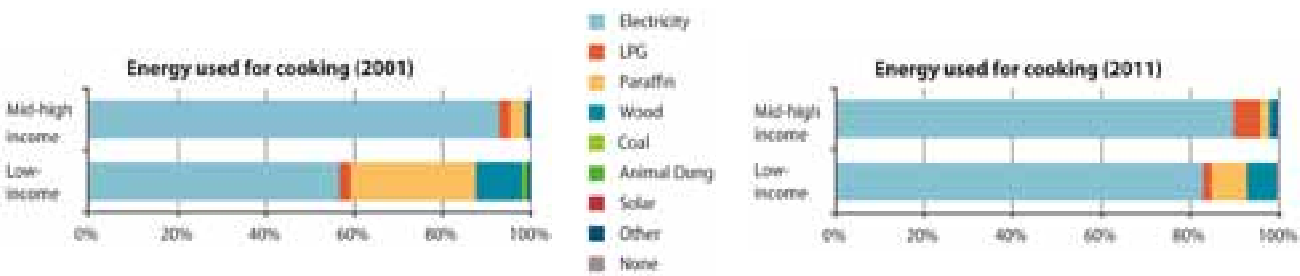
KEY INDICATORS

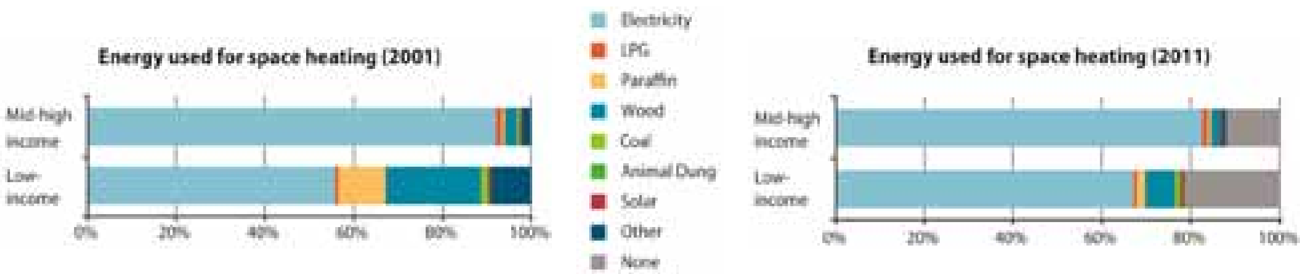
Energy and emissions overview	Value	Year
Energy per capita (GJ)	16,0	2012
Energy per GVA (GJ/R millions)	245,7	2012
GHG per capita (tonnes CO_2e)	3,3	2012
GHG per GVA (tCO_2e/R millions)	50,1	2012

General	Value	Year	Value	Year
Population density (people/km^2)	315	2011	228	2001
Population growth (% p.a.)	3,3%	2001-2011		
Umemployment (narrow)	25%	2011	34%	2001
Umemployment (broad)	35%	2011	38%	2001
Informal households (%)	11%	2011	21%	2001
Indigent households (<R3 200/month)	23%	2011		
Households that own a car (%)	23%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	90%	2011	75%	2001
Households using safe/clean energy for cooking (%)	89%	2011	66%	2001
Households using safe/clean energy for heating (%)	73%	2011	63%	2001
No. of households without formal electricity connection	6 876	2012		
Potential maximum share of indigent households accessing FBE (%)	24%	2012		

KWADUKUZA HOUSEHOLD ENERGY USE

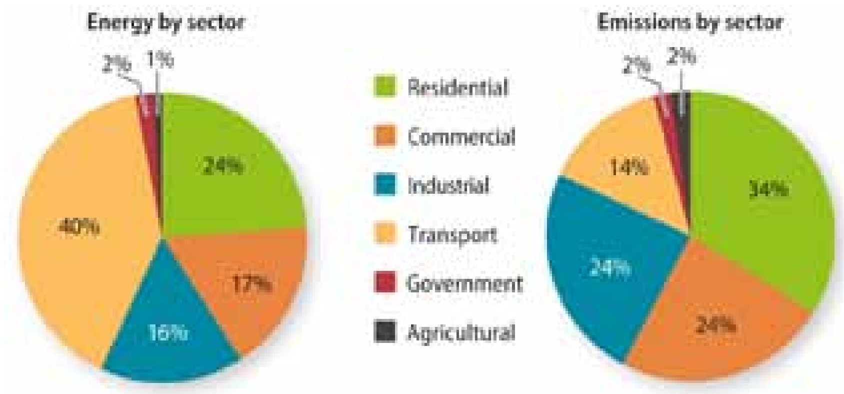




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

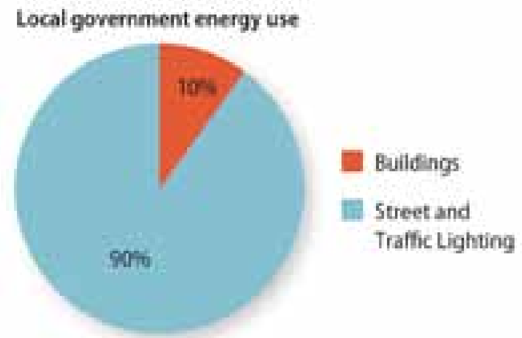
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

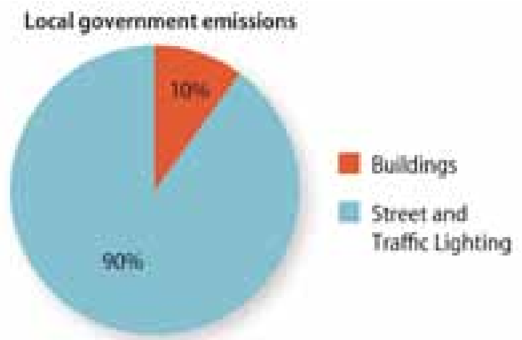
Sector	GJ	tCO_2e
Residential	812 968	232 508
Commercial	575 743	164 726
Industrial	567 285	159 953
Transport	1 381 049	94 273
Government	53 411	15 281
Agriculture	40 848	11 687
Losses	260 241	74 458
TOTAL	**3 691 545**	**752 886**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	5 406	–	–	5 406
WWTW	–	–	–	–
Buildings	–	–	–	–
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	47 863	–	–	47 863
TOTAL	**53 269**	**–**	**–**	**53 269**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	1 547	–	–	1 547
WWTW	–	–	–	–
Buildings	–	–	–	–
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	13 694	–	–	13 694
TOTAL	**15 241**	**–**	**–**	**15 241**





MANGAUNG

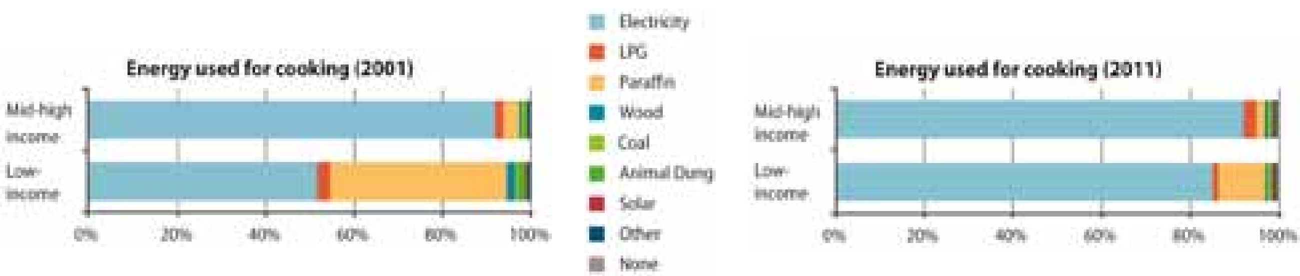
KEY INDICATORS

Energy and emissions overview	Value	Year
Energy per capita (GJ)	20,2	2012
Energy per GVA (GJ/R millions)	564,0	2012
GHG per capita (tonnes CO_2e)	2,9	2012
GHG per GVA (tCO_2e/R millions)	82,2	2012

General	Value	Year	Value	Year
Population density (people/km^2)	119	2011	103	2001
Population growth (% p.a.)	1,5%	2001–2011		
Umemployment (narrow)	28%	2011	10%	2001
Umemployment (broad)	36%	2011	44%	2001
Informal households (%)	14%	2011	24%	2001
Indigent households (<R3 200/month)	44%	2011		
Households that own a car (%)	30%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	91%	2011	85%	2001
Households using safe/clean energy for cooking (%)	91%	2011	64%	2001
Households using safe/clean energy for heating (%)	57%	2011	56%	2001
No. of households without formal electricity connection	No data	2012		
Potential maximum share of indigent households accessing FBE (%)	14%	2012		

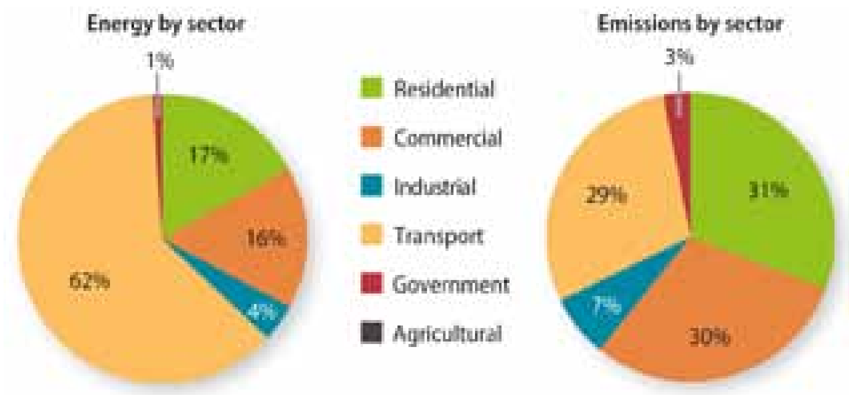
MANGAUNG HOUSEHOLD ENERGY USE



ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

Sector	GJ	tCO_2e
Residential	2 566 386	686 325
Commercial	2 340 899	666 727
Industrial	608 530	149 964
Transport	9 406 084	647 151
Government	192 091	52 474
Agriculture	–	–
Losses	–	–
TOTAL	**15 113 990**	**2 202 641**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	–	–	–	–
WWTW	–	–	–	–
Buildings	–	–	–	–
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	–	–	–	–
TOTAL	**–**	**–**	**–**	**–**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	–	–	–	–
WWTW	–	–	–	–
Buildings	–	–	–	–
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	–	–	–	–
TOTAL	**–**	**–**	**–**	**–**

MBOMBELA

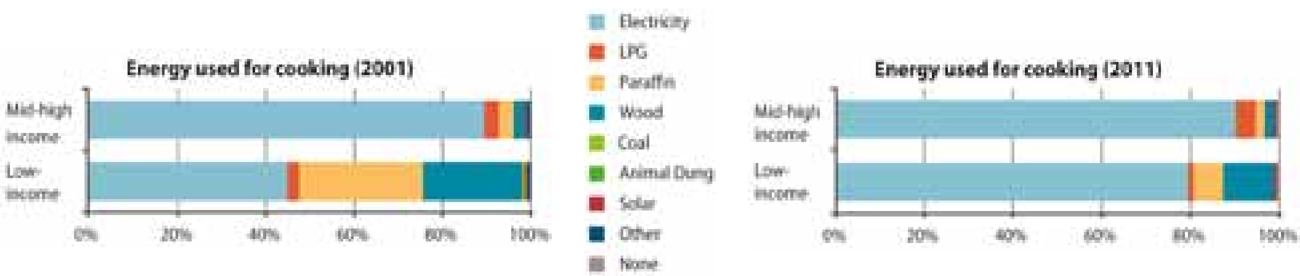
KEY INDICATORS

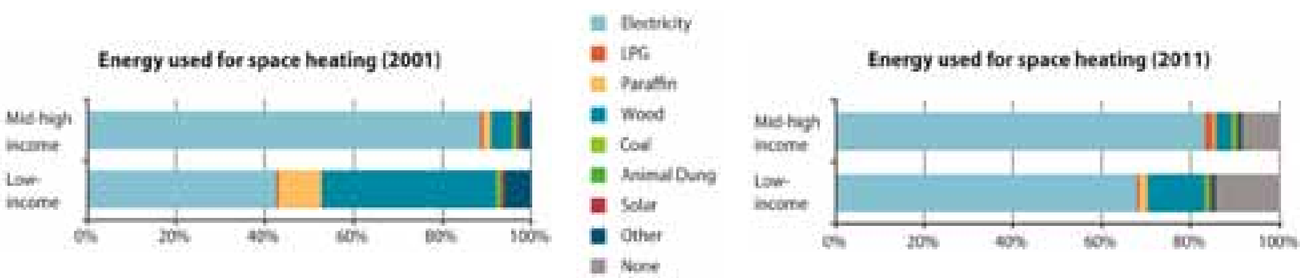
Energy and emissions overview	Value	Year
Energy per capita (GJ)	21,9	2011
Energy per GVA (GJ/R millions)	645,1	2011
GHG per capita (tonnes CO_2e)	3,8	2011
GHG per GVA (tCO_2e/R millions)	112,3	2011

General	Value	Year	Value	Year
Population density (people/km^2)	171	2011	138	2001
Population growth (% p.a.)	2,1%	2001–2011		
Umemployment (narrow)	28%	2011	28%	2001
Umemployment (broad)	38%	2011	47%	2001
Informal households (%)	5%	2011	9%	2001
Indigent households (<R3 200/month)	65%	2011		
Households that own a car (%)	28%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	90%	2011	72%	2001
Households using safe/clean energy for cooking (%)	87%	2011	56%	2001
Households using safe/clean energy for heating (%)	75%	2011	51%	2001
No. of households without formal electricity connection	19 040	2011		
Potential maximum share of indigent households accessing FBE (%)	12%	2011		

MBOMBELA HOUSEHOLD ENERGY USE

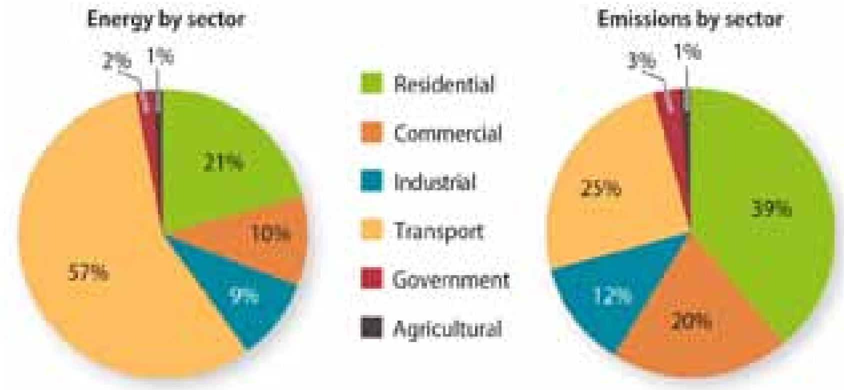




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

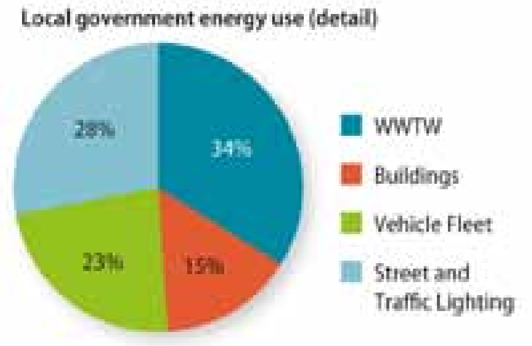
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

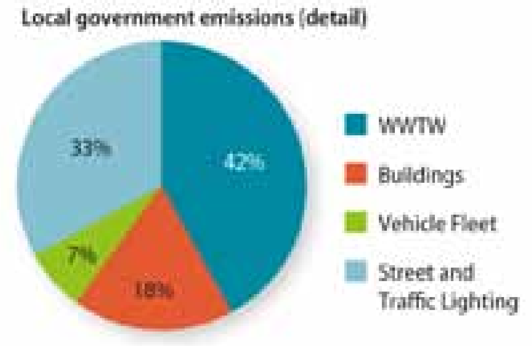
Sector	GJ	tCO_2e
Residential	2 367 779	669 792
Commercial	1 165 135	332 671
Industrial	988 770	212 232
Transport	6 228 392	427 747
Government	191 558	45 322
Agriculture	65 243	18 667
Losses	1 866 517	534 031
TOTAL	**12 873 393**	**2 240 462**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	94 817	–	–	94 817
WWTW	66 107	–	–	66 107
Buildings	28 710	–	–	28 710
Vehicle Fleet	–	43 688	–	43 688
Street and Traffic Lighting	53 053	–	–	53 053
TOTAL	**242 687**	**43 688**	**–**	**286 375**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	94 817	–	–	94 817
WWTW	66 107	–	–	66 107
Buildings	28 710	–	–	28 710
Vehicle Fleet	–	43 688	–	43 688
Street and Traffic Lighting	53 053	–	–	53 053
TOTAL	**242 687**	**43 688**	**–**	**286 375**





NELSON MANDELA BAY

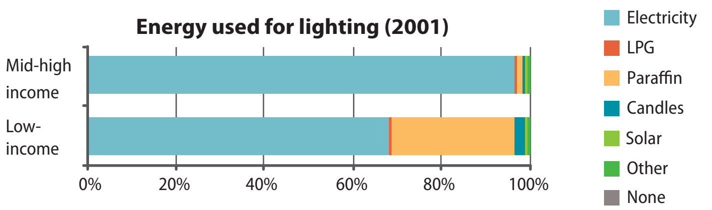
KEY INDICATORS

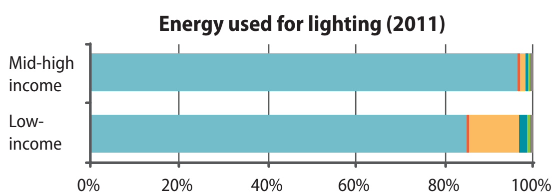
Energy and emissions overview	Value	Year
Energy per capita (GJ)	26,8	2012
Energy per GVA (GJ/R millions)	558,3	2012
GHG per capita (tonnes CO_2e)	4,5	2012
GHG per GVA (tCO_2e/R millions)	92,9	2012

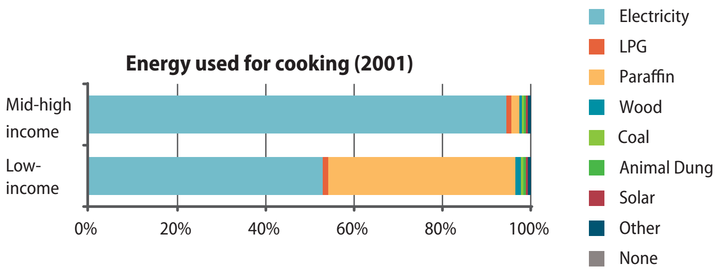
General	Value	Year	Value	Year
Population density (people/km²)	588	2011	513	2001
Population growth (% p.a.)	1,4%	2001–2011		
Umemployment (narrow)	37%	2011	10%	2001
Umemployment (broad)	45%	2011	50%	2001
Informal households (%)	12%	2011	23%	2001
Indigent households (<R3 200/month)	59%	2011		
Households that own a car (%)	36%	2011		

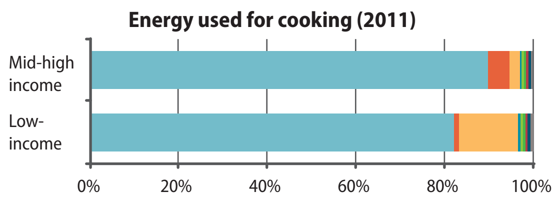
Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	90%	2011	75%	2001
Households using safe/clean energy for cooking (%)	89%	2011	67%	2001
Households using safe/clean energy for heating (%)	57%	2011	60%	2001
No. of households without formal electricity connection	No data	2012		
Potential maximum share of indigent households accessing FBE (%)	37%	2012		

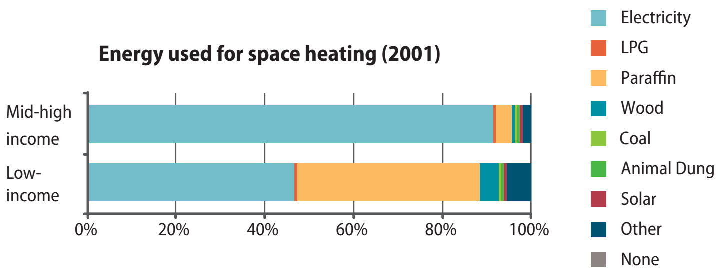
NELSON MANDELA BAY HOUSEHOLD ENERGY USE

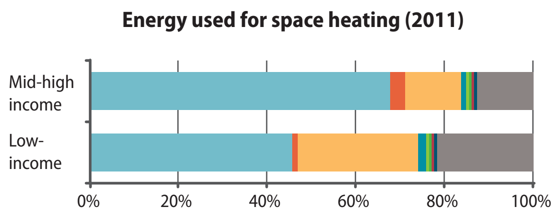








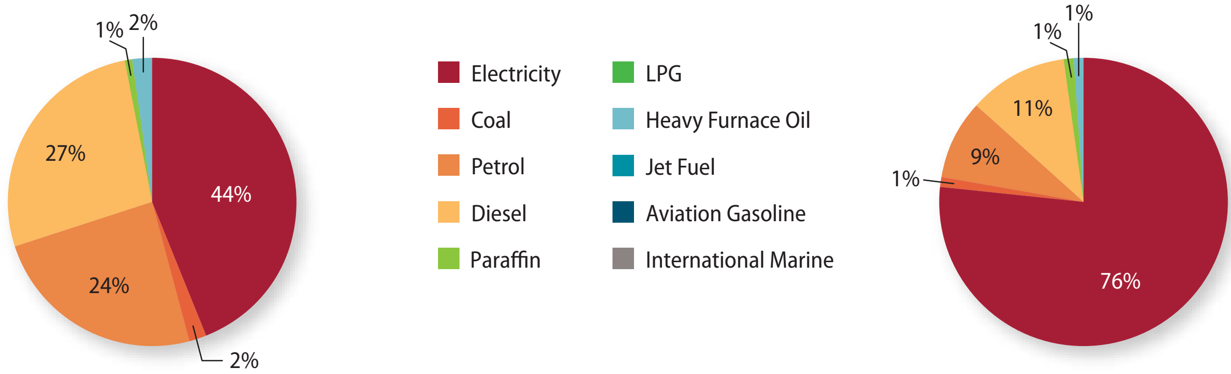




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

Energy by fuel

Emissions by fuel

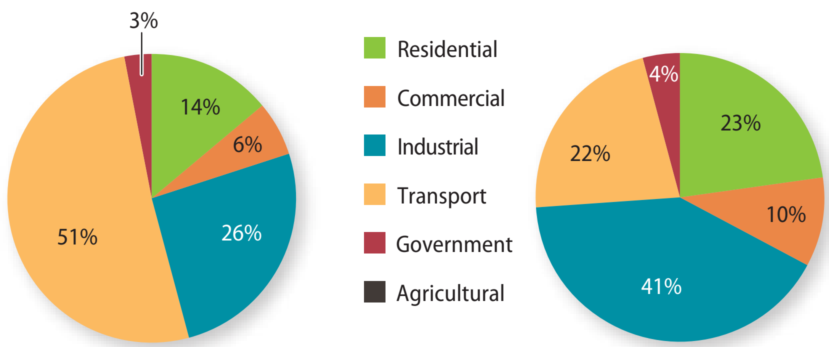


ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

Sector	GJ	tCO_2e
Residential	4 168 042	1 105 264
Commercial	1 698 082	484 166
Industrial	7 879 156	2 001 279
Transport	15 264 242	1 051 395
Government	782 467	187 767
Agriculture	515	147
Losses	1 046 073	299 293
TOTAL	**30 838 577**	**5 129 312**

Energy by sector

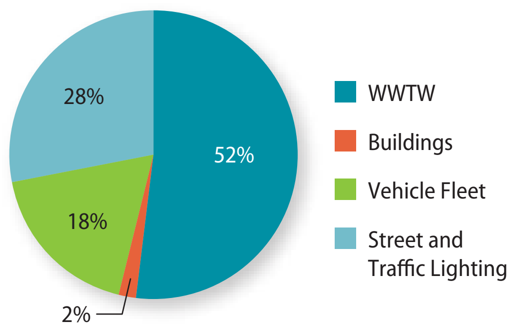
Emissions by sector



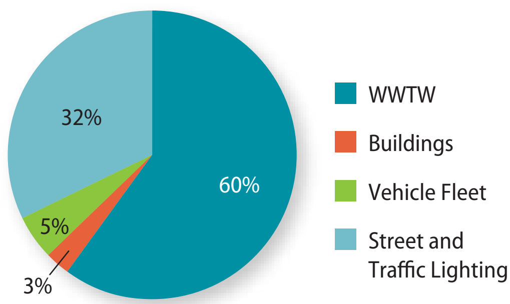
LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	399 609	–	–	399 609
WWTW	381 151	–	–	381 151
Buildings	18 458	–	–	18 458
Vehicle Fleet	–	132 003	–	132 003
Street and Traffic Lighting	207 115	–	–	207 115
TOTAL	**1 006 333**	**132 003**	**–**	**1 138 336**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	114 333	–	–	114 333
WWTW	109 052	–	–	109 052
Buildings	5 281	–	–	5 281
Vehicle Fleet	–	9 119	–	9 119
Street and Traffic Lighting	59 258	–	–	59 258
TOTAL	**287 923**	**9 119**	**–**	**297 042**

Local government energy use



Local government emissions



POLOKWANE

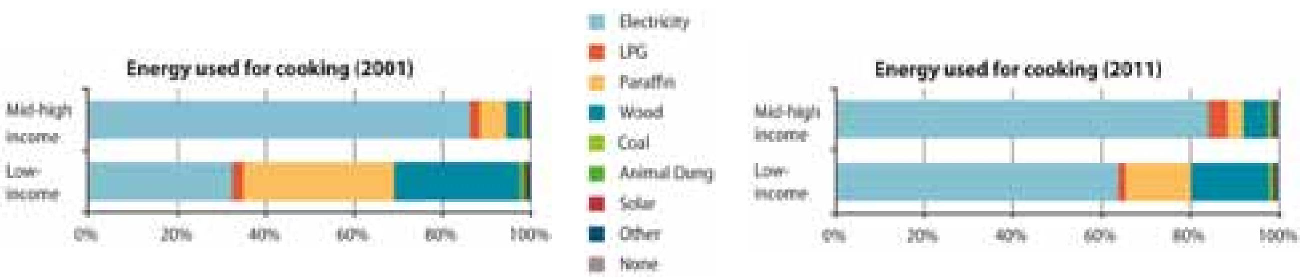
KEY INDICATORS

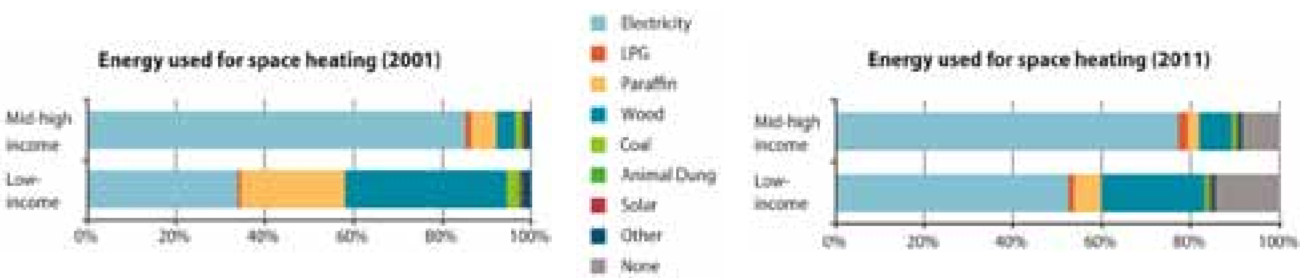
Energy and emissions overview	Value	Year
Energy per capita (GJ)	28,1	2011
Energy per GVA (GJ/R millions)	1 040,2	2011
GHG per capita (tonnes CO_2e)	4,0	2011
GHG per GVA (tCO_2e/R millions)	146,3	2011

General	Value	Year	Value	Year
Population density (people/km^2)	167	2011	135	2001
Population growth (% p.a.)	2,2%	2001–2011		
Umemployment (narrow)	32%	2011	41%	2001
Umemployment (broad)	40%	2011	48%	2001
Informal households (%)	9%	2011	16%	2001
Indigent households (<R3 200/month)	47%	2011		
Households that own a car (%)	27%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	83%	2011	64%	2001
Households using safe/clean energy for cooking (%)	74%	2011	45%	2001
Households using safe/clean energy for heating (%)	62%	2011	44%	2001
No. of households without formal electricity connection	30 260	2011		
Potential maximum share of indigent households accessing FBE (%)	32%	2011		

POLOKWANE HOUSEHOLD ENERGY USE

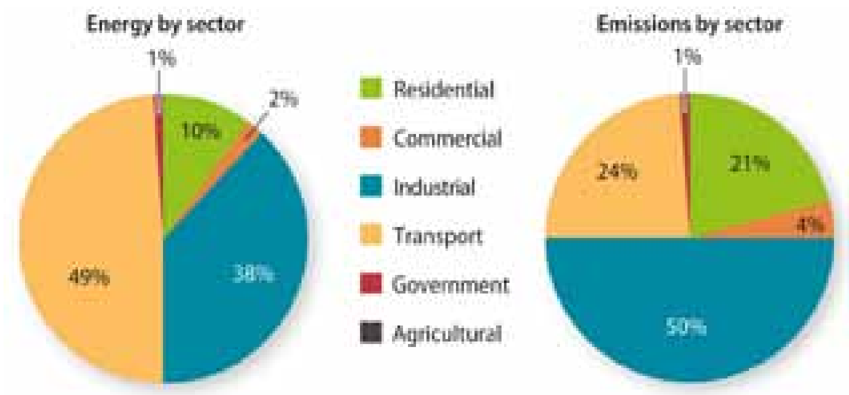




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

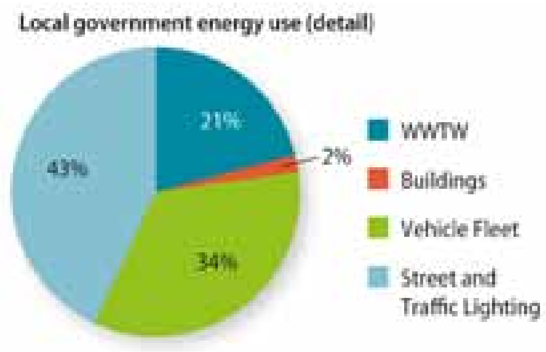
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

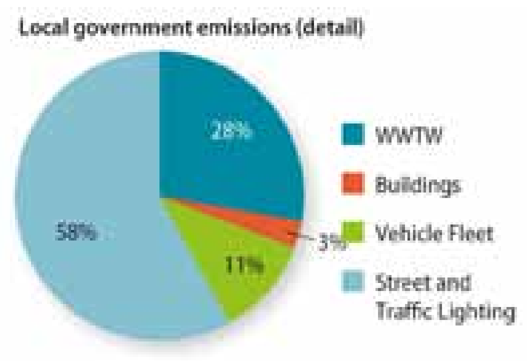
Sector	GJ	tCO_2e
Residential	1 871 740	512 969
Commercial	354 767	100 848
Industrial	6 676 622	1 237 835
Transport	8 591 265	586 984
Government	123 520	26 276
Agriculture	1 620	464
Losses	82 573	23 625
TOTAL	**17 702 108**	**2 489 001**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	28 710	–	–	28 710
WWTW	26 168	–	–	26 168
Buildings	2 542	–	–	2 542
Vehicle Fleet	–	41 757	–	41 757
Street and Traffic Lighting	53 053	–	–	53 053
TOTAL	**110 473**	**41 757**	**–**	**152 230**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	8 214	–	–	8 214
WWTW	7 487	–	–	7 487
Buildings	727	–	–	727
Vehicle Fleet	–	2 883	–	2 883
Street and Traffic Lighting	15 179	–	–	15 179
TOTAL	**31 608**	**2 883**	**–**	**34 491**





RUSTENBURG

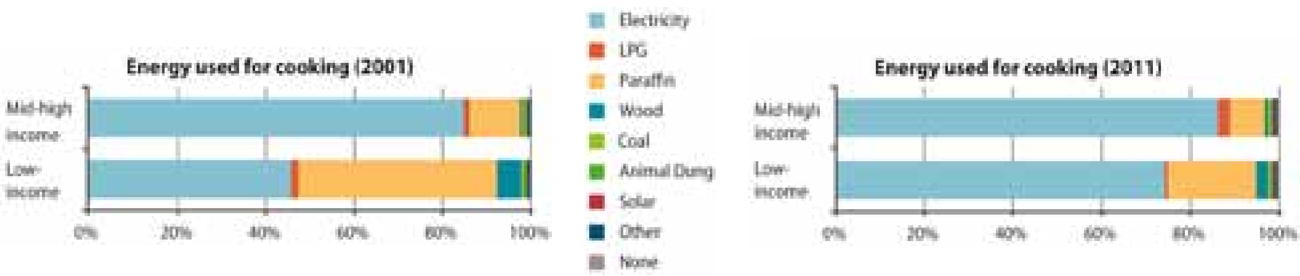
KEY INDICATORS

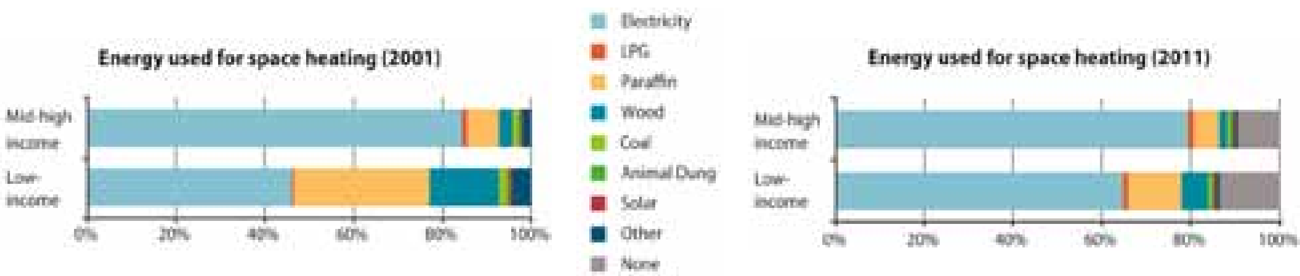
Energy and emissions overview	**Value**	**Year**
Energy per capita (GJ)	101,2	2011
Energy per GVA (GJ/R millions)	2 089,0	2011
GHG per capita (tonnes CO_2e)	23,1	2011
GHG per GVA (tCO_2e/R millions)	475,9	2011

General	**Value**	**Year**	**Value**	**Year**
Population density (people/km^2)	161	2011	113	2001
Population growth (% p.a.)	3,6%	2001–2011		
Umemployment (narrow)	26%	2011	32%	2001
Umemployment (broad)	32%	2011	36%	2001
Informal households (%)	30%	2011	40%	2001
Indigent households (<R3 200/month)	33%	2011		
Households that own a car (%)	75%	2011		

Energy Poverty	**Value**	**Year**	**Value**	**Year**
Electrified households, lighting as proxy (%)	83%	2011	92%	2001
Households using safe/clean energy for cooking (%)	82%	2011	57%	2001
Households using safe/clean energy for heating (%)	73%	2011	55%	2001
No. of households without formal electricity connection	5 500	2011		
Potential maximum share of indigent households accessing FBE (%)	4%	2011		

RUSTENBURG HOUSEHOLD ENERGY USE

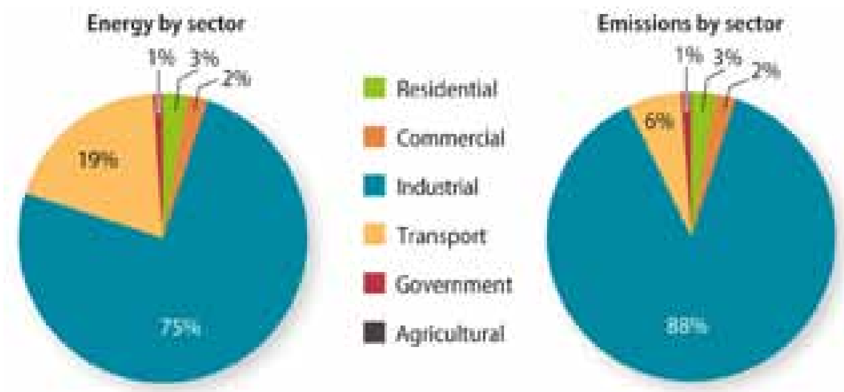




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

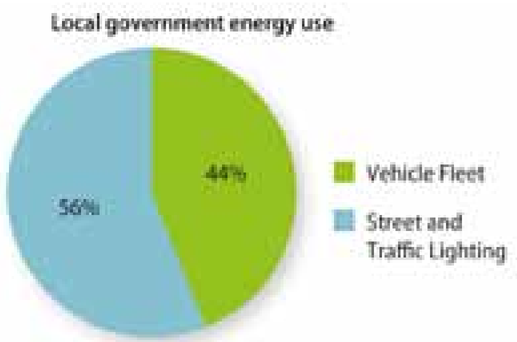
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

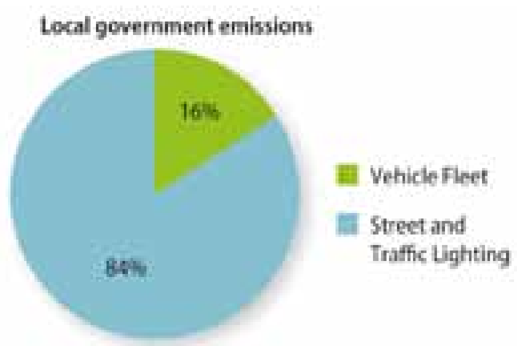
Sector	GJ	tCO_2e
Residential	1 449 755	361 413
Commercial	1 048 750	291 503
Industrial	41 562 371	11 033 443
Transport	10 697 267	746 231
Government	97 364	19 937
Agriculture	473 130	135 368
Losses	281 477	80 534
TOTAL	**55 610 115**	**12 668 428**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	15	–	–	15
WWTW	–	–	–	–
Buildings	15	–	–	15
Vehicle Fleet	–	36 549	–	36 549
Street and Traffic Lighting	46 163	–	–	46 163
TOTAL	**46 192**	**36 549**	**–**	**82 741**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	4	–	–	4
WWTW	–	–	–	–
Buildings	4	–	–	4
Vehicle Fleet	–	2 537	–	2 537
Street and Traffic Lighting	13 208	–	–	13 208
TOTAL	**13 216**	**2 537**	**–**	**15 753**





SALDANHA BAY

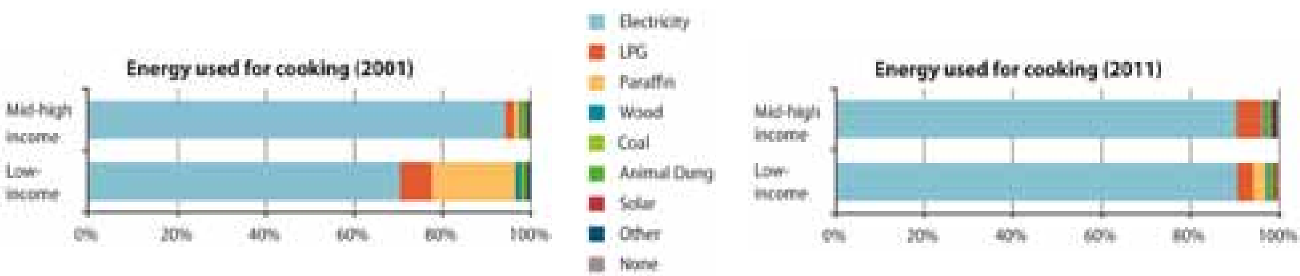
KEY INDICATORS

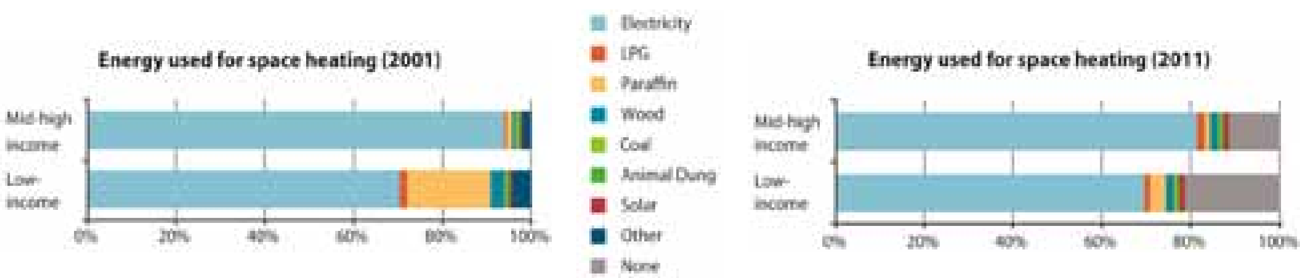
Energy and emissions overview	Value	Year
Energy per capita (GJ)	338,2	2012
Energy per GVA (GJ/R millions)	8 587,6	2012
GHG per capita (tonnes CO_2e)	50,4	2012
GHG per GVA (tCO_2e/R millions)	1 278,7	2012

General	Value	Year	Value	Year
Population density (people/km²)	49	2011	35	2001
Population growth (% p.a.)	3,5%	2001–2011		
Umemployment (narrow)	23%	2011	22%	2001
Umemployment (broad)	29%	2011	25%	2001
Informal households (%)	17%	2011	14%	2001
Indigent households (<R3 200/month)	48%	2011		
Households that own a car (%)	43%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	97%	2011	92%	2001
Households using safe/clean energy for cooking (%)	98%	2011	87%	2001
Households using safe/clean energy for heating (%)	78%	2011	82%	2001
No. of households without formal electricity connection	122	2012		
Potential maximum share of indigent households accessing FBE (%)	47%	2012		

SALDANHA BAY HOUSEHOLD ENERGY USE

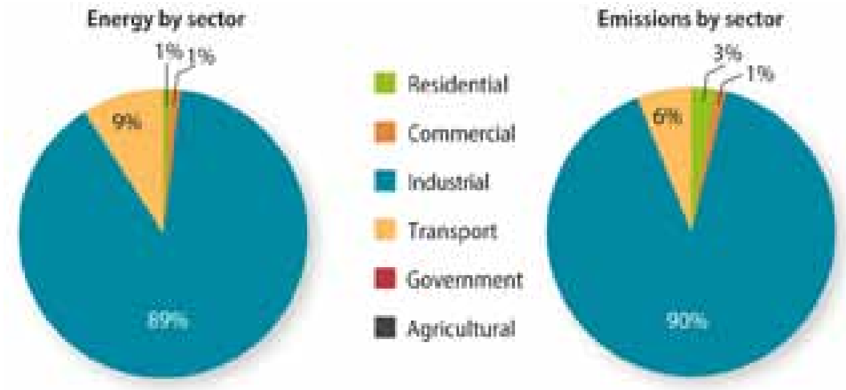




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

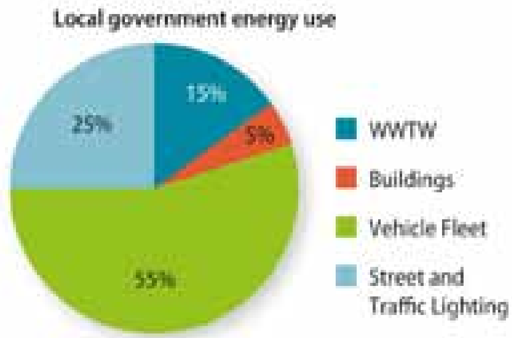
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

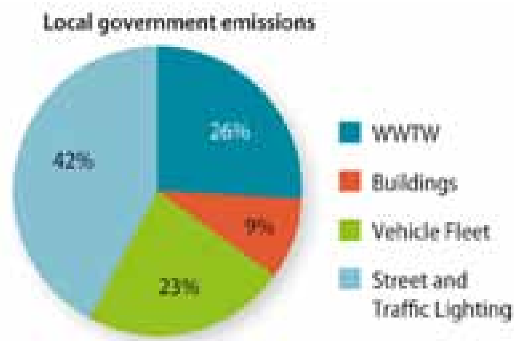
Sector	GJ	tCO_2e
Residential	302 723	86 595
Commercial	107 644	30 798
Industrial	24 026 495	2 812 731
Transport	2 466 326	171 158
Government	56 535	9 486
Agriculture	–	–
Losses	6 586 333	1 884 423
TOTAL	**33 546 058**	**4 995 191**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	11 494	–	–	11 494
WWTW	8 576	–	–	8 576
Buildings	2 918	–	–	2 918
Vehicle Fleet	–	30 979	–	30 979
Street and Traffic Lighting	14 063	–	–	14 063
TOTAL	**37 051**	**30 979**	**–**	**68 030**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	3 289	–	–	3 289
WWTW	2 454	–	–	2 454
Buildings	835	–	–	835
Vehicle Fleet	–	2 173	–	2 173
Street and Traffic Lighting	4 023	–	–	4 023
TOTAL	**10 601**	**2 173**	**–**	**12 774**





SOL PLAATJE

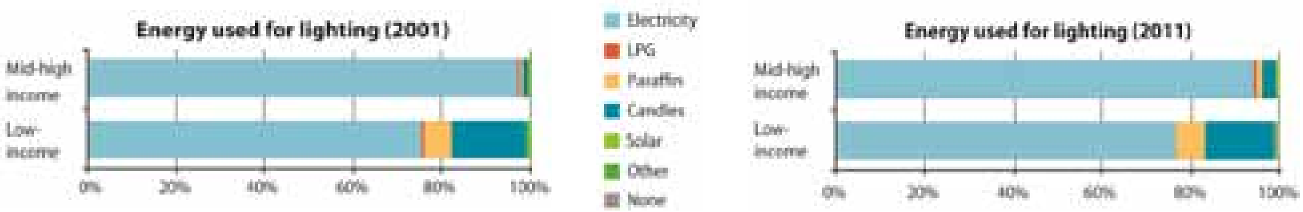
KEY INDICATORS

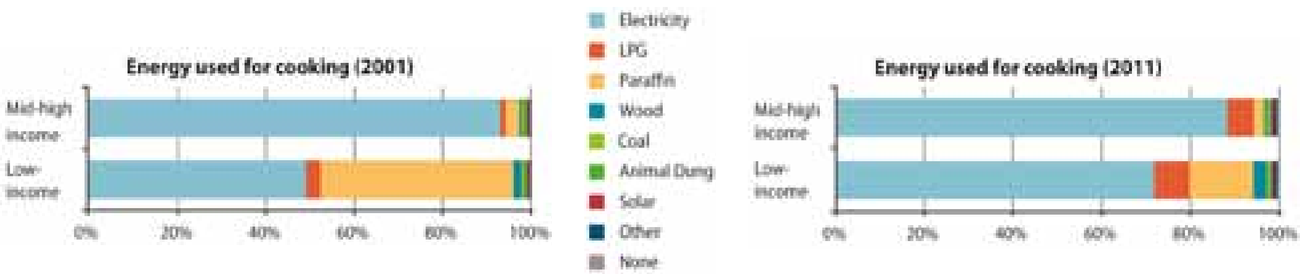
Energy and emissions overview	Value	Year
Energy per capita (GJ)	18,1	2011
Energy per GVA (GJ/R millions)	405,1	2011
GHG per capita (tonnes CO_2e)	3,5	2011
GHG per GVA (tCO_2e/R millions)	77,3	2011

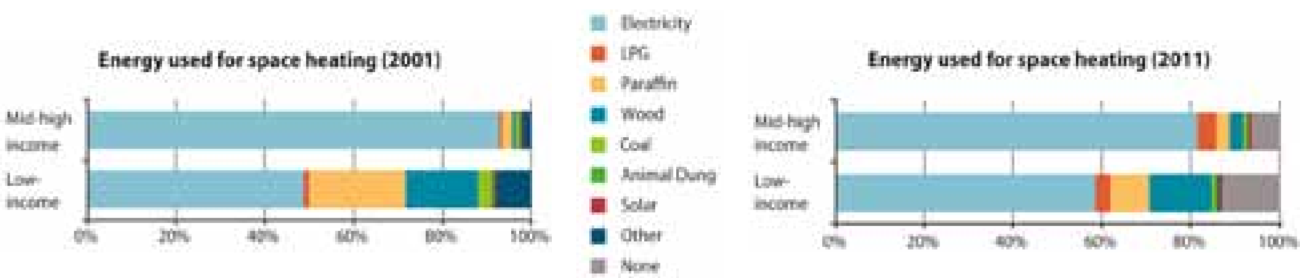
General	Value	Year	Value	Year
Population density (people/km^2)	79	2011	64	2001
Population growth (% p.a.)	2,1%	2001–2011		
Umemployment (narrow)	32%	2011	41%	2001
Umemployment (broad)	40%	2011	44%	2001
Informal households (%)	17%	2011	17%	2001
Indigent households (<R3 200/month)	40%	2011		
Households that own a car (%)	34%	2011		

Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	85%	2011	82%	2001
Households using safe/clean energy for cooking (%)	88%	2011	65%	2001
Households using safe/clean energy for heating (%)	73%	2011	62%	2001
No. of households without formal electricity connection	9 127	2012		
Potential maximum share of indigent households accessing FBE (%)	91%	2011		

SOL PLAATJE HOUSEHOLD ENERGY USE



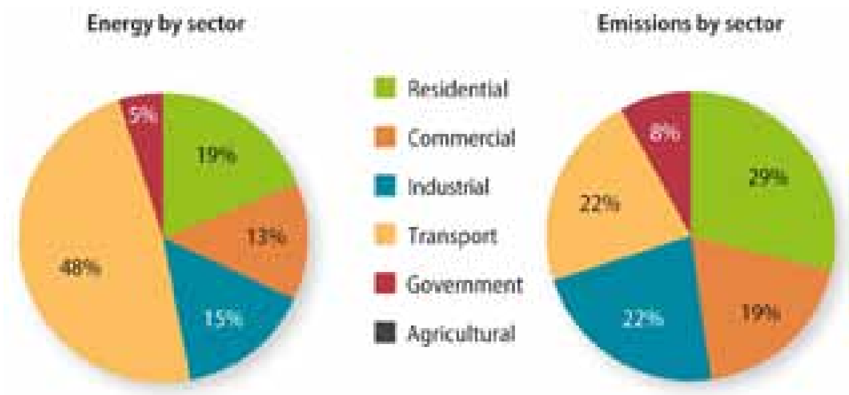




ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)

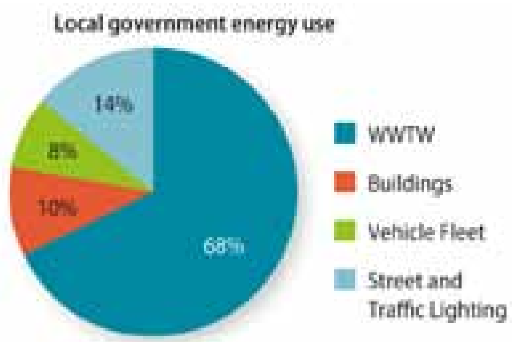
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

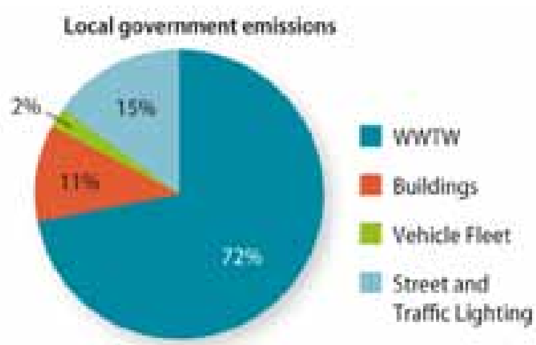
Sector	GJ	tCO_2e
Residential	788 814	222 730
Commercial	531 621	146 242
Industrial	633 568	168 346
Transport	2 038 128	175 328
Government	230 504	65 950
Agriculture	–	–
Losses	279 039	79 836
TOTAL	**4 501 675**	**858 432**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	196 070	–	–	196 070
WWTW	170 492	–	–	170 492
Buildings	25 578	–	–	25 578
Vehicle Fleet	–	20 930	–	20 930
Street and Traffic Lighting	34 434	–	–	34 434
TOTAL	**426 574**	**20 930**	**–**	**447 504**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	53 919	–	–	53 919
WWTW	46 885	–	–	46 885
Buildings	7 034	–	–	7 034
Vehicle Fleet	–	1 529	–	1 529
Street and Traffic Lighting	9 469	–	–	9 469
TOTAL	**117 307**	**1 529**	**–**	**118 836**





STEVE TSHWETE

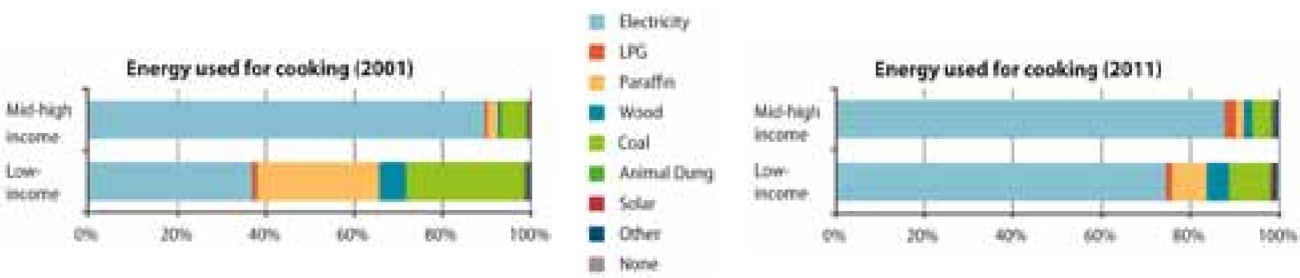
KEY INDICATORS

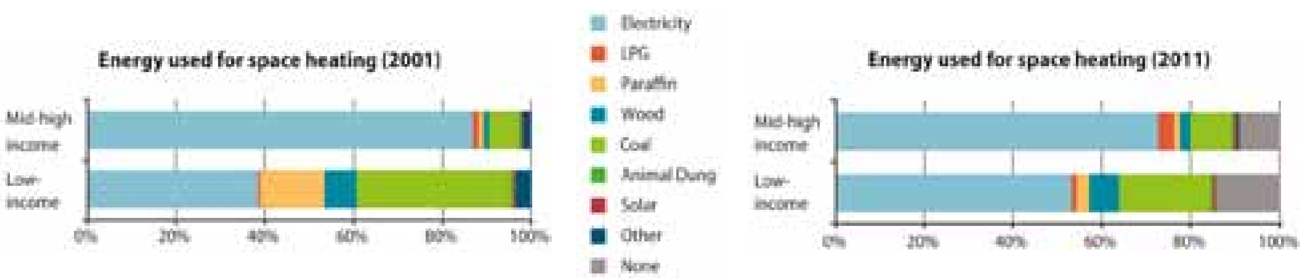
Energy and emissions overview	Value	Year
Energy per capita (GJ)	84,0	2012
Energy per GVA (GJ/R millions)	1 177,4	2012
GHG per capita (tonnes CO_2e)	16,2	2012
GHG per GVA (tCO_2e/R millions)	227,3	2012

General	Value	Year	Value	Year
Population density (people/km^2)	58	2011	36	2001
Population growth (% p.a.)	4,9%	2001–2011		
Umemployment (narrow)	20%	2011	35%	2001
Umemployment (broad)	27%	2011	38%	2001
Informal households (%)	14%	2011	16%	2001
Indigent households (<R3 200/month)	32%	2011		
Households that own a car (%)	41%	2011		

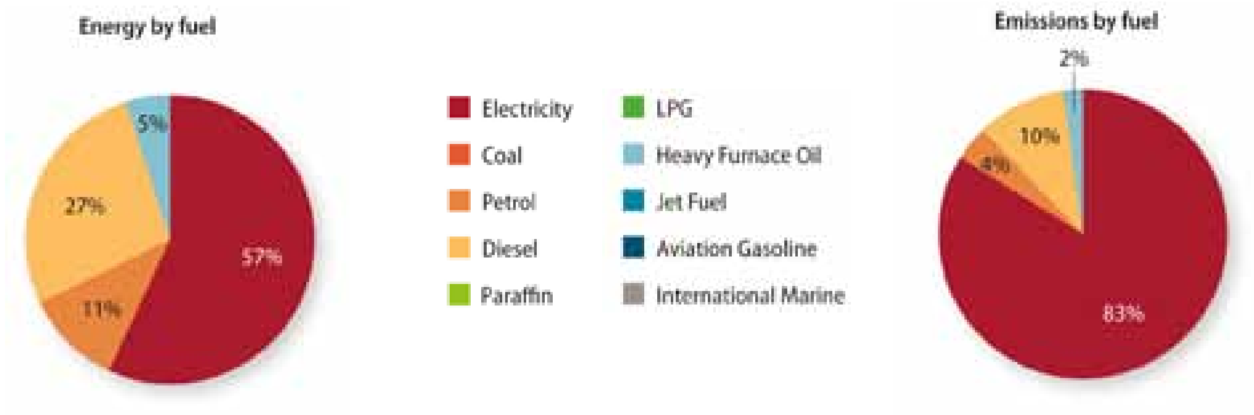
Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	91%	2011	75%	2001
Households using safe/clean energy for cooking (%)	84%	2011	54%	2001
Households using safe/clean energy for heating (%)	66%	2011	54%	2001
No. of households without formal electricity connection	532	2012		
Potential maximum share of indigent households accessing FBE (%)	74%	2012		

STEVE TSHWETE HOUSEHOLD ENERGY USE



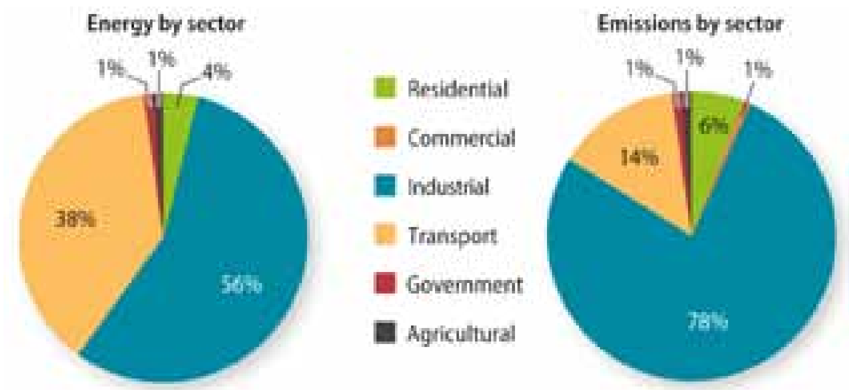


ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)



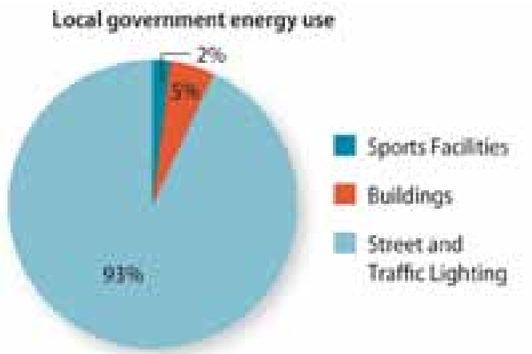
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA INCLUDED)

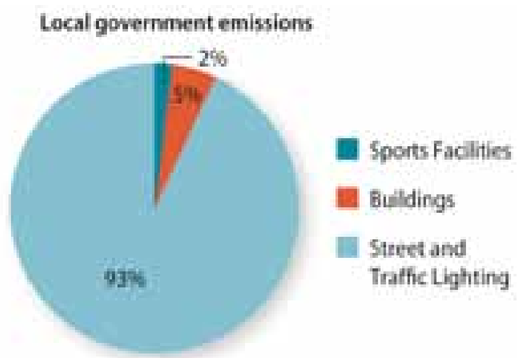
Sector	GJ	tCO_2e
Residential	825 945	226 847
Commercial	76 455	21 875
Industrial	10 785 681	2 869 864
Transport	7 255 388	505 731
Government	95 196	27 237
Agriculture	99 237	28 393
Losses	161 729	46 272
TOTAL	**19 299 631**	**3 726 218**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	6 413	–	–	6 413
WWTW	1 314	–	–	1 314
Buildings	5 100	–	–	5 100
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	88 321	–	–	88 321
TOTAL	**101 148**	**–**	**–**	**101 148**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	1 835	–	–	1 835
WWTW	376	–	–	376
Buildings	1 459	–	–	1 459
Vehicle Fleet	–	–	–	–
Street and Traffic Lighting	25 270	–	–	25 270
TOTAL	**28 939**	**–**	**–**	**28 939**





TSHWANE

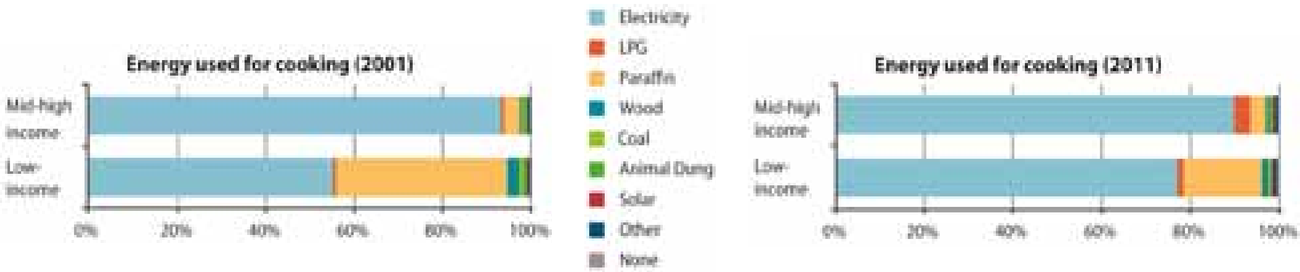
KEY INDICATORS

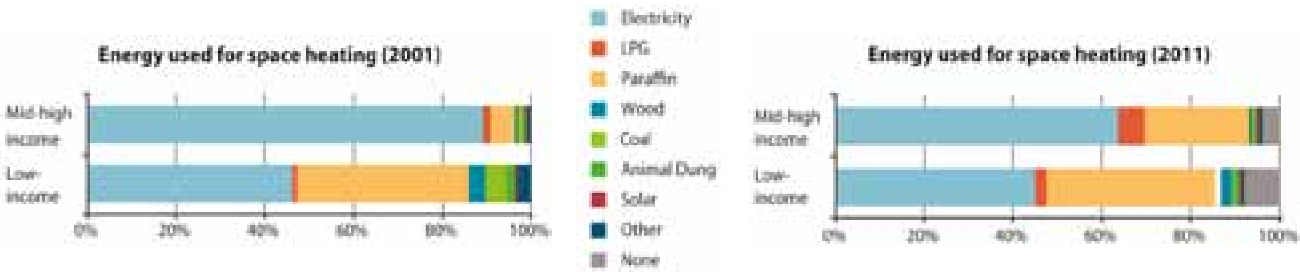
Energy and emissions overview	Value	Year
Energy per capita (GJ)	31,7	2012
Energy per GVA (GJ/R millions)	526,7	2012
GHG per capita (tonnes CO_2e)	5,7	2012
GHG per GVA (tCO_2e/R millions)	93,9	2012

General	Value	Year	Value	Year
Population density (people/km^2)	464	2011	340	2001
Population growth (% p.a.)	3,2%	2001-2011		
Umemployment (narrow)	24%	2011	7%	2001
Umemployment (broad)	31%	2011	40%	2001
Informal households (%)	18%	2011	23%	2001
Indigent households (<R3 200/month)	48%	2011		
Households that own a car (%)	44%	2011		

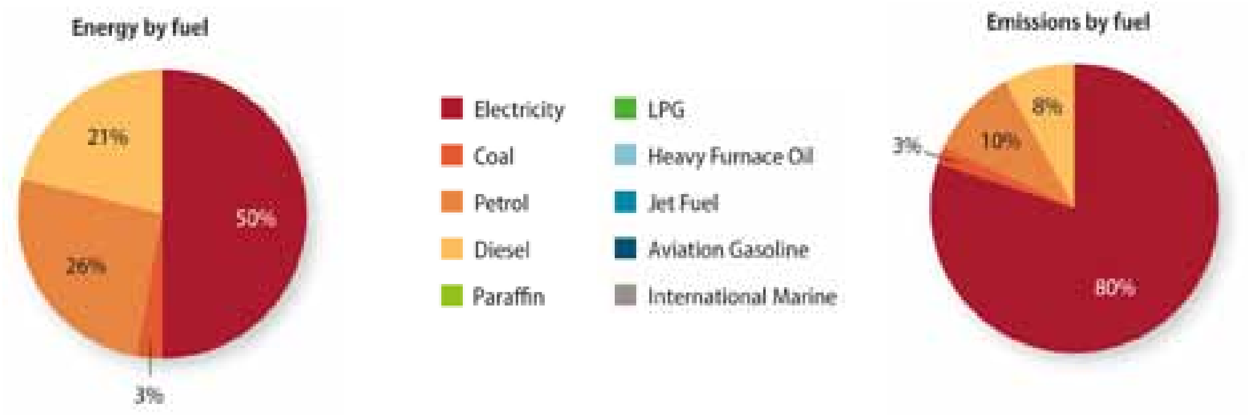
Energy Poverty	Value	Year	Value	Year
Electrified households, lighting as proxy (%)	89%	2011	80%	2001
Households using safe/clean energy for cooking (%)	87%	2011	72%	2001
Households using safe/clean energy for heating (%)	78%	2011	70%	2001
No. of households without formal electricity connection	145 000	2012		
Potential maximum share of indigent households accessing FBE (%)	25%	2012		

TSHWANE HOUSEHOLD ENERGY USE



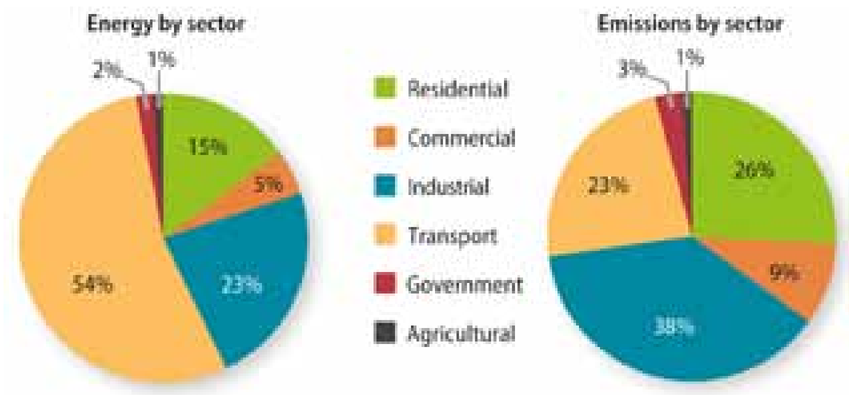


ENERGY AND EMISSIONS BY FUEL (ESKOM DISTRIBUTION DATA INCLUDED)



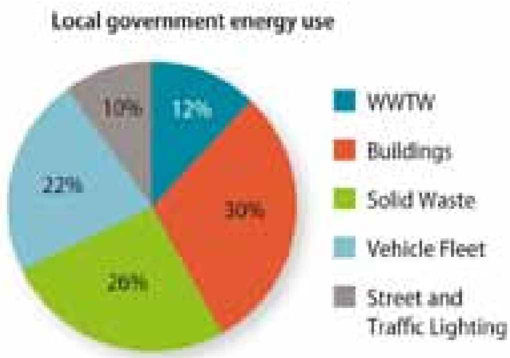
ENERGY AND EMISSIONS BY SECTOR (ESKOM DISTRIBUTION DATA EXCLUDED)

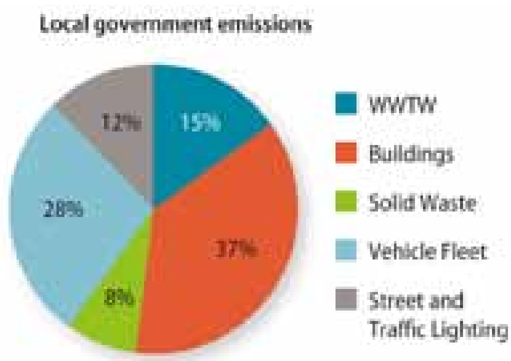
Sector	GJ	tCO_2e
Residential	11 980 261	3 364 393
Commercial	4 030 792	1 147 661
Industrial	18 609 021	4 776 023
Transport	42 579 816	2 915 381
Government	1 682 505	387 744
Agriculture	589 365	168 624
Losses	13 107 865	3 750 306
TOTAL	**92 579 626**	**16 510 131**



LOCAL GOVERNMENT

Fuel Use (GJ)	Electricity	Liquid Fuel	Coal	TOTAL
Buildings and Facilities	704 054	271	–	704 325
WWTW	199 608	–	–	199 608
Buildings	500 622	–	–	500 622
Solid Waste	3 825	–	–	3 825
Vehicle Fleet	–	434 454	–	434 454
Street and Traffic Lighting	378 372	–	–	378 372
TOTAL	**1 786 479**	**434 725**	**–**	**2 221 205**
Emissions (tCO_2e)	**Electricity**	**Liquid Fuel**	**Coal**	**tCO_2e**
Buildings and Facilities	201 438	19	–	201 457
WWTW	57 110	–	–	57 110
Buildings	143 233	–	–	143 233
Solid Waste	1 094	–	–	1 094
Vehicle Fleet	–	30 662	–	30 662
Street and Traffic Lighting	108 256	–	–	108 256
TOTAL	**511 132**	**30 682**	**–**	**541 813**





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APPENDIX 1: METHODOLOGY NOTES

Data overview

The baseline data year for the 2015 State of Energy in SA Cities Report was set for 2011. This is the most recent year for which there is a comprehensive national household dataset available, namely Census 2011, which includes reliable demographic and energy services information. Although more recent datasets were available for other energy-related variables, such as electricity consumption at a municipal level, using the same data year throughout (as far as possible) was considered more statistically sound.

Data sources, collection and categorisation

Table 5: Summary of data sources used in this report

Data category	Data	Primary data source	Secondary/Tertiary data source
Energy consumption	Electricity consumption	Municipal electricity departments; detailed state of energy reports and GHG inventories of various municipalities; Western Cape DEADP	–
	Liquid fuel data	South African Petroleum Industry Association (SAPIA)	–
	Coal data (Residential sector)	Census 2011 (Stats SA) and methodology developed by Aurecon Consultancy	–
	Coal data (Industrial and commercial)	Coal suppliers	–
	Household fuels	Census 2001 and 2011 (Stats SA)	–
Conversion factors	GHG emission conversion factors	www.emissionfactors.com (using the IPCC's 4th Assessment Report Global Warming Potential) and Eskom's annual report (in the case of electricity).	–
	Energy conversion factors	National Department of Energy's Draft 2012 Integrated Energy Planning Report	–
Demographic, economic and socioeconomic indicators	Population, total number of households, indigent households and dwelling types	Census 2001 and 2011 (Stats SA)	–
	Service delivery data – electrification and housing backlog, FBE	Relevant municipal department; state of energy reports, annual reports; Census 2011 (Stats SA) and IDP reports.	http://www.localgovernment.co.za
	Indigent households	Census 2011 (Stats SA)	–
	Gross Value Added (GVA)	Global Insight, Quantec 2011 and Stats SA (Statistical Release P0441)	–

Energy consumption data

In this study, total energy consumption is made up of 10 fuel categories: electricity, petrol, diesel, paraffin, LPG, coal, heavy furnace oil, jet fuel, aviation gasoline and international marine fuel. Fuel consumption data were reported by fuel type for the following six sectors (where applicable and available): residential, commercial, industrial, transport, government and agriculture.

- The cross-sectional analysis, i.e. all graphs with 2012 data only (energy/emissions per capita, energy/emissions per GVA, etc.), INCLUDES aviation and marine fuel.
- The longitudinal analysis, i.e. all graphs looking at indicators over time, EXCLUDES aviation, marine, biomass, natural gas (i.e. any fuel that was not consistently included across all state of energy reports).

City data: Energy-related data collection is becoming more and more mainstream in municipalities. In the case of eThekwini, year-on-year energy data collection took place from 2010–2012 for Greenhouse Gas Inventories. Some municipalities' data could be drawn from pre-existing State of Energy reports for 2011 (compiled by Aurecon, Ozone, ICLEI and WCG).

Electricity: Municipalities remain a critical source for the primary supply and demand-side energy and related services data required for state of energy reports of this magnitude; especially electricity consumption data. As has been the practice for all previous reports, participating municipalities were contacted and sent a detailed questionnaire on electricity consumption within their municipality. These primary sources also include detailed state of energy reports and GHG Inventories undertaken by municipalities – where available for relevant municipalities and close enough to the baseline year of this study.

Electricity departments are generally able to provide electricity consumption totals, with some degree of breakdown between user categories, although this is not uniform across municipalities. The end-user categories used in this report are: residential, commercial, industrial, municipal/local government own use, agriculture and transport. In some of the municipalities, these categories were indistinguishable. Different billing structures makes sector breakdown difficult and creates some degree of complexity in terms of consistency and comparability between municipalities. Thus, in order to retain the standard categorical breakdown of this report a few assumptions were necessary. For example, 'medium power users' (term used in billing) were reclassified as the commercial sector, while 'large power users' and 'TOU customers' were joined and reclassified as the industrial sector. A scan of the 2011 State of Energy report (using 2007 data), showed similar sectoral proportions which confirmed a 'fair and consistent' estimate albeit imperfect.

Electricity in a municipality is distributed to customers either via the municipal grid or directly via the Eskom grid. The electricity consumption data collected consists of 'municipal distributed electricity' data and the 'Eskom direct electricity supply' data. The 'municipal distributed electricity' is purchased from Eskom and distributed by the municipality to different end users. In addition, technical and non-technical losses (e.g. theft or non-payment) were taken into account in order to derive the total electricity purchased by a municipality. A very big area of concern is that distribution data was not available to the public for areas supplied by Eskom and within a municipal boundary. Many municipal electricity officials are able to provide fairly defensible estimates of Eskom distribution figures within their jurisdiction, but of course this is not ideal.

Liquid fuel: The South African Petroleum Industry Association (SAPIA) is the official body that collects and holds data relating to liquid fuel in the country. Liquid fuel data included in this report are petrol, diesel, LPG, paraffin, jet fuel, aviation gasoline and heavy fuel oil. SAPIA data is still measured along magisterial district lines which means that a municipality may straddle across more than one magisterial district making local estimations somewhat clumsy. Thus, extracting municipal data requires the overlay of magisterial district data onto the municipal area to determine the total proportion of liquid fuel consumed within the municipal boundary. For example, the City of Johannesburg municipality covers the entire district of Johannesburg, Randburg and Roodepoort. It also extends to parts of Kempton Park (15%), Krugersdorp (5%), Pretoria (8%), Vanderbijl Park (5%), Vereeniging (5%), and Westonaria (20%). When estimating the total liquid fuel consumption for the municipality, the liquid fuel data from these magisterial districts are multiplied by their percentage shares and aggregated. (The method assumes that the liquid fuel is evenly spread across the municipal district.) SEA have provided a national 'tool' that makes a broad sweep estimation and can be used by municipalities; however, detailed local level studies should refine this.

This report disaggregates liquid fuel consumption into the residential, commercial, agricultural, government and transport sectors. DOE liquid fuel data provide retail-level disaggregation, which show the amount of a particular fuel sold to, say, the commercial sector or the agricultural sector. Unfortunately, certain retail categories (e.g. general dealers and are more difficult to assign to sectors such as general dealers and retail-garages. These were assigned entirely to the transport sector, assumed to have the largest customer base and highest consumption. Sector liquid fuel use allocations were made on the following basis:

- According to a National Treasury Report (PDC & SCE, 2013) over 70% of paraffin is consumed by households. Due to the age of this data and uncertainty as to the apportioning of the remaining paraffin, it was decided to assign paraffin use entirely to the residential sector.
- There have been no detailed studies on LPG use in the country. In considering how to apportion liquid fuel, this study drew on LPG allocations in the City of Cape Town LTMS (Long-term Mitigation Scenarios) work: 25%/25%/50% to the residential/ commercial/ industrial sectors respectively. However, more research is required in future.
- HFO was allocated to the industrial sector.
- Petrol and diesel were mainly allocated to the transport sector. Aside from a few processes using diesel generators, the main use for these fuels is in transport; regardless of the sector (e.g. petrol use in the commercial sector could be used for couriering services). The Air Quality data for the City of Cape Town does show diesel use in industry, but the process use is not clear. If this was clarified, the data may be worth developing and utilising for greater degrees of disaggregation. However at this stage there is no consistent methodology to do this.
- It should be noted that consumption of diesel by Eskom at its two peaking Open Cycle Gas Turbine power stations in the Western Cape has been excluded from the study (i.e. subtracted from the SAPIA data). This is to avoid double accounting: the fuel is used to generate electricity, which is accounted for in the electricity use data.
- Fuels from the Department of Energy dataset that were not included in this analysis include asphalt, paraffin wax, automotive oil, grease, solvents, industrial oil and process oil. This is because these products are used for construction, lubrication, insulation, etc. and not as an energy source.
- Jet, aviation gasoline and international marine fuel were included to derive the total energy consumption in the respective municipalities who have airports and harbours. There are some discrepancies with the jet fuel data sourced from SAPIA for municipalities where the fuel sale does not occur in the same district as the fuel consumption e.g. some cities with airports (NMMB) have a zero jet fuel consumption suggesting that the fuel sale occurred outside that district. The jet fuel for NMMB was therefore left unreported.
- Marine fuel is a mix of fuels that include diesel, HFO and oil. SAPIA only provides an aggregated figure in litres. The difficulty is that a fuel specific conversion factor is required for the energy conversion. For this study the diesel conversion factor was used which introduces some inaccuracy, but it is based on the fact

that diesel is the largest proportion of the marine fuel mix. When looking at the liquid fuel consumption as a share of national in 2012, these fuels were however excluded because there are no national SAPIA figures available

Coal data: Updated coal consumption data for the industrial and commercial sectors posed a challenge. Cities with detailed and up-to-date state of energy reports (or GHG inventories) have the most reliable coal data (notably Cape Town and Durban), but recent coal data was unavailable for most municipalities, in which case 2004 coal data was used. This is the latest data in most cases and was also used in the 2011 report (which was based mainly on 2007 data).[51] Communication with coal suppliers did provide some indication of total consumption levels for regions, but not disaggregated to the local level, and thus not applicable to this data exercise. The deregulation of coal makes it virtually impossible to obtain city-level consumption data, unless, as in the case of a town such as Mangaung, there is a single, local coal yard. This would provide a total demand figure, but the sectoral breakdown would remain obscure. As in the instance of Eskom, the large distributor MacPhail, which was prepared to give a fairly detailed picture of their distribution in the study area in 2006/7, is no longer providing this information. This may also be due to rulings by the Competitions Commission.

Coal consumption data for the residential sector were derived using a methodology developed by Aurecon Consultancy, allocating an average of 10kg/household/month for cooking and/or space heating. Their estimate was based on a household survey conducted in a low-income community. The Census 2011 data were used to determine the number of households using coal for cooking and/or space heating in each municipality, applying appropriate filters to avoid double counting households who are reported under both cooking and space heating.

51 A limited recourse finance transaction is a debt in which the creditor has limited claims on the loan in the event of default.

Demographic, economic and socio-economic data

Population: The broad population data (population of each municipality and number of households were sourced from the last national census (Stats SA 2011). The 2001 national census data were also recorded to compare the changes over time.

Service delivery – electrification backlog, housing backlog and FBE: The service delivery data were sourced directly from the relevant municipal department or from their state of energy reports, annual reports or IDP reports. Secondary sources were pursued where primary data was either unavailable or unobtainable – this includes a local government website available from http://www.localgovernment.co.za.

Indigent households: Indigent household data were extracted from Census 2011 (Stats SA, 2011) and grouped into two main categories – the extreme indigent households and indigent households. Extreme indigent households are those that earn up to R400 (2011 prices) per month and indigent households are those that earn between R400 and R3200 (2011 prices) per month.

Gross value added (GVA): Most of the GVA data for the municipalities are expressed in 2005 ZAR terms. For consistency, all the source data that were not expressed in 2005 terms were converted to using the CPI values from Stats SA. The GVA data for the metros were found from Global Insight, and Quantec 2011 data were used for some secondary cities. For some of the smaller municipalities, HSRC data were used. Some municipalities report GVA values were reported in their state of energy reports.

Conversion Factors

Energy conversion factors were sourced from the national DOE's Draft 2012 Integrated Energy Planning Report (DOE, 2013a). Locally appropriate emissions conversion factors were sourced from www.emissionfactors.com (using the IPCC's 4th Assessment Report Global Warming Potential) and from Eskom's annual report (in the case of electricity).

Table 6: Greenhouse gas emission factors

Fuel type	Unit	tCO_2e
Diesel	litres	0.00702
Petrol	litres	0.002277
Aviation Gasoline	litres	0.002205
Jet fuel	litres	0.002516
Paraffin	litres	0.002577
Heavy Furnace Oil	litres	0.002968
Electricity	kWh	0.001030
LPG	litres	0.001622
Coal (Bituminous)	kg	0.002810
Marine fuels (using diesel as main fuel)	litres	0.003060

Note: Carbon emissions from liquid fuels are calculated without factoring in local liquefaction (coal to synthetic fuel), which supplies some 35% of national petroleum fuel consumption. Current national emissions calculation methods include these carbon emissions as point source emissions from Sasol plants.

Table 7: Energy conversion factors

Energy Source	Conversion	Units
Diesel	0.0381	GJ/litre
Petrol	0.0342	GJ/litre
Aviation Gasoline	0.0339	GJ/litre
Jet fuel	0.0343	GJ/litre
Paraffin Illuminating	0.0370	GJ/litre
Heavy Furnace Oil	0.0416	GJ/litre
Electricity	0.0036	GJ/kWh
LPG	0.0267	GJ/litre
Coal (general purpose)	0.0243	GJ/kg
Marine fuels (using diesel as main fuel)	0.0381	GJ/litre

Source: DOE (2013a)

APPENDIX 2: DIFFERENTIATED MUNICIPAL APPROACHES TO INTEGRATING SSEG INSTALLATIONS

A national working group consisting of SALGA, AMEU, Eskom and technical experts is, with NERSA, developing technical and tariff guidelines and procedures related to the integration of SSEG into the municipal electricity distribution network.

Metros	Technical Guidelines	Tariff in place
EThekwini	There are strict guidelines to ensure quality and safety.	The municipality has developed an SSEG tariff which is awaiting approval from NERSA. The tariff compensates embedded generators at a rate equal to the average Eskom Megaflex [52] purchase price. Depending on net consumption, a service charge is billed. Under the PPA, The municipality is allowed to compensate the generator at the average Megaflex rate.
Nelson Mandela Bay Metropolitan Municipality	Has taken the lead in developing the standard practice procedures and guidelines for SSEG in order to boost economic development in its municipality.	There is no tariff established for SSEG. Excess electricity will be fed into the grid, and the generator will pay the net consumption amount to the municipality. If the generator is a net generator (i.e. generator consumes the amount of electricity it has generated), only administrative fees will be charged, but the generator will not be compensated for the extra kWhs. A possible service charge will be applied in future. The municipality will install subsidised bi-directional, four-quadrant credit metres that record forward and reverse energy flow. Residential single phase installations are capped at 4.6kWp.
Ekurhuleni Metropolitan Municipality	No SSEG policy in place.	There is no SSEG tariff. The generator will only be compensated as a net consumer with a reduced bill. The municipality is one of the first to implement large-scale solar PV plants (3 × 200kW sites planned).
City of Cape Town	Has developed guidelines for residential, commercial and industrial generators.	The municipality has tariffs for small-scale generators with capacity of less than 1 MVA. Only net consumption will be permitted. There are separate consumption and generation charges, and customers will be compensated in monetary terms, not kWh, on their monthly bill. A daily service charge is billed. Customers also have the option to feed excess electricity generated into the grid (electricity distribution network) by remaining on their existing tariff but will not be compensated for the feed in. Customers who choose to be credited for the feed-in of electricity onto the grid must install a bi-directional metre (metre which measure the amount of electricity fed onto the grid) at their own cost. If no compensation is required, a device that blocks reverse flow must still be installed. Residential single phase installations will be capped at 3.26kWp. The municipality has signed their first contract with Black River Parkway Business Park's 1.2MW rooftop PV system.
Mangaung Metropolitan Municipality	Has adopted the NRS specification	While the municipality allows feed-in from residential customers, there is no compensation. In the interim, the municipality has a RE feed-in tariff of 75 cents/kWh. Generators will be credited on their bill. The municipality is investigating TOU meters for embedded generation installations to allow for purchase of generated electricity at the Megaflex rate.
Polokwane Municipality	Currently developing guidelines and standards for SSEG.	The municipality has a proposed tariff for purchasing power from net generators at R0.20c/kWh to compensate for the loss of profit from its own electricity sales.
City of Johannesburg	Has adopted the NRS specification	A tariff has been developed and approved. Generators must be net consumers and will be compensated for feeding into the grid at a negotiated price of up to a maximum of the average Megaflex tariff if they have a bidirectional metre installed. A daily grid connection charge is billed.

52 Megaflex is a time of use electricity tariff for urban customers who are able to shift load and with an Notified Maximum Demand (NMD) greater than 1MVA

APPENDIX 3: KEY SEA RESEARCH AND REPORTS

The State of Energy in South African Cities 2015 report is informed by a number of SEA research projects and reports.

Since 2000, SEA has been working with South African cities on sustainable energy issues and was instrumental in bringing the concept of energy thinking (as opposed to just electricity) into city planning and strategic direction. SEA has supported the development of a sustainable energy learning network for cities and towns, which has grown and developed over the past 15 years. Today, the network is convened by SEA, in partnership with the SALGA and SACN; ICLEI-Africa is also a close partner.

This learning network and information hub is fed through work taking place in the cities and through associated research and support work of SEA, SALGA, SACN and other organisations. The importance of the link to the network is that the research, or project support work, emerges directly out of the concerns, barriers, issues identified by the city partners, and feeds directly back into the network, where it is oriented to be of direct, practical value to those cities and towns. This work supports the work of cities and towns and contributes enormously (as does the network itself) to SEA's ability to put together a State of Energy in SA Cities report. Key, recent research and development work SEA has engaged with, informing this initiative, includes:

City Energy Support Unit (2009 onwards): This project (A Low-carbon and Sustainable Development Future for South African Cities) drives SEA's core work of supporting South African cities to move towards a less carbon-intensive future, while at the same time reducing social inequality. The focus is on supporting implementation by local government of 'flagship projects' identified in the National Climate Change Response Strategy, including data collection and collation, energy efficiency and renewable energy development. It also facilitates the urban energy learning network and information hub provided through the website: www.cityenergy.org.za. (Donors: British High Commission 2009–2012, Bread for the World 2012 onwards)

SALGA-led Energy Efficiency and Renewable Energy Strategy for Local Government (June 2013–March 2014). SEA was appointed by SALGA to develop an EE and RE strategic framework for local government. The intention was to develop a clear direction in order to ensure greater coordination of efforts within the sector. The project involved detailed consultation with municipalities across the country – through workshops hosted by the SALGA regional offices in each of the nine provinces. This was an amazing opportunity to hear the voice of local government on these issues, and the emerging strategy was truly led by local government itself. A Status Quo document and a Strategic Guide have been developed. (Client/Partner: SALGA)

Tackling Urban Energy Poverty in South Africa (Sept 2013–Sept 2014): SEA undertook a series of research initiatives and stakeholder engagements that explored the state of urban energy poverty in South Africa. The research provided a consolidated picture of household energy use patterns and choices of the urban poor, and examined the effectiveness of the various national pro-poor energy policies, strategies and programmes aimed at improving the household energy choices of the urban poor, for the full socioeconomic benefits underlying energy access to be realised. (Donor: Heinrich Boell Stiftung Foundation)

Solar PV programme initiation in Cape Town, eThekwini and Ekurhuleni (March 2013–March 2014): SEA supported three municipalities in advancing their solar PV embedded generation objectives. The project included work on pilot site selection, tender documentation development, tender adjudication, technical and process guide development, application form development, rooftop solar PV rollout potential assessments and participation in national working groups to advance the municipal solar PV agenda. (Donor: British High Commission)

GIZ-SALGA Municipal RE implementation case studies (October 2014–March 2015): SEA supported GIZ to develop further case studies looking at municipal renewable energy development. The case studies are to be published in 2015. (Client/Partner: GIZ-SALGA)

Promoting Low-Carbon Development in the Cape Town Central City Development Strategy (Jan-Dec 2013): SEA, in partnership with the Cape Town Partnership, the Stockholm Environment Institute and the City, developed a detailed low-carbon development path to augment the current Central City Development Strategy. A central aim was to strengthen synergy and collaboration among all stakeholders to reduce overall carbon emissions in the central city. (Donor: Swedish International Development Agency)

Municipal Revenue Impact from Energy Efficiency and Renewable Energy (2013–2014): SEA undertook research and developed a tool to calculate the impact of customer energy efficiency and embedded PV on municipal revenue. The tool was used to assess the potential impact on revenue in Ekurhuleni, eThekwini, Johannesburg and Cape Town. The results vary across the municipalities and economic sectors, but overall the projected losses against business as usual ten years from now will be between 3% and 15%. Municipal officials were trained in the use of the tool. (Donor: Renewable Energy and Energy Efficiency Partnership).

Modelling energy efficiency potential in municipal-owned facilities of the nine SACN member cities (Feb–June 2014): SACN commissioned a study to analyse the potential energy savings that can be realised from energy efficiency in municipal facilities and operations in the nine member cities. The energy efficiency potential was modelled using the Municipal Energy Efficiency Planning Tool, developed by SEA for this study and also available for future use by individual municipalities. (Client/Partner: SACN).

Mass solar water heater (SWH) rollout support for Cape Town (2011–2013): To increase the sale of SWHs in the mid-high income residential sector in Cape Town, the municipality developed and launched a mass residential SWH programme. SEA provided technical support that contributed to political, legal, technical and financial department buy-on within the city, development of detailed and watertight SWH service provider application, accreditation and delisting processes, communications campaign and ongoing implementation support. (Donor: Energy and Environment Partnership)

Energy Efficiency and Sustainability Settlements Advisor, Joe Slovo Settlement (Oct 2012–Jan 2014): SEA worked with the national Department of Human Settlements (DHS) to support the department to integrate energy efficiency, particularly solar water heating and sustainability within the low-income housing sector. The pilot implementation was done in the N2 Gateway Joe Slovo 3 Precinct. All interventions were achieved within the standard housing allocation. Joe Slovo 3 is a practical demonstration of ***settlement making*** that provides a more integrated, sustainable, inclusive and higher density alternative for subsidy housing. SEA conducted monitoring and evaluation to provide both qualitative and quantitative assessment of the sustainable interventions implemented. (Client/Partner: Department of Human Settlements)

All related reports can be found online on www.cityenergy.org.za or www.sustainable.org.za

APPENDIX 4: NATIONAL POLICIES RELEVANT TO SUSTAINABLE URBAN DEVELOPMENT

The **White Paper on Renewable Energy (2003),** ensures that renewable energy is a significant part of the country's energy mix and sets a target of 10 000 GWh of RE by 2013 (target date currently under revision);

Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) issued by the Department of Energy in 2011 has resulted in 64 private energy plants to generate electricity. It represents the largest order of renewables in the world. The procurement is based on a bidding schedule and is expected to result in a total procured capacity of 6925 MW by 2020. Three procurement rounds have concluded and 3916 MW have been allocated to date.

The Integrated Resource Plan (IRP) 2010 and 2012 update – This national electricity plan emanates from the Electricity Regulation Act of 2006, and is established by the national government to give effect to national policy. It refers to the coordinated schedule of generation expansion and demand-side intervention programmes, taking into account multiple criteria to meet the electricity demand. This national electricity plan makes provision for efficiency and renewable energy development and yet also calls for new coal-fired power stations and nuclear. It has given priority to the deployment of RE technologies and calls for RE to make up 42% of new power generation and is considering small scale embedded generation at the municipal level;

Biofuels Industrial Strategy (adopted in 2006 and revised in 2007) stipulates a 2% (400 million litres per year) penetration into the national liquid fuels mix. While this is considerably small, when finally implemented, this would contribute to a shift in the country's energy and emissions profile considering that liquid fuels (petrol and diesel) account on average for half the total energy consumed in consumed in the major urban centres. The biofuels strategy offers an opportunity for municipalities to participate. The rapidly increasing liquid fuel prices, for instance, enhances the viability of conversion of landfill gas into biofuels at the municipal level.

Local Government Energy Efficiency and Renewable Energy Strategy (SALGA, 2014): This recently developed comprehensive strategy was developed through a consultative process with municipalities throughout the country. It provides guidance to municipalities and enables them to pursue this work without the potentially costly, exercise of a consultant-developed strategy for a municipality. The strategy intends to support an ongoing level of coordination amongst external support organisations (including Provincial and National Government) and stakeholders. The Strategic Priority Areas include renewable energy, energy efficiency, energy access and mobility and urban form.

National Energy Efficiency Strategy (DME, 2005, 2008, 2011), which came into effect in 2005 and was revised in 2008 and 2011, strives for affordable energy for all and to minimise the negative effects of energy usage on human health and the environment through sustainable energy development and efficient practices. The recently updated strategy prioritises energy efficiency programmes and has an overall target of 12% of energy efficiency for the country, 10% for residential and 15% for other sectors by 2015.

National Building Regulations – South African National Standards (SANS) 10400-XA: Energy Efficiency

The National Buildings Regulation was recently amended and now required all new residential and commercial buildings and renovations to existing buildings to be energy efficient. It includes efficient water heating and insulation. These requirements have also been extended to include government delivered low income housing. Local government has the responsibility for the implementation of these standards. Serious capacity shortages in this regard need to be addressed.

	Buffalo City	Cape Town	Ekurhuleni	EThekwini	Johannesburg	Mangaung	Nelson Mandela Bay	Tshwane
Municapility type	Metro	Metro	Metro	Metro	Metro	Metro	Metro	Metro
Data year	**2011**	**2012**	**2011**	**2011**	**2011**	**2012**	**2012**	**2012**
Energy and emissions overview								
Energy per capita (GJ)	30,4	42,4	39,9	61,1	39,6	20,2	26,8	31,7
Energy per GVA (GJ/R millions)	741,4	800,9	1 153,1	1 151,3	614,6	564,0	558,3	526,7
GHG per capita (tonnes CO_2e)	4,0	5,5	5,5	7,3	5,7	2,9	4,5	5,7
GHG per GVA (tCO_2e/ R millions)	97,5	107,4	159,3	137,0	88,0	82,2	92,9	93,9
Total energy consumption (GJ)	22 965 453	158 685 055	126 689 542	210 218 833	175 720 664	15 113 990	30 838 577	92 579 626
Energy consumption share of national consumption (2004)	0,7%	5,0%	6,2%	4,7%	4,8%	0,7%	1,1%	3,4%
Energy consumption share of national consumption (2007)	0,8%	4,7%	4,1%	4,6%	5,3%	–	1,2%	3,9%
Energy consumption share of national consumption (2011)	0,8%	5,9%	4,7%	7,8%	6,5%	0,6%	1,1%	3,4%
Total electricity consumption (GJ)	6 263 430	46 792 716	39 547 868	42 365 652	58 839 270	5 325 126	13 690 099	46 081 807
Electricity consumption per capita (GJ)	8,3	12,5	12,4	12,3	13,3	7,1	11,9	15,8
Electricity consumption share of national consumption (2011)	0,9%	6,4%	5,4%	5,8%	8,1%	0,7%	1,9%	6,3%
Liquid fuel consumption INCL aviation, EXCL marine (GJ)	15 022 521	100 313 095	84 903 637	97 064 755	111 908 698	9 664 252	16 519 089	43 506 165
Liquid fuel consumption EXCL aviation/marine (GJ)	14 467 753	90 220 035	61 970 132	95 447 293	86 138 911	9 466 140	16 519 072	43 378 137
Liquid fuel consumption INCL aviation, EXCL marine (share of national)	1,5%	10,2%	8,7%	9,9%	11,4%	1,0%	1,7%	4,4%
Liquid fuel consumption EXCL aviation/marine (share of national)	1,6%	10,1%	6,9%	10,6%	9,6%	1,1%	1,8%	4,8%
Total emissions (tCO_2e)	3 019 145	21 282 238	17 498 014	25 019 574	25 147 445	2 202 641	5 129 312	16 510 131
General								
Area (km²)	2 515	2 445	1 975	2 292	1 645	6 284	1 959	6 298
Area of municiaplity as percentage of national area	0,21%	0,20%	0,16%	0,19%	0,13%	0,52%	0,16%	0,52%
Population density (2011) (people/km²)	300	1 530	1 609	1 502	2 696	119	588	463 9
Population (2001)	704 855	2 892 243	2 481 762	3 090 122	3 226 055	645 440	1 005 779	2 142 322
Population (2011)	755 200	3 740 026	3 178 470	3 442 361	4 434 827	747 431	1 152 115	2 921 488
Population as % national (2011)	1,5%	7,2%	6,1%	6,6%	8,6%	1,4%	2,2%	5,6%
Population growth 2001–2011 (% avg. annual)	0,69%	2,60%	2,51%	1,09%	3,23%	1,48%	1,37%	3,15%
Gross Value Added (GVA) (constant 2005 ZAR millions)	30 976	198 123	109 873	182 594	285 926	26 797	55 233	175 787
GVA as % of national GDP	1,8%	11,4%	6,4%	10,7%	16,8%	1,5%	3,2%	10,1%
GVA per capita (constant 2005 ZAR/capita)	41 017	52 974	34 568	53 043	64 473	35 852	47 940	60 170
Umemployment (narrow)	35%	24%	29%	30%	25%	28%	37%	24%
Umemployment (broad)	45%	31%	35%	40%	31%	36%	45%	31%
Average household size (people)	3,4	3,5	3,1	3,6	3,1	3,2	3,6	3,2
Informal households (%)	22%	20%	21%	16%	17%	14%	12%	18%
Extreme indigent households (<R400/month)	22%	16%	22%	21%	20%	16%	20%	18%
Indigent households (<R3 200/month)	43%	47%	55%	59%	52%	44%	59%	48%

	Buffalo City	Cape Town	Ekurhuleni	EThekwini	Johannesburg	Mangaung	Nelson Mandela Bay	Tshwane
Municapility type	Metro	Metro	Metro	Metro	Metro	Metro	Metro	Metro
Data year	**2011**	**2012**	**2011**	**2011**	**2011**	**2012**	**2012**	**2012**
Transport								
Households that own a car (%)	28%	46%	35%	33%	38%	30%	36%	44%
Diesel consumption (litres)	146 896 296	917 373 532	682 755 212	1 215 151 988	682 063 708	119 764 355	214 391 774	493 724 813
Petrol consumption (litres)	199 937 470	1 433 710 154	983 079 500	1 072 900 391	1 741 030 831	135 817 254	211 342 135	703 956 911
Petrol and diesel consumption (litres)	346 833 766	2 351 083 686	1 665 834 712	2 288 052 378	2 423 094 539	255 581 609	425 733 909	1 197 681 724
Petrol as share of total diesel and petrol (%)	58%	61%	59%	47%	72%	53%	50%	59%
Diesel consumption share of national (2011)	1,3%	8,2%	6,1%	10,8%	6,1%	1,1%	1,9%	4,4%
Petrol consumption share of national (2011)	1,7%	12,0%	8,2%	9,0%	14,6%	1,1%	1,8%	5,9%
Petrol and diesel consumption share of national (2011)	1,5%	10,1%	7,2%	9,9%	10,4%	1,1%	1,8%	5,2%
Energy poverty								
Electrified households, lighting as proxy (%)	80,9%	94,0%	82,2%	89,9%	90,8%	91,4%	90,5%	88,6%
Households using safe/clean energy for cooking (%)	78,4%	95,2%	82,1%	88,6%	90,9%	90,7%	89%	87%
Households using safe/clean energy for heating (%)	43,7%	66,9%	70,1%	77,7%	86,1%	57,2%	57%	78%
No. of households without formal electricity connection	1 500	–	285 000	96 971	26 393	–	–	145 000
Potential max. share of indigent hhs accessing FBE (%)	61,0%	72,1%	52,4%	15,6%	3,2%	14,0%	37%	25%

NATIONAL GVA 2011 (constant 2005 ZAR millions)	1 703 801	Source: Statssa – Statistical release P0441
NATIONAL GVA 2012 (constant 2005 ZAR millions)	1 745 353	Source: Statssa – Statistical release P0441
NATIONAL Energy Consumption 2011 (GJ)	2 704 007 821	Source: DoE National Energy Balance 2011
NATIONAL Electricity Consumption 2011 (GJ)	729 103 033	Source: DoE National Energy Balance 2011
Population (2011)	51 770 560	Source: Stats SA 2011
NATIONAL carbon emissions 2010 (tonnes CO_{2-eq})	460 124 000	Source:http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions
National CO_2 (eq) emissions (tonnes CO_{2-eq})) per capita	9 041	Source:http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions .

	Drakenstein	George	Mbombela	Polokwane	Rustenburg	Sol Plaatje	Steve Tshwete	King Sabata Dalindyebo	KwaDukuza	Saldanha Bay
Municipality type	Secondary City	Secondary City	Secondary City	Secondary City	Secondary City	Secondary City	Secondary City	Smaller town	Smaller town	Smaller town
Data year	**2012**	**2012**	**2011**	**2011**	**2011**	**2011**	**2012**	**2011**	**2012**	**2012**
Energy and emissions overview										
Energy per capita (GJ)	25,4	15,6	21,9	28,1	101,2	18,1	84,0	10,3	16,0	338,2
Energy per GVA (GJ/R millions)	785,4	512,1	645,1	1 040,2	2 089,0	405,1	1 177,4	584,9	584,9	8 587,6
GHG per capita (tonnes CO_2e)	4,4	3,0	3,8	4,0	23,1	3,5	16,2	1,2	3,3	50,4
GHG per GVA (tCO_2e/ R millions)	136,0	99,7	112,3	146,3	475,9	77,3	227,3	66,6	50,1	1 278,7
Total energy consumption (GJ)	6 371 607	3 021 035	12 873 393	17 702 108	55 610 115	4 501 675	19 299 631	4 632 739	3 691 545	33 546 058
Energy consumption share of national consumption (2004)	–	–	–	–	–	0,2%	–	0,2%	–	1,1%
Energy consumption share of national consumption (2007)	–	–	–	0,4%	–	0,2%	–	–	–	0,9%
Energy consumption share of national consumption (2011)	0,2%	0,1%	0,5%	0,7%	2,1%	0,2%	0,7%	0,2%	0,1%	1,2%
Total electricity consumption (GJ)	2 880 419	1 745 361	6 221 710	5 038 963	39 628 548	2 498 684	10 988 079	969 258	2 299 023	7 230 498
Electricity consumption per capita (GJ)	11,5	9,0	10,6	8,0	72,1	10,1	47,8	2,1	9,9	72,9
Electricity consumption share of national consumption (2011)	0,4%	0,2%	0,9%	0,7%	5,4%	0,3%	1,5%	0,1%	0,3%	1,0%
Liquid fuel consumption INCL aviation, EXCL marine (GJ)	2 640 207	1 275 448	6 586 170	8 820 667	11 062 501	1 891 697	8 280 935	3 647 081	1 392 084	2 523 450
Liquid fuel consumption EXCL aviation/marine (GJ)	2 640 207	924 138	6 544 062	8 810 141	11 052 130	1 842 414	8 271 793	3 635 620	1 392 084	2 522 801
Liquid fuel consumption INCL aviation, EXCL marine (share of national)	0,3%	0,1%	0,7%	0,9%	1,1%	0,2%	0,8%	0,4%	0,1%	0,3%
Liquid fuel consumption EXCL aviation/marine (share of national)	0,3%	0,1%	0,7%	1,0%	1,2%	0,2%	0,9%	0,4%	0,2%	0,3%
Total emissions (tCO_2e)	1 103 120	588 120	2 240 462	2 489 001	12 668 428	858 432	3 726 218	527 205	752 886	4 995 191
General										
Area (km^2)	1 538	5 191	3 451	3 776	3 423	3 150	3 976	3 027	735	2 015
Area of municiaplity as percentage of national area	0,13%	0,43%	0,28%	0,31%	0,28%	0,26%	0,33%	0,25%	0,06%	0,17%
Population density (2011) (people/km^2)	163	37	171	167	161	78,7	57,8	149	315	49
Population (2001)	194 417	149 436	476 903	508 277	387 096	202 246	142 772	416 348	167 805	70 261
Population (2011)	251 262	193 672	588 794	628 999	549 575	248 041	229 831	451 710	231 187	99 193
Population as % national (2011)	0,5%	0,4%	1,1%	1,2%	1,1%	0,5%	0,4%	0,9%	0,4%	0,2%
Population growth 2001–2011 (% avg. annual)	2,60%	2,63%	2,13%	2,15%	3,57%	2,06%	4,88%	0,82%	3,26%	3,51%
Gross Value Added (GVA) (constant 2005 ZAR millions)	8 112	5 900	19 956	17 017	26 620	11 111	16 391	7 920	15 022	3 906
GVA as % of national GDP	0,5%	0,3%	1,2%	1,0%	1,6%	0,7%	0,9%	0,5%	0,9%	0,2%
GVA per capita (constant 2005 ZAR/capita)	32 286	30 463	33 893	27 054	48 437	44 797	71 319	17 533	64 980	39 381
Umemployment (narrow)	18%	21%	28%	32%	26%	32%	20%	38%	25%	23%
Umemployment (broad)	27%	30%	38%	40%	32%	40%	27%	54%	35%	29%
Average household size (people)	4,2	3,6	3,6	3,5	2,8	4,1	3,5	4,3	3,3	3,4
Informal households (%)	13%	14%	5%	9%	30%	17%	14%	2%	11%	17%
Extreme indigent households (<R400/month)	15%	15%	18%	19%	19%	15%	15%	23%	17%	16%
Indigent households (<R3 200/month)	64%	37%	65%	47%	33%	40%	32%	53%	23%	48%

	Drakenstein	George	Mbombela	Polokwane	Rustenburg	Sol Plaatje	Steve Tshwete	King Sabata Dalindyebo	KwaDukuza	Saldanha Bay
Municapility type	Secondary City	Secondary City	Secondary City	Secondary City	Secondary City	Secondary City	Secondary City	Smaller town	Smaller town	Smaller town
Data year	**2012**	**2012**	**2011**	**2011**	**2011**	**2011**	**2012**	**2011**	**2012**	**2012**
Transport										
Households that own a car (%)	44%	43%	28%	27%	75%	34%	41%	16%	23%	43%
Diesel consumption (litres)	24 742 784	9 438 777	77 200 639	91 144 593	142 376 194	26 931 293	137 223 367	29 700 589	14 054 359	42 694 055
Petrol consumption (litres)	45 188 627	16 161 288	96 119 977	150 581 483	153 531 044	23 497 811	59 006 883	66 149 866	24 724 515	25 438 961
Petrol and diesel consumption (litres)	69 931 411	25 600 065	173 320 616	241 726 075	295 907 238	50 429 103	196 230 250	95 850 455	38 778 874	68 133 016
Petrol as share of total diesel and petrol (%)	65%	63%	55%	62%	52%	47%	30%	69%	64%	37%
Diesel consumption share of national (2011)	0,2%	0,1%	0,7%	0,8%	1,3%	0,2%	1,2%	0,3%	0,1%	0,4%
Petrol consumption share of national (2011)	0,4%	0,1%	0,8%	1,3%	1,3%	0,2%	0,5%	0,6%	0,2%	0,2%
Petrol and diesel consumption share of national (2011)	0,3%	0,1%	0,7%	1,0%	1,3%	0,2%	0,8%	0,4%	0,2%	0,3%
Energy poverty										
Electrified households, lighting as proxy (%)	95,0%	91,0%	90,2%	83,0%	83,0%	84,9%	90,9%	73,3%	90,2%	97,0%
Households using safe/clean energy for cooking (%)	95,5%	90,9%	87%	74%	82%	88%	84%	62,6%	88,7%	98%
Households using safe/clean energy for heating (%)	75,3%	60,7%	75%	62%	73%	73%	66%	22,0%	73,1%	78%
No. of households without formal electricity connection	–	–	19 040	30 260	5 500	9 127	532	31 467	6 876	122
Potential max. share of indigent hhs accessing FBE (%)	48,2%	78,9%	12%	32%	4%	91%	74%	13,5%	23,5%	47%

NATIONAL GVA 2011 (constant 2005 ZAR millions)	1 703 801	Source: Statssa – Statistical release P0441
NATIONAL GVA 2012 (constant 2005 ZAR millions)	1 745 353	Source: Statssa – Statistical release P0441
NATIONAL Energy Consumption 2011 (GJ)	2 704 007 821	Source: DoE National Energy Balance 2011
NATIONAL Electricity Consumption 2011 (GJ)	729 103 033	Source: DoE National Energy Balance 2011
Population (2011)	51 770 560	Source: Stats SA 2011
NATIONAL carbon emissions 2010 (tonnes $CO_{2\text{-eq}}$)	460 124 000	Source:http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions
National CO_2 (eq) emissions (tonnes $CO_{2\text{-eq}}$)) per capita	9 041	Source:http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions .

	SOUTH AFRICA	Recorded munics % of national	Metros	7 Secondary Cities	3 Smaller Towns	Rest of South Africa
Data year	**2011**	**2011/12**	**2011/12**	**2011/12**	**2011/12**	**2011/12**
Energy and emissions overview						
Energy per capita (GJ)	52.2	N/A	40.9	44.4	53.5	–
Energy per GVA (GJ/R millions)	1,587.0	N/A	781.8	1,135.8	1,559.5	–
GHG per capita (tonnes CO_2e)	9.0	N/A	5.2	8.8	8.0	–
GHG per GVA (tCO_2e/ R millions)	270.1	N/A	99.8	224.9	233.7	–
Total energy consumption (GJ)	2,704,007,821	36.8%	832,811,741	119,379,563	41,870,342	1,709,946,176
Energy consumption share of national consumption (2004)	2,717,859,800	28.1%	26.6%	0.2%	1.3%	71.9%
Energy consumption share of national consumption (2007)	100%	25.9%	24.5%	0.6%	0.9%	74.1%
Energy consumption share of national consumption (2011)	100%	37%	30.8%	4.4%	1.5%	63.2%
Total electricity consumption (GJ)	729,103,033	46.4%	258,905,968	69,001,764	10,498,779	390,696,521
Electricity consumption per capita (GJ)	14.1	N/A	12.7	25.6	13.4	14.0
Electricity consumption share of national consumption (2011)	100.0%	46.4%	35.5%	9.5%	1.4%	53.6%
Liquid fuel consumption INCL aviation, EXCL marine (GJ)	981,532,523	53.7%	478,902,212	40,557,624	7,562,616	454,510,071
Liquid fuel consumption EXCL aviation/marine (GJ)	897,294,586	51.8%	417,607,472	40,084,884	7,550,505	432,051,725
Liquid fuel consumption INCL aviation, EXCL marine (share of national)	100.0%	53.7%	48.8%	4.1%	0.8%	46.3%
Liquid fuel consumption EXCL aviation/marine (share of national)	100.0%	51.8%	46.5%	4.5%	0.8%	48.2%
Total emissions (tCO_2e)	460,124,000	31.7%	25.2%	5.1%	1.4%	68.3%
General						
Area (km²)	1 219 912	4,6%	25 413	24 505	5 777	1 164 217
Area of municiaplity as percentage of national area	100,00%	4,6%	2,08%	2,01%	0,47%	95,43%
Population density (2011) (people/km²)	42	N/A	802	110	135	24
Population (2001)	44 819 777	42,2%	16 188 578	2 061 147	654 414	25 915 638
Population (2011)	51 770 560	46,1%	20 371 918	2 690 174	782 090	27 926 378
Population as % national (2011)	100%	46,1%	16,12%	5,2%	1,5%	53,9%
Population growth 2001–2011 (% avg. annual)	1,45%	N/A	2,33%	2,70%	1,80%	0,75%
Gross Value Added (GVA) (constant 2005 ZAR millions)	1 703 801	70,3%	1 065 310	105 108	26 849	506 534
GVA as % of national GDP	100,0%	69,6%	61,9%	6,1%	1,5%	30,4%
GVA per capita (constant 2005 ZAR/capita)	32 911	N/A	52 293	39 071	34 330	18 138
Umemployment (narrow)	30%	48%	27%	27%	30%	33%
Umemployment (broad)	40%	53%	34%	34%	42%	46%
Average household size (people)	3,6	N/A	3,3	3,5	3,8	3,8
Informal households (%)	14%	63,1%	18%	15,5%	7,2%	9,8%
Extreme indigent households (<R400/month)	4%	–	19%	18%	20%	–
Indigent households (<R3 200/month)	63%	–	53%	57%	69%	–

	SOUTH AFRICA	Recorded munics % of national	Metros	7 Secondary Cities	3 Smaller Towns	Rest of South Africa
Data year	**2011**	**2011/12**	**2011/12**	**2011/12**	**2011/12**	**2011/12**
Transport						
Households that own a car (%)	30%	N/A	39%	31%	22%	22%
Diesel consumption (litres)	11 224 553 285	45,1%	4 472 121 679	509 057 646	86 449 002	6 156 924 958
Petrol consumption (litres)	11 963 310 914	59,7%	6 481 774 645	544 087 112	116 313 342	4 821 135 815
Petrol and diesel consumption (litres)	23 187 864 199	52,7%	10 953 896 324	1 053 144 758	202 762 345	10 978 060 773
Petrol as share of total diesel and petrol (%)	52%	N/A	59%	52%	57%	44%
Diesel consumption share of national (2011)	100,0%	45,1%	39,8%	4,5%	0,8%	54,9%
Petrol consumption share of national (2011)	100,0%	59,7%	54,2%	4,5%	1,0%	40,3%
Petrol and diesel consumption share of national (2011)	100,0%	52,7%	47,2%	4,5%	0,9%	47,3%
Energy poverty						
Electrified households, lighting as proxy (%)	84,7%	N/A	89,1%	86,8%	82,5%	80,9%
Households using safe/clean energy for cooking (%)	78%	N/A	–	–	–	–
Households using safe/clean energy for heating (%)	62%	N/A	–	–	–	–
No. of households without formal electricity connection	–	–	–	–	–	–
Potential max. share of indigent hhs accessing FBE (%)	–	–	–	–	–	–

NATIONAL GVA 2011 (constant 2005 ZAR millions)	1 703 801	Source: Statssa – Statistical release P0441
NATIONAL GVA 2012 (constant 2005 ZAR millions)	1 745 353	Source: Statssa – Statistical release P0441
NATIONAL Energy Consumption 2011 (GJ)	2 704 007 821	Source: DoE National Energy Balance 2011
NATIONAL Electricity Consumption 2011 (GJ)	729 103 033	Source: DoE National Energy Balance 2011
Population (2011)	51 770 560	Source: Stats SA 2011
NATIONAL carbon emissions 2010 (tonnes $CO_{2\text{-eq}}$)	460 124 000	Source:http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions
National CO_2 (eq) emissions (tonnes $CO_{2\text{-eq}}$)) per capita	9 041	Source:http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions .

Municipality	Type	ENERGY TOTALS									
		Energy all fuels (GJ)			Energy all fuels excl. aviation & marine (GJ)				Electricity (GJ)		
		2004	2007	2011	2004	2007	2011	Growth pa 2004–2011	2004	2007	2011
Buffalo City	Metro	18 226 570	21 430 786	22 965 453	17 998 768	21 253 607	21 408 537	2,51%	4 700 046	4 652 112	5 261 281
Cape Town	Metro	135 791 249	127 645 128	158 685 055	120 383 932	127 595 553	141 095 151	2,29%	42 746 400	48 576 102	46 792 716
Ekurhuleni	Metro	167 319 123	109 679 907	126 689 542	108 965 099	109 679 908	103 756 037	–0,70%	44 768 383	55 802 917	39 547 868
EThekwini	Metro	127 271 937	123 705 214	210 218 833	111 942 629	123 705 214	153 462 453	4,61%	38 429 919	39 328 763	42 365 652
Johannesburg	Metro	130 941 453	142 612 254	175 720 664	130 724 110	142 612 254	149 950 876	1,98%	44 895 773	52 493 812	58 839 270
Mangaung	Metro	18 181 414	–	15 113 990	17 915 797	–	14 915 878	–2,58%	5 028 098	–	5 325 126
Nelson Mandela Bay	Metro	30 092 498	32 191 176	30 838 577	28 832 253	32 191 176	30 838 560	0,97%	11 044 793	11 133 645	13 690 099
Tshwane	Metro	92 323 596	104 513 830	92 579 626	92 054 119	104 513 830	92 451 598	0,06%	28 564 243	42 497 981	46 081 807
Drakenstein	Secondary City		–	6 371 607	–	–	6 371 607	–	–	–	2 880 419
George	Secondary City		–	3 021 035	–	–	2 669 724	–	–	–	1 745 361
Mbombela	Secondary City		11 684 300	12 873 393	–	11 684 300	12 831 285	–	–	1 204 936	6 221 710
Polokwane	Secondary City		9 619 878	17 702 108	–	11 461 953	17 691 582	–	–	1 842 075	5 038 963
Rustenburg	Secondary City		–	55 610 115	–	–	55 599 743	–	–	–	39 628 548
Sol Plaatje	Secondary City	6 274 145	5 642 450	4 501 675	6 221 403	5 642 451	4 452 392	–4,67%	1 850 972	1 338 037	2 498 684
Steve Tshwete	Secondary City		–	19 299 631	–	–	19290489,326	–	–	–	10 988 079
King Sabata Dalindyebo	Smaller town	5 473 868	–	4 632 739	5 492 468	–	4 621 278	–2,44%	1 382 254	–	969 258
KwaDukuza	Smaller town	–	–	3 691 545	–	–	3 691 545	–	–	–	2 299 023
Saldanha Bay	Smaller town	29 638 927	23 477 790	33 546 058	47 343 070	23 477 790	33 545 409	–4,80%	5 643 076	4 021 563	7 230 498
National		**2 717 859 800**	**2 705 336 000**	**2 704 007 821**	**2 233 060 786**	**2 373 985 258**	**2 704 007 821**	**2,77%**	**707 756 746**	**786 152 590**	**729 103 033**
All Metros		**720 147 840**	**661 778 295**	**832 811 741**	**628 816 708**	**661 551 542**	**707 879 090**	**–**	**220 177 656**	**254 485 332**	**257 903 820**
All Metros excl. Mangaung		**701 966 426**	**661 778 295**	**817 697 751**	**610 900 910**	**661 551 542**	**692 963 211**	**1,82%**	**215 149 557**	**254 485 332**	**252 578 694**
Secondary Cities		**6 274 145**	**26 946 628**	**119 379 563**	**6 221 403**	**28 788 704**	**118 906 822**	**–**	**1 850 972**	**4 385 048**	**69 001 764**
Smaller Towns		**35 112 795**	**23 477 790**	**41 870 342**	**52 835 538**	**23 477 790**	**41 858 231**	**–**	**7 025 330**	**4 021 563**	**10 498 779**

Notes
2004 national liquid fuel figures from DoE Energy Balances (SAPIA data not available)
2007 & 2011 national coal figures from DoE Energy Balances
2007 national LPG figure from DoE Energy Balances (SAPIA data not available)
All other liquid fuel data from SAPIA
All other coal data from suppliers

National Petrol consumption 2011 (GJ)	11 963 310 914	Source: SAPIA 2011
National Petrol consumption 2012 (GJ)	11 733 080 659	Source: SAPIA 2012
National CO_2 (eq) emissions (tonnes CO_2(eq))	9,041	Source: 2010 – the United States Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC) for the United Nations. Funded by World Bank.
NATIONAL GVA **2001** (constant 2005 ZAR millions)	1 191 007	Source: Statistics South Africa, Statistical Release P0441
NATIONAL GVA **2004** (constant 2005 ZAR millions)	1 330 390	Source: Statistics South Africa, Statistical Release P0441
NATIONAL GVA **2007** (constant 2005 ZAR millions)	1 561 076	Source: Statistics South Africa, Statistical Release P0441
National elec GJ (2007)	786 152 590	Source: DoE Energy Balance
National elec GJ (2004)	707 756 746	Source: Electricity Supply Statistics for South Africa – National Electricity Regulator 2003

		ENERGY TOTALS											
		Petrol (GJ)			Diesel (GJ)			Coal (GJ)			Paraffin (GJ)		
Municipality	**Type**	**2004**	**2007**	**2011**	**2004**	**2007**	**2011**	**2004**	**2007**	**2011**	**2004**	**2007**	**2011**
Buffalo City	Metro	5 230 558	6 916 710	6 837 861	3 710 560	5 526 508	5 596 749	2 170 000	1 686 804	1 679 502	1 350 770	2 064 721	1 719 711
Cape Town	Metro	41 161 231	39 392 695	49 032 887	22 447 842	27 874 053	34 951 932	5 037 500	3 055 992	4 082 400	2 439 917	2 830 399	2 166 212
Ekurhuleni	Metro	34 795 242	26 324 768	33 621 319	20 487 317	19 367 156	26 012 974	4 629 633	6 117 440	2 238 037	2 347 762	608 622	1 289 219
EThekwini	Metro	30 452 115	31 739 142	36 693 193	30 799 214	42 052 292	46 297 291	37 200	58 320	15 649 508	4 517 874	3 134 336	4 419 178
Johannesburg	Metro	54 828 474	54 608 582	59 543 254	21 060 701	29 815 847	25 986 627	8 525 000	4 140 720	4 972 696	1 056 383	1 498 703	245 124
Mangaung	Metro	6 110 847	–	4 644 950	5 919 478	–	4 563 022	248 000	–	124 612	364 472	–	204 382
Nelson Mandela Bay	Metro	8 295 106	9 648 975	7 227 901	7 084 454	9 167 559	8 168 327	821 500	626 940	629 389	832 672	457 560	393 452
Tshwane	Metro	34 377 785	30 923 181	24 075 326	12 329 816	20 580 435	18 810 915	12 507 353	9 432 385	2 991 654	1 508 879	745 096	247 874
Drakenstein	Secondary City	–	–	1 545 451	–	–	942 700	–	–	850 981	–	–	1 830
George	Secondary City	–	–	552 716	–	–	359 617	–	–	225	–	–	2
Mbombela	Secondary City	–	4 926 428	3 287 303	–	4 574 582	2 941 344	–	0	65 513	–	166 030	18 126
Polokwane	Secondary City	–	5 328 693	5 149 887	–	4 120 665	3 472 609	–	0	3 842 477	–	127 048	99 982
Rustenburg	Secondary City	–	–	5 250 762	–	–	5 424 533	–	–	4 919 066	–	–	244 671
Sol Plaatje	Secondary City	2 061 647	2 093 809	803 625	1 926 170	2 015 557	1 026 082	93 000	68 040	111 294	103 594	76 824	10 417
Steve Tshwete	Secondary City	–	–	2 018 035	–	–	5 228 210	–	–	30 618	–	–	19 613
King Sabata Dalindyebo	Smaller town	2 140 331	–	2 262 325	1 154 853	–	1 131 592	37 200	–	16 400	614 219	–	114 447
KwaDukuza	Smaller town	–	–	845 578	–	–	535 471	–	–	437	–	–	78
Saldanha Bay	Smaller town	950 711	1 048 518	870 012	1 751 328	1 660 082	1 626 643	38 750 000	16 451 884	23 792 110	66 368	81 090	38
National		**386 177 940**	**395 653 416**	**409 145 233**	**292 696 640**	**386 394 361**	**427 655 480**	**778 229 900**	**743 262 111**	**511 113 029**	**29 506 550**	**26 186 989**	**21 485 600**
All Metros		**215 251 358**	**199 554 053**	**221 676 693**	**123 839 382**	**154 383 850**	**170 387 836**	**33 976 186**	**25 118 601**	**32 367 798**	**14 418 729**	**11 339 437**	**10 685 152**
All Metros excl. Mangaung		**209 140 511**	**199 554 053**	**217 031 743**	**117 919 904**	**154 383 850**	**165 824 814**	**33 728 186**	**25 118 601**	**32 243 186**	**14 054 257**	**11 339 437**	**10 480 770**
Secondary Cities		**2 061 647**	**12 348 930**	**18 607 779**	**1 926 170**	**10 710 804**	**19 395 096**	**93 000**	**68 040**	**9 820 174**	**103 594**	**369 902**	**394 641**
Smaller Towns		**3 091 042**	**1 048 518**	**3 977 916**	**2 906 181**	**1 660 082**	**3 293 707**	**38 787 200**	**16 451 884**	**23 808 947**	**680 587**	**81 090**	**114 563**

Notes

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National Petrol consumption 2011 (GJ)	11 963 310 914	Source: SAPIA 2011
National Petrol consumption 2012 (GJ)	11 733 080 659	Source: SAPIA 2012
National CO_2 (eq) emissions (tonnes CO_2(eq))	9,041	Source: 2010 – the United States Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC) for the United Nations. Funded by World Bank.
NATIONAL GVA **2001** (constant 2005 ZAR millions)	1 191 007	Source: Statistics South Africa, Statistical Release P0441
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National elec GJ (2007)	786 152 590	Source: DoE Energy Balance
National elec GJ (2004)	707 756 746	Source: Electricity Supply Statistics for South Africa – National Electricity Regulator 2003

Municipality	Type	ENERGY TOTALS								
		LPG (GJ)			HFO (GJ)			Jet Fuel and AvGas(GJ)		
		2004	2007	2011	2004	2007	2011	2004	2007	2011
Buffalo City	Metro	299 620	28 524	189 557	537 214	378 228	123 875	440 661	–	554 768
Cape Town	Metro	2 608 792	1 750 168	2 435 083	3 942 250	4 116 144	1 633 921	14 114 892	–	10 093 060
Ekurhuleni	Metro	857 083	233 306	506 537	1 079 679	1 225 699	540 083	51 490 556	–	22 933 505
EThekwini	Metro	2 045 980	3 728 055	6 066 539	5 660 327	3 664 306	1 971 092	2 764 492	–	1 617 462
Johannesburg	Metro	236 655	14 160	145 690	121 124	40 430	218 215	2 249 981	–	25 769 788
Mangaung	Metro	197 257	–	53 786	47 645	–	0	217 062	–	198 112
Nelson Mandela Bay	Metro	278 454	156 927	29 707	475 274	999 570	699 685	2 978 871	–	17
Tshwane	Metro	256 489	51 450	99 282	2 509 554	283 302	144 740	107 239	–	128 029
Drakenstein	Secondary City	–	–	27	–	–	150 198	–	–	–
George	Secondary City	–	–	8 273	–	–	3 529	–	–	351 310
Mbombela	Secondary City	–	21 678	6 554	–	790 646	290 735	–	–	42 108
Polokwane	Secondary City	–	2 628	11 626	–	40 844	76 038	–	–	10 526
Rustenburg	Secondary City	–	–	3 074	–	–	129 090	–	–	10 372
Sol Plaatje	Secondary City	186 020	50 184	2 289	0	0	0	58 941	–	49 283
Steve Tshwete	Secondary City	–	–	–	–	–	1 005 934	–	–	9 142
King Sabata Dalindyebo	Smaller town	54 328	–	72 090	109 283	–	55 165	0	–	11 462
KwaDukuza	Smaller town	–	–	–	–	–	10 957	–	–	–
Saldanha Bay	Smaller town	11 113	0	–	170 474	214 653	26 107	57 854	–	649
National		**15 048 150**	**16 990 842**	**19 150 945**	**23 644 860**	**19 344 949**	**19 857 327**	**71 986 870**	**–**	**84 237 937**
All Metros		**6 780 330**	**5 962 590**	**9 526 181**	**14 373 067**	**10 707 679**	**5 331 611**	**74 363 754**	**–**	**61 294 740**
All Metros excl. Mangaung		**6 583 073**	**5 962 590**	**9 472 394**	**14 325 422**	**10 707 679**	**5 331 611**	**74 146 692**	**–**	**61 096 628**
Secondary Cities		**186 020**	**74 490**	**31 842**	**0**	**831 490**	**1 655 524**	**58 941**	**–**	**472 741**
Smaller Towns		**65 441**	**–**	**72 090**	**279 757**	**214 653**	**92 229**	**57 854**	**–**	**12 110**

Notes

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All other coal data from suppliers

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NATIONAL GVA **2004** (constant 2005 ZAR millions)	1 330 390	Source: Statistics South Africa, Statistical Release P0441
NATIONAL GVA **2007** (constant 2005 ZAR millions)	1 561 076	Source: Statistics South Africa, Statistical Release P0441
National elec GJ (2007)	786 152 590	Source: DoE Energy Balance
National elec GJ (2004)	707 756 746	Source: Electricity Supply Statistics for South Africa – National Electricity Regulator 2003

Municipality	Type	ENERGY TOTALS												
		International marine (GJ)			Petrol and diesel (GJ)			Liquid fuel INCL. aviation, EXCL marine (GJ)			Liquid fuel EXCL. marine, aviation (GJ)			
		2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011	
Buffalo City	Metro	–	–	–	8 941 118	12 443 218	12 434 610	11 569 383	14 914 691	15 022 521	11 128 722	14 914 691	14 467 753	
Cape Town	Metro	–	–	7 496 844	63 609 073	67 266 748	83 984 819	86 714 924	75 963 459	100 313 095	72 600 032	75 963 459	90 220 035	
Ekurhuleni	Metro	–	–	–	55 282 559	45 691 924	59 634 292	111 057 639	47 759 551	84 903 637	59 567 083	47 759 551	61 970 132	
EThekwini	Metro	–	–	55 138 918	61 251 329	73 791 434	82 990 484	76 240 002	84 318 131	97 064 755	73 475 510	84 318 131	95 447 293	
Johannesburg	Metro	–	–	–	75 889 175	84 424 429	85 529 882	79 553 318	85 977 722	111 908 698	77 303 337	85 977 722	86 138 911	
Mangaung	Metro	–	–	–	12 030 325	–	9 207 972	12 856 761	–	9 664 252	12 639 699	–	9 466 140	
Nelson Mandela Bay	Metro	–	–	–	15 379 560	18 816 534	15 396 228	19 944 831	20 430 591	16 519 089	16 965 960	20 430 591	16 519 072	
Tshwane	Metro	–	–	–	46 707 601	51 503 616	42 886 242	51 089 762	52 583 464	43 506 165	50 982 523	52 583 464	43 378 137	
Drakenstein	Secondary City	–	–	–	–	–	2 488 151	–	–	2 640 207	–	–	2 640 207	
George	Secondary City	–	–	–	–	–	912 333	–	–	1 275 448	–	–	924 138	
Mbombela	Secondary City	–	–	–	–	9 501 010	6 228 648	–	10 479 364	6 586 170	–	10 479 364	6 544 062	
Polokwane	Secondary City	–	–	–	–	9 449 358	8 622 496	–	9 619 878	8 820 667	–	9 619 878	8 810 141	
Rustenburg	Secondary City	–	–	–	–	–	10 675 295	–	–	11 062 501	–	–	11 052 130	
Sol Plaatje	Secondary City	–	–	–	3 987 817	4 109 366	1 829 707	4 336 372	–	1 891 697	4 277 431	4 236 374	1 842 414	
Steve Tshwete	Secondary City	–	–	–	–	–	7 246 246	–	–	8 280 935	–	–	8 271 793	
King Sabata Dalindyebo	Smaller town	–	–	–	3 295 184	–	3 393 918	4 073 014	–	3 647 081	4 073 014	–	3 635 620	
KwaDukuza	Smaller town	–	–	–	–	–	1 381 049	–	–	1392084.443	–	–	1 392 084	
Saldanha Bay	Smaller town	–	–	–	2 702 039	2 708 600	2 496 656	3 007 848	3 004 343	2 523 450	2 949 994	3 004 343	2 522 801	
National		**–**	**–**	**–**	**678 874 580**	**782 047 777**	**836 800 713**	**819 061 010**	**844 570 558**	**981 532 523**	**747 074 140**	**844 570 558**	**897 294 586**	
All Metros		**–**	**–**	**62 635 762**	**339 090 740**	**353 937 903**	**392 064 529**	**449 026 620**	**381 947 609**	**478 902 212**	**374 662 866**	**381 947 609**	**417 607 472**	
All Metros excl. Mangaung		**–**	**–**	**62 635 762**	**327 060 415**	**353 937 903**	**382 856 557**	**436 169 859**	**381 947 609**	**469 237 960**	**362 023 167**	**381 947 609**	**408 141 332**	
Secondary Cities		**–**	**–**	**–**	**3 987 817**	**23 059 734**	**38 002 876**	**4 336 372**	**20 099 242**	**40 557 624**	**4 277 431**	**24 335 616**	**40 084 884**	
Smaller Towns		**–**	**–**	**–**	**5 997 223**	**2 708 600**	**7 271 623**	**7 080 862**	**3 004 343**	**7 562 616**	**7 023 008**	**3 004 343**	**7 550 505**	

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National elec GJ (2007)	786 152 590	Source: DoE Energy Balance
National elec GJ (2004)	707 756 746	Source: Electricity Supply Statistics for South Africa – National Electricity Regulator 2003

Municipality	Type	EMISSIONS												
		All fuels (tCO_2)			All fuels excl. aviation, marine (tCO_2e)				Electricity (tCO_2e)			Petrol (tCO_2e)		
		2004	2007	2011	2004	2007	2011	Growth pa 2004–2011	2004	2007	2011	2004	2007	2011
Buffalo City	Metro	2 449 144	2 647 901	3 019 145	3,03%	2 357 672	2 647 902	2 978 551	1 344 735	1 423 546	1 792 037	348 245	477 253	455 258
Cape Town	Metro	19 736 885	20 563 319	21 360 786	1,14%	17 754 870	20 563 319	20 018 674	12 230 220	14 864 287	13 387 916	2 740 471	2 718 096	3 264 558
Ekurhuleni	Metro	22 917 257	21 053 208	17 498 014	–3,78%	17 406 272	21 053 209	15 816 260	12 808 732	17 075 693	11 315 085	2 316 631	1 816 409	2 238 472
EThekwini	Metro	18 405 182	18 084 645	25 019 574	4,48%	16 054 034	18 084 645	20 474 251	10 995 227	12 034 601	12 121 284	2 027 470	2 190 001	2 442 994
Johannesburg	Metro	19 994 863	22 538 611	25 147 445	3,33%	19 071 604	22 538 611	23 258 356	12 845 179	16 063 106	16 834 569	3 650 422	3 767 992	3 964 327
Mangaung	Metro	2 495 297	–	2 202 641	–1,77%	2 334 696	–	2 188 349	1 438 595	–	1 523 578	406 854	–	309 256
Nelson Mandela Bay	Metro	4 754 204	4 929 804	5 129 312	1,09%	4 418 553	4 929 802	5 129 311	3 160 038	3 406 895	3 916 889	552 279	665 779	481 226
Tshwane	Metro	13 537 109	17 626 381	16 510 131	2,88%	13 081 841	17 626 379	16 501 042	8 172 547	13 004 382	13 184 517	2 288 837	2 133 699	1 602 910
Drakenstein	Secondary City	–	–	1 103 120	–	–	–	1 103 120	–	–	824 120	–	–	102 895
George	Secondary City	–	–	588 120	–	–	–	562 451	–	–	499 367	–	–	36 799
Mbombela	Secondary City	–	1 121 353	2 240 462	–	–	1 121 354	2 237 541	–	368 711	1 780 100	–	339 924	218 865
Polokwane	Secondary City	–	1 248 742	2 489 001	–	–	1 248 742	2 488 281	–	563 675	1 441 703	–	367 680	342 874
Rustenburg	Secondary City	–	–	12 668 428	–	–	–	12 667 727	–	–	11 338 168	–	–	349 590
Sol Plaatje	Secondary City	882 234	718 152	858 432	–0,39%	832 717	718 152	854 909	529 584	409 439	714 901	137 262	144 473	53 505
Steve Tshwete	Secondary City	–	–	3 726 218	–	–	–	3 725 624	–	–	3 143 811	–	–	134 359
King Sabata Dalindyebo	Smaller town	713 526	–	527 205	–4,23%	678 058	–	526 373	395 478	–	277 316	142 501	–	150 623
KwaDukuza	Smaller town	–	–	752 886	–	–	–	752 886	–	–	657 776	–	–	56 298
Saldanha Bay	Smaller town	**3 923 771**	**2 994 636**	**4 995 191**	**3,51%**	**6 300 473**	**2 994 635**	**4 995 144**	**1 614 547**	**1 230 598**	**2 068 726**	**63 297**	**72 348**	**57 925**
National		**391 327 499**	**433 527 000**	**460 124 000**	**2,34%**	**343 615 098**	**368 857 234**	**4 995 144**	**202 497 069**	**224 926 991**	**208 604 479**	**25 711 321**	**26 342 188**	**27 240 459**
All Metros		**104 289 941**	**107 443 869**	**115 887 050**	**–**	**92 479 543**	**107 443 867**	**106 364 794**	**62 995 274**	**77 872 510**	**74 075 874**	**14 331 209**	**13 769 229**	**14 759 001**
All Metros excl. Mangaung		**101 794 644**	**107 443 869**	**113 684 408**	**1,59%**	**90 144 847**	**107 443 867**	**104 176 445**	**61 556 679**	**77 872 510**	**72 552 297**	**13 924 355**	**13 769 229**	**14 449 745**
Secondary Cities		**882 234**	**3 088 247**	**23 673 782**	**–**	**832 717**	**3 088 248**	**23 639 651**	**529 584**	**1 341 825**	**19 742 171**	**137 262**	**852 077**	**1 238 886**
Smaller Towns		**4 637 297**	**2 994 636**	**6 275 283**	**–**	**6 978 531**	**2 994 635**	**6 274 403**	**2 010 025**	**1 230 598**	**3 003 817**	**205 798**	**72 348**	**264 845**

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Municipality	Type	EMISSIONS														
		Diesel (tCO_2e)			LPG (tCO_2e)			Paraffin (tCO_2e)			HFO (tCO_2e)			Coal (tCO_2e)		
		2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011
Buffalo City	Metro	263 148	408 962	396 914	18 202	1 797	11 515	94 079	148 660	119 776	38 328	29 124	8 838	250 934	158 560	194 214
Cape Town	Metro	1 591 970	2 062 680	2 478 743	158 482	110 261	147 929	169 937	203 789	150 874	281 264	316 943	116 574	582 526	287 263	472 080
Ekurhuleni	Metro	1 452 933	1 433 170	1 844 805	52 067	14 698	30 772	163 518	43 821	89 792	77 031	94 379	38 533	535 361	575 039	258 802
EThekwini	Metro	2 184 238	3 111 870	3 283 341	124 291	234 867	368 537	314 664	225 672	307 790	403 843	282 152	140 630	4 302	5 482	1 809 676
Johannesburg	Metro	1 493 596	2 206 373	1 842 936	14 377	892	8 851	73 576	107 907	17 073	8 642	3 113	15 569	985 813	389 228	575 032
Mangaung	Metro	419 801	–	323 603	11 983	–	3 267	25 385	–	14 235	3 399	–	0	28 678	–	14 410
Nelson Mandela Bay	Metro	502 420	678 399	579 287	16 916	9 886	1 805	57 994	32 944	27 403	33 909	76 967	49 920	94 997	58 932	72 781
Tshwane	Metro	874 414	1 522 952	1 334 044	15 581	3 241	6 031	105 091	53 647	17 264	179 047	21 814	10 327	1 446 324	886 644	345 948
Drakenstein	Secondary City	–	–	66 855	–	–	2	–	–	127	–	–	10 716	–	–	98 406
George	Secondary City	–	–	25 504	–	–	503	–	–	0	–	–	252	–	–	26
Mbombela	Secondary City	–	338 519	208 596	–	1 366	398	–	11 954	1 262	–	60 880	20 743	–	0	7 576
Polokwane	Secondary City	–	304 929	246 273	–	166	706	–	9 147	6 964	–	3 145	5 425	–	0	444 336
Rustenburg	Secondary City	–	–	384 700	–	–	187	–	–	17 041	–	–	9 210	–	–	568 830
Sol Plaatje	Secondary City	136 601	149 151	72 768	11 301	3 162	139	7 215	5 531	726	–	0	0	10 754	6 396	12 870
Steve Tshwete	Secondary City	–	–	370 778	–	–	0	–	–	1 366	–	–	71 770	–	–	3 541
King Sabata Dalindyebo	Smaller town	81 901	–	80 251	3 300	–	4 379	42 780	–	7 971	7 797	–	3 936	4 302	–	1 896
KwaDukuza	Smaller town	–	–	37 975	–	–	0	–	–	5	–	–	782	–	–	51
Saldanha Bay	Smaller town	124 202	122 846	115 359	675	0	0	4 622	5 838	3	12 163	16 528	1 863	4 480 967	1 546 477	2 751 269
National		**20 757 646**	**27 402 561**	**30 328 743**	**914 161**	**1 032 178**	**1 163 402**	**2 055 091**	**1 823 888**	**1 496 443**	**1 686 970**	**1 380 188**	**1 416 744**	**89 992 840**	**85 949 240**	**59 104 017**
All Metros		**8 782 520**	**11 424 406**	**12 083 673**	**411 899**	**375 642**	**578 707**	**1 004 245**	**816 440**	**744 206**	**1 025 463**	**824 492**	**380 390**	**3 928 933**	**2 361 148**	**3 742 943**
All Metros excl. Mangaung		**8 362 719**	**11 424 406**	**11 760 069**	**399 916**	**375 642**	**575 439**	**978 860**	**816 440**	**729 971**	**1 022 064**	**824 492**	**380 390**	**3 900 255**	**2 361 148**	**3 728 533**
Secondary Cities		**136 601**	**792 599**	**1 375 474**	**11 301**	**4 694**	**1 934**	**7 215**	**26 632**	**27 486**	**0**	**64 025**	**118 115**	**10 754**	**6 396**	**1 135 584**
Smaller Towns		**206 102**	**122 846**	**233 585**	**3 975**	**0**	**4 379**	**47 402**	**5 838**	**7 979**	**19 960**	**16 528**	**6 580**	**4 485 269**	**1 546 477**	**2 753 216**

Notes

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		OTHER KEY INDICATORS														
		GVA (2005 ZAR millions)					Population						Households			
Municipality	Type	2001	2004	2007	2011	Growth pa 2001–2011	1996	2001	2004	2007	2011	Growth pa 2001–2011	1996	2001	2011	Growth pa 1996–2011
Buffalo City	Metro	20 754	22 951	27 906	30 976	4,09%	685 727	704 855	702 671	724 308	755 200	0,69%	161 167	191 958	223 568	2,21%
Cape Town	Metro	128 905	145 101	172 953	198 123	4,39%	2 562 277	2 892 243	3 069 404	3 497 097	3 740 026	2,60%	651 755	759 485	1 068 573	3,35%
Ekurhuleni	Metro	74 339	84 518	99 809	109 873	3,98%	2 026 978	2 481 762	2 761 253	2 724 227	3 178 470	2,51%	542 719	745 576	1 015 465	4,27%
EThekwini	Metro	122 832	137 609	164 498	182 594	4,04%	2 748 299	3 090 122	3 269 641	3 468 087	3 442 361	1,09%	646 345	786 746	956 713	2,65%
Johannesburg	Metro	192 600	220 542	260 388	285 926	4,03%	2 638 471	3 226 055	3 585 545	3 888 182	4 434 827	3,23%	732 845	1 006 910	1 434 856	4,58%
Mangaung	Metro	20 356	23 205	25 972	26 797	2,79%	603 528	645 440	662 063	–	747 431	1,48%	153 203	185 013	231 921	2,80%
Nelson Mandela Bay	Metro	40 734	44 452	51 258	55 233	3,09%	969 518	1 005 779	1 013 883	1 050 934	1 152 115	1,37%	225 677	260 799	324 292	2,45%
Tshwane	Metro	108 001	121 703	149 570	175 787	4,99%	1 792 357	2 142 322	1 678 806	2 345 909	2 921 488	3,15%	459 122	606 025	911 536	4,68%
Drakenstein	Secondary City	–	–	–	8 112	–	186 334	194 417	–	–	251 262	2,60%	42 108	44 410	59 774	2,36%
George	Secondary City	–	–	–	5 900	–	120 148	149 436	–	–	193 672	2,63%	28 325	38 867	53 551	4,34%
Mbombela	Secondary City	–	–	–	19 956	–	426 090	476 903	–	527 203	588 794	2,13%	91 584	112 321	161 773	3,87%
Polokwane	Secondary City	–	–	–	17 017	–	424 835	508 277	–	561 770	628 999	2,15%	85 373	124 978	178 001	5,02%
Rustenburg	Secondary City	–	–	–	26 620	–	311 787	387 096	–	–	549 575	3,57%	75 793	113 394	199 044	6,65%
Sol Plaatje	Secondary City	–	–	–	11 111	–	205 103	202 246	196 846	243 015	248 041	2,06%	45 321	50 529	60 297	1,92%
Steve Tshwete	Secondary City	–	–	–	16 391	–	135 335	142 772	–	–	229 831	4,88%	33 619	36 229	64 971	4,49%
King Sabata Dalindyebo	Smaller town	–	–	–	7 920	–	396 312	416 348	421 233	–	451 710	0,82%	80 711	89 697	105 240	1,78%
KwaDukuza	Smaller town	–	–	–	15 022	–	143 758	167 805	–	–	231 187	3,26%	39 417	44 117	70 284	3,93%
Saldanha Bay	Smaller town	–	–	–	3 906	–	56 557	70 261	79 315	78 985	99 193	3,51%	12 810	18 663	28 835	5,56%
National		**1 191 007**	**1 330 390**	**1 561 076**	**1 703 801**	**3,65%**	**40 583 572**	**44 819 777**	**47 016 862**	**48 502 063**	**51 770 561**	**1,45%**	**9 059 571**	**11 205 706**	**14 450 162**	**3,16%**
All Metros		**708 521**	**800 081**	**952 354**	**1 065 310**	**–**	**14 027 155**	**16 188 578**	**16 743 266**	**17 698 744**	**20 371 918**	**2,33%**	**3 572 833**	**4 542 512**	**6 166 924**	**3,71%**
All Metros excl. Mangaung		**688 165**	**776 876**	**926 382**	**1 038 513**	**4,20%**	**13 423 627**	**15 543 138**	**16 081 203**	**17 698 744**	**19 624 487**	**2,36%**	**3 419 630**	**4 357 499**	**5 935 003**	**3,74%**
Secondary Cities		**–**	**–**	**–**	**–**	**–**	**1 809 632**	**2 061 147**	**–**	**–**	**2 690 174**	**2,70%**	**402 123**	**520 728**	**777 411**	**4,49%**
Smaller Towns		**–**	**–**	**–**	**–**	**–**	**596 627**	**654 414**	**–**	**–**	**782 090**	**1,80%**	**132 938**	**152 477**	**204 359**	**2,91%**

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Municipality	Type	INTENSITY FIGURES: Total Energy (GJ/capita) (excl, marine and aviation fuels)			Total Energy/GVA (GJ/2005 ZAR millions) (excl, marine and aviation fuels)			Electricity (GJ/capita)			Petrol (GJ/capita)		
		2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011
Buffalo City	Metro	25,6	29,3	28,3	784	762	741	6,7	6,4	7,0	7,4	9,5	9,1
Cape Town	Metro	39,2	36,5	37,7	830	738	801	13,9	13,9	12,5	13,4	11,3	13,1
Ekurhuleni	Metro	39,5	40,3	32,6	1 289	1 099	1 153	16,2	20,5	12,4	12,6	9,7	10,6
EThekwini	Metro	34,2	35,7	44,6	813	752	1 151	11,8	11,3	12,3	9,3	9,2	10,7
Johannesburg	Metro	36,5	36,7	33,8	593	548	615	12,5	13,5	13,3	15,3	14,0	13,4
Mangaung	Metro	27,1	–	20,0	772	–	564	7,6	–	7,1	9,2	–	6,2
Nelson Mandela Bay	Metro	28,4	30,6	26,8	649	628	558	10,9	10,6	11,9	8,2	9,2	6,3
Tshwane	Metro	54,8	44,6	31,6	756	699	527	17,0	18,1	15,8	20,5	13,2	8,2
Drakenstein	Secondary City	–	–	25,4	–	–	785	–	–	11,5	–	–	6,2
George	Secondary City	–	–	13,8	–	–	512	–	–	9,0	–	–	2,9
Mbombela	Secondary City	–	22,2	21,8	–	–	645	–	2,3	10,6	–	9,3	5,6
Polokwane	Secondary City	–	20,4	28,1	–	–	1 040	–	3,3	8,0	–	9,5	8,2
Rustenburg	Secondary City	–	–	–	–	–	2 089	–	–	72,1	–	–	9,6
Sol Plaatje	Secondary City	31,6	23,2	18,0	–	–	405	9,4	5,5	10,1	10,5	8,6	3,2
Steve Tshwete	Secondary City	–	–	83,9	–	–	1 177	–	–	47,8	–	–	8,8
King Sabata Dalindyebo	Smaller town	13,0	–	10,2	–	–	585	3,3	–	2,1	5,1	–	5,0
KwaDukuza	Smaller town	–	–	16,0	–	–	246	–	–	9,9	–	–	3,7
Saldanha Bay	Smaller town	–	–	–	–	–	8 588	71,1	50,9	72,9	12,0	13,3	8,8
National		**57,8**	**55,8**	**52,2**	**2 043**	**1 586**	**1 587**	**15,1**	**16,2**	**14,1**	**8,2**	**8,2**	**7,9**
All Metros		**37,6**	**37,4**	**34,7**	**786**	**695**	**664**	**13,2**	**14,4**	**12,7**	**12,86**	**11,28**	**10,88**
All Metros excl. Mangaung		**38,0**	**37,4**	**35,3**	**786**	**714**	**667**	**13,4**	**14,4**	**12,9**	**13,01**	**11,28**	**11,06**
Secondary Cities		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Smaller Towns		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**

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Municipality	Type	INTENSITY FIGURES											
		Diesel (GJ/capita)			Petrol & diesel (GJ/capita)			Coal (GJ/capita)			Paraffin (GJ/capita)		
		2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011
Buffalo City	Metro	5,3	7,6	7,4	12,7	17,2	16,5	3,1	2,3	2,2	1,9	2,9	2,3
Cape Town	Metro	7,3	8,0	9,3	20,7	19,2	22,5	1,6	0,9	1,1	0,8	0,8	0,6
Ekurhuleni	Metro	7,4	7,1	8,2	20,0	16,8	18,8	1,7	2,2	0,7	0,9	0,2	0,4
EThekwini	Metro	9,4	12,1	13,4	18,7	21,3	24,1	0,0	0,0	4,5	1,4	0,9	1,3
Johannesburg	Metro	5,9	7,7	5,9	21,2	21,7	19,3	2,4	1,1	1,1	0,3	0,4	0,1
Mangaung	Metro	8,9	–	6,1	18,2	–	12,3	0,4	–	0,2	0,6	–	0,3
Nelson Mandela Bay	Metro	7,0	8,7	7,1	15,2	17,9	13,4	0,8	0,6	0,5	0,8	0,4	0,3
Tshwane	Metro	7,3	8,8	6,4	27,8	22,0	14,7	7,5	4,0	1,0	0,9	0,3	0,1
Drakenstein	Secondary City	–	–	3,8	–	–	9,9	–	–	3,4	–	–	0,0
George	Secondary City	–	–	1,9	–	–	4,7	–	–	0,0	–	–	0,0
Mbombela	Secondary City	–	8,7	5,0	–	18,0	10,6	–	0,0	0,1	–	0,3	0,0
Polokwane	Secondary City	–	7,3	5,5	–	16,8	13,7	–	0,0	6,1	–	0,2	0,2
Rustenburg	Secondary City	–	–	9,9	–	–	19,4	–	–	9,0	–	–	0,4
Sol Plaatje	Secondary City	9,8	8,3	4,1	20,3	16,9	7,4	0,5	0,3	0,4	0,5	0,3	0,0
Steve Tshwete	Secondary City	–	–	22,7	–	–	31,5	–	–	0,1	–	–	0,1
King Sabata Dalindyebo	Smaller town	2,7	–	2,5	7,8	–	7,5	0,1	–	0,0	1,5	–	0,3
KwaDukuza	Smaller town	–	–	2,3	–	–	6,0	–	–	0,0	–	–	0,0
Saldanha Bay	Smaller town	22,1	21,0	16,4	34,1	34,3	25,2	–	–	–	0,8	1,0	0,0
National		**6,2**	**8,0**	**8,3**	**14,4**	**16,1**	**16,2**	**16,6**	**15,3**	**9,9**	**0,6**	**0,5**	**0,4**
All Metros		**7,4**	**8,7**	**8,4**	**20,3**	**20,0**	**19,2**	**2,0**	**1,4**	**1,6**	**0,9**	**0,6**	**0,5**
All Metros excl. Mangaung		**7,3**	**8,7**	**8,4**	**20,3**	**20,0**	**19,5**	**2,1**	**1,4**	**1,6**	**0,9**	**0,6**	**0,5**
Secondary Cities		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Smaller Towns		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**

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Municipality	Type	INTENSITY FIGURES													
		LPG (GJ/capita)			Total Emissions (tCO_2e/capita) (excl. marine and aviation fuels)			Total Emissions/GVA (tCO_2e/2005 ZAR millions) (excl. marine and aviation fuels)			GVA/capita (2005 ZAR)				
		2004	2007	2011	2004	2007	2011	2004	2007	2011	2001	2004	2007	2011	Growth pa 2001-2011
Buffalo City	Metro	0,4	0,0	0,3	3,4	3,7	3,9	103	95	96	29 445	32 662	38 528	41 017	3,37%
Cape Town	Metro	0,8	0,5	0,7	5,8	5,9	5,4	122	119	101	44 569	47 273	49 456	52 974	1,74%
Ekurhuleni	Metro	0,3	0,1	0,2	6,3	7,7	5,0	206	211	144	29 954	30 608	36 638	34 568	1,44%
EThekwini	Metro	0,6	1,1	1,8	4,9	5,2	5,9	117	110	112	39 750	42 087	47 432	53 043	2,93%
Johannesburg	Metro	0,1	0,0	0,0	5,3	5,8	5,2	86	87	81	59 701	61 509	66 969	64 473	0,77%
Mangaung	Metro	0,3	–	0,1	3,5	–	2,9	101	–	82	31 538	35 050	–	35 852	1,29%
Nelson Mandela Bay	Metro	0,3	0,1	0,0	4,4	4,7	4,5	99	96	93	40 500	43 844	48 774	47 940	1,70%
Tshwane	Metro	0,2	0,0	0,0	7,8	7,5	5,6	107	118	94	50 413	72 494	63 758	60 170	1,79%
Drakenstein	Secondary City	–	–	0,0	–	–	4,4	–	–	136	–	–	–	32 286	–
George	Secondary City	–	–	0,0	–	–	2,9	–	–	95	–	–	–	30 463	–
Mbombela	Secondary City	–	0,0	0,0	–	2,1	3,8	–	–	112	–	–	–	33 893	–
Polokwane	Secondary City	–	0,0	0,0	–	2,2	4,0	–	–	146	–	–	–	27 054	–
Rustenburg	Secondary City	–	–	0,0	–	–	23,1	–	–	476	–	–	–	48 437	–
Sol Plaatje	Secondary City	0,9	0,2	0,0	4,2	3,0	3,4	–	–	77	–	–	–	44 797	–
Steve Tshwete	Secondary City	–	–	0,0	–	–	16,2	–	–	227	–	–	–	71 319	–
King Sabata Dalindyebo	Smaller town	0,1	–	0,2	1,6	–	1,2	–	–	66	–	–	–	17 533	–
KwaDukuza	Smaller town	–	–	0,0	–	–	3,3	–	–	50	–	–	–	64 980	–
Saldanha Bay	Smaller town	0,1	0,0	0,0	79,4	37,9	50,4	–	–	1 279	–	–	–	39 381	–
National		**0,3**	**0,4**	**0,4**	**7,3**	**7,6**	**0,1**	**258**	**236**	**3**	**26 573**	**28 296**	**32 186**	**32 911**	**2,16%**
All Metros		**0,4**	**0,3**	**0,5**	**5,5**	**6,1**	**5,2**	**116**	**113**	**100**	**43 767**	**47 785**	**53 809**	**52 293**	**–**
All Metros excl. Mangaung		**0,4**	**0,3**	**0,5**	**5,6**	**6,1**	**5,3**	**116**	**116**	**100**	**44 275**	**48 310**	**52 342**	**52 919**	**1,80%**
Secondary Cities		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Smaller Towns		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**

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National elec GJ (2004)	707 756 746	Source: Electricity Supply Statistics for South Africa – National Electricity Regulator 2003

Municipality	Type	HOUSEHOLD STATSSA DATA											
		Households using elec for lighting				Households using clean fuels for cooking				Households using clean fuels for heating			
		2001	2001	2011	2011	2001	2001	2011	2011	2001	2001	2011	2011
Buffalo City	Metro	120 843	63%	180 906	81%	88 615	46%	175 204	78%	70 504	37%	97 755	44%
Cape Town	Metro	674 231	89%	1 004 327	94%	628 601	83%	1 017 815	95%	579 433	76%	714 525	67%
Ekurhuleni	Metro	557 957	75%	834 379	82%	498 241	67%	833 312	82%	473 432	63%	711 742	70%
EThekwini	Metro	627 305	80%	859 680	90%	581 603	74%	847 680	89%	571 665	73%	743 393	78%
Johannesburg	Metro	854 455	85%	1 302 865	91%	814 406	81%	1 304 835	91%	792 140	79%	1 235 298	86%
Mangaung	Metro	157 220	85%	180 906	78%	118 199	64%	210 306	91%	103 909	56%	132 665	57%
Nelson Mandela Bay	Metro	195 618	75%	293 424	90%	173 978	67%	289 719	89%	157 013	60%	184 283	57%
Tshwane	Metro	483 977	80%	807 090	89%	434 943	72%	796 699	87%	426 858	70%	707 308	78%
Drakenstein	Secondary City	38 550	87%	56 798	95%	37 239	84%	57 054	95%	34 023	77%	44 999	75%
George	Secondary City	33 650	87%	48 735	91%	31 576	81%	48 702	91%	28 776	74%	32 525	61%
Mbombela	Secondary City	81 231	72%	145 917	90%	62 646	56%	140 229	87%	57 176	51%	120 859	75%
Polokwane	Secondary City	79 526	64%	147 700	83%	55 682	45%	131 153	74%	54 532	44%	111 056	62%
Rustenburg	Secondary City	81 237	72%	165 190	83%	64 129	57%	163 396	82%	62 472	55%	145 968	73%
Sol Plaatje	Secondary City	41 546	82%	51 170	85%	32 867	65%	52 857	88%	31 455	62%	43 959	73%
Steve Tshwete	Secondary City	27 059	75%	59 025	91%	19 612	54%	54 514	84%	19 655	54%	42 881	66%
King Sabata Dalindyebo	Smaller town	37 385	42%	77 180	73%	22 463	25%	65 860	63%	13 326	15%	23 199	22%
KwaDukuza	Smaller town	32 964	75%	63 402	90%	29 066	66%	62 301	89%	27 958	63%	51 384	73%
Saldanha Bay	Smaller town	17 090	92%	27 968	97%	16 196	87%	28 148	98%	15 338	82%	22 615	78%
National		**7 815 271**	**70%**	**12 242 402**	**85%**	**6 069 876**	**54%**	**11 204 962**	**78%**	**5 641 515**	**50%**	**8 898 542**	**62%**
All Metros		**3 671 608**	**81%**	**5 495 061**	**89%**	**3 338 586**	**73%**	**5 475 570**	**89%**	**3 174 954**	**70%**	**4 526 969**	**73%**
All Metros excl. Mangaung		–	–	–	–	–	–	–	–	–	–	–	–
Secondary Cities		**382 799**	**74%**	**674 535**	**87%**	**303 751**	**58%**	**647 905**	**83%**	**288 089**	**55%**	**542 247**	**70%**
Smaller Towns		**87 439**	**57%**	**168 550**	**82%**	**67 725**	**44%**	**156 309**	**76%**	**56 622**	**37%**	**97 198**	**48%**

Notes

2004 national liquid fuel figures from DoE Energy Balances (SAPIA data not available)
2007 & 2011 national coal figures from DoE Energy Balances
2007 national LPG figure from DoE Energy Balances (SAPIA data not available)
All other liquid fuel data from SAPIA
All other coal data from suppliers

National Petrol consumption 2011 (GJ)	11 963 310 914	Source: SAPIA 2011
National Petrol consumption 2012 (GJ)	11 733 080 659	Source: SAPIA 2012
National CO_2 (eq) emissions (tonnes CO_2(eq))	9,041	Source: 2010 – the United States Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC) for the United Nations. Funded by World Bank.
NATIONAL GVA **2001** (constant 2005 ZAR millions)	1 191 007	Source: Statistics South Africa, Statistical Release P0441
NATIONAL GVA **2004** (constant 2005 ZAR millions)	1 330 390	Source: Statistics South Africa, Statistical Release P0441
NATIONAL GVA **2007** (constant 2005 ZAR millions)	1 561 076	Source: Statistics South Africa, Statistical Release P0441
National elec GJ (2007)	786 152 590	Source: DoE Energy Balance
National elec GJ (2004)	707 756 746	Source: Electricity Supply Statistics for South Africa – National Electricity Regulator 2003

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