Cape Town 2011

State of Energy and Energy Futures Report

Energy use, carbon emissions inventory and scenarios for the future

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

THIS CITY WORKS FOR YOU

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

THIS CITY WORKS FOR YOU

Published by:
City of Cape Town
First edition November 2011
ISBN 978-0-9802784-8-4

Printed on:
sappi
triple green™
sugar cane fibre, chlorine-free, sustainable afforestation.

Photographer: Bruce Sutherland, CCT

The climate is changing, what about you?

The City of Cape Town has been a leading city in developing its energy and climate change work. In 1998 we started as active participants in the Sustainable Energy for Environment and Development (SEED) programme and started to build our capacity and projects in this area. The City's first state of Energy report came out in 2003, and was swiftly followed by the draft Energy and Climate Change Strategy. The City then hosted the first City Energy Strategies conference, where we brought international experts and South African local government together. In 2006 the Council adopted the Energy and Climate Change Strategy. In 2007 we brought out the second State of Energy Report and in 2008, on the heels of the national electricity supply shortage blackouts, the City made the far-reaching decision to establish a political committee to drive energy and climate change matters and the City started to employ dedicated staff to coordinate and run projects.

Great strides have been made since then and we do in fact have a very comprehensive Energy and Climate Action Plan, a Climate Change Think Tank with specialist and academics and we completed a scenario based energy futures study for the City. Progress in this new area for a local government requires good data, which is kept up to date and on the basis of which we can monitor our progress. The information in this report is the most comprehensive to date, and we are seeing crucial information gaps being filled. This gives our energy futures study a high level of reliability and this study is inspiring much of the City's development strategies into the future.

Cape Town's energy future holds enormous potential for supporting economic development and delivering on jobs. It is a major driver for Cape Town's vision for the future as we move towards a greener economy which services our citizens.

Patricia de Lille
Executive Mayor: City of Cape Town

Table of contents

List of figures

List of tables

Executive summary

This State of Energy and Energy Futures report 2011 is the third such report done by the City of Cape Town, following on the 2003 and 2007 editions. However, this report differs from the previous two in that it includes a significant amount of information from a study commissioned by the City of Cape Town entitled *Energy Scenarios for Cape Town*: Exploring the implications of different energy futures for the City up to 2050. This study provided extensive, detailed information on current energy consumption patterns, and has been the first to disaggregate energy consumption data from the commercial and industrial sectors.

Another reason why this study is important for the City is that it has modelled various scenarios for the future, and allows the City to see the impact of various energy choices on energy consumption levels, carbon emissions and cost to the economy until 2050.

The *Energy Scenarios for Cape Town* project was undertaken by Sustainable Energy Africa and the University of Cape Town's Energy Research Centre to enable the City of Cape Town to improve its strategic planning and the implementation of the City's Energy and Climate Action Plan, which was adopted by Council in May 2010. The Action Plan comprises both existing and proposed City energy and climate change projects across all directorates and departments.

Setting the Cape Town context: The South African and Western Cape energy picture

South Africa, including the Western Cape, is dependent on coal based electricity to meet its energy demands. Some 61% of all energy requirements in South Africa are met by coal, and 85% of all electricity is generated through burning coal. This dependence on low-grade coal has resulted in South Africa having excessively high carbon emissions, particularly for a developing country.

Similarly, more than half of the Western Cape's carbon emissions result from electricity consumption. The Western Cape consumes 11% of the total energy generated nationally, and in 2004, approximately 250 million GJ of energy was consumed across all sectors.

The industrial sector is responsible for the greatest share of energy consumed in both South Africa as a whole and within the Western Cape. This highlights the energy intensity of industries within South Africa.

The Cape Town energy picture, including a breakdown by sector

Cape Town's energy picture is very different to that of the Western Cape and South Africa. This report takes a detailed look at five sectors, namely the residential, commercial, industrial, transport and local government sector.

The residential sector in Cape Town consumes 18% of all energy, and the majority of the energy demand is for electricity (91%). This sector accounts for 29% of carbon emissions, mostly because of the carbon intensity of electricity used in South Africa. The amount and types of energy consumed by households of varying income levels are diverse. Low-income households, which make up 44% of all households, contribute to only 24% of total residential energy use. On the other hand, high-income or very high-income households, which make up only 24% of total households, use 43% of all energy. This demonstrates the extent of energy poverty and inequality in Cape Town, where those living in poverty are unable to afford basic energy services, and also highlights the energy intensity of higher-income households.

The commercial sector accounts for 16% of energy consumption, of which 95.6% is consumed as electricity. Like the residential sector, the commercial sector's dependency on coal based electricity as its primary energy source has made it carbon intensive. Accordingly, it is responsible for 28% of total carbon emissions. The commercial sector includes retail and office buildings, tourism activities, education facilities, hospitals and other non-industrial activities.

The industrial sector's share of energy consumption in Cape Town (14%) is considerably smaller than in the Western Cape (47–49% with mining included) or in South Africa (34–41% with mining included). This is due to the fact that much of Cape Town's economy is largely based on the tertiary sector, comprising organisations that are often classified as members of the commercial sector.

Half (50%) of Cape Town's energy is consumed by the transport sector. This is a much larger proportion than in the Western Cape (35%) and in South Africa (28%). However, only 1% of all transport in Cape Town is powered by electricity, and this has resulted in the transport sector having a lower carbon intensity than other sectors, particularly the commercial and residential sector. This is due to the relative carbon intensity of electricity when compared to liquid fuels.

The transport sector is still a high carbon emitter, being responsible for 27% of Cape Town's total carbon emissions. Current passenger transport is heavily dependent on private vehicles, which make up 48% of the modal share in terms of passenger kilometres. Public and sustainable transport infrastructure is therefore a priority in order to shift the modal split towards public transport.

The local government sector (the City of Cape Town) accounts for only 1% of total energy consumed in Cape Town, and 1% of carbon emissions. However, this sector in Cape Town comprises a single organisation. Accordingly, it has vast potential to reduce energy consumption. This would allow the City of Cape Town to lead by example, and would reduce pressure on the public funds required to meet the energy requirements of Council operations.

Cape Town's optimum energy future

Data collected during the *Energy Scenarios for Cape Town* study generated a set of models that outline possible future energy consumption levels and trajectories. The study considers and models various scenarios up until 2050, and sketches the effect that various energy related interventions, actions or global events (such as peak oil) may have on Cape Town's energy picture. As part of this, a baseline scenario entitled "Business as Usual" was modelled.

Based on the modelling of a range of different scenarios, an optimum energy future scenario was developed, which supports the City of Cape Town's objective of energy security and diversity. Striving towards the optimum energy future would moreover maximise job creation, optimise and reduce future energy costs, and promote sustainable and 'green' economic development.

In order to reduce carbon emissions in future, the optimum energy future considered the following three main intervention areas:

1. Electricity efficiency
2. Transport efficiency
3. Renewable electricity supply

Changes in these three focus areas would minimise growth in energy consumption, decouple energy consumption and economic growth, and reduce the carbon intensity of electricity.

1. Context: The South African and Western Cape energy picture

1.1 The South African energy picture

South Africa is a country rich in mineral resources, with an extensive mining industry. South Africa is ranked first for platinum production, second for gold production and fifth for coal production in the world. In 2007, 247.7 million tonnes of coal was mined in the country. It is estimated that a further 31 billion tonnes of recoverable coal resources remain. (GCIS, 2008) It is this availability of cheap and abundant coal that has formed South Africa's historical and contemporary energy picture. The country's current energy picture is shown in figure 1 below.

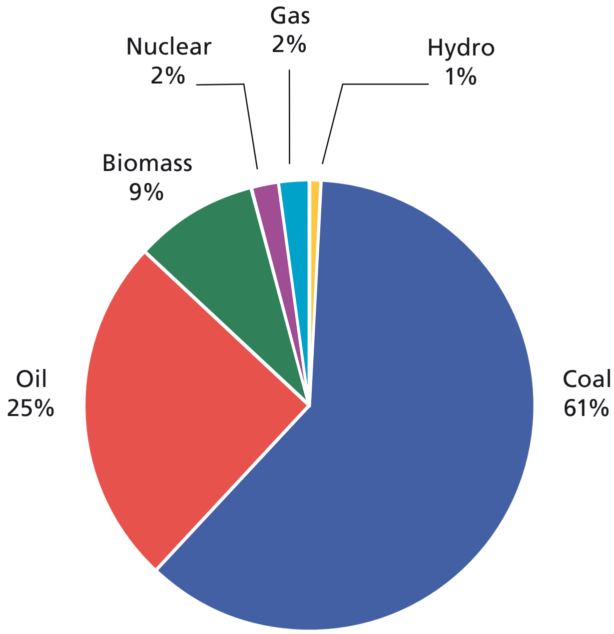


Figure 1: Total South African energy mix (Ward, 2008)

In 2006, South Africa consumed 2 627 million GJ of energy. The relative energy intensity of the industrial and mining sectors can be seen in figure 2 below, where these sectors account for 41% of all energy consumption. The transport sector is second, using 28% of energy. The agriculture, commercial and residential sectors account for the rest.

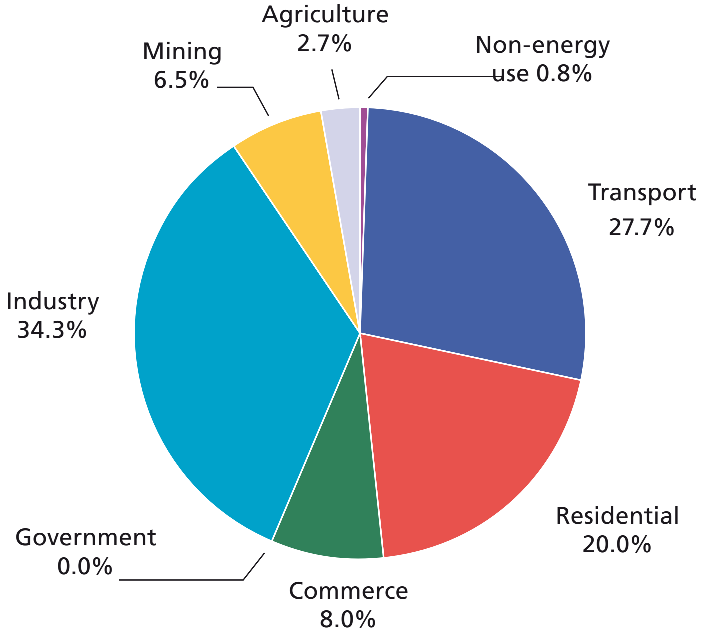


Figure 2: Energy demand by economic sector for 2006, total: 2 627 PJ (DME, 2009)

The relative electricity consumption by different sectors also highlights the energy intensity of South Africa's industry and mining sector, accounting for 59% of total electricity consumption. In figure 3 below, the commercial and residential sectors' reliance on electricity, with their respective electricity consumption at 15% and 21%, is shown compared to their cumulative consumption of 28% of total energy.

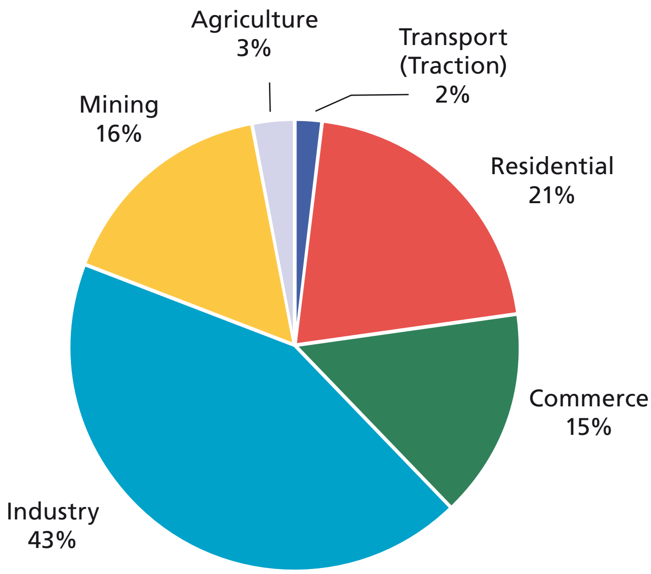


Figure 3: South African electricity consumption by sector (Eskom, 2011b)

South Africa's abundance of coal and extensive use thereof to meet its energy requirements have contributed to the country's carbon emissions being among the highest in the world. South Africa, as a developing country, emits 1% of total global carbon (see table 1).

Table 1: Comparison of South Africa's annual and cumulative emissions (DEAT, 2007a)

	Annual carbon emissions, 2000		Cumulative carbon dioxide (CO_2) emissions, 1950–2000	
	Mt CO_2 equivalent	%	Mt CO_2	%
	Six gases, energy & LULUCF	As share of global total	CO_2 only, energy & LULUCF	As share of global total
South Africa	415	1.0%	10 250	0.9%
World	41 240	100%	1 113 122	100%

1.1.1 Oil and liquid-fuel supply

South Africa depends heavily on imports in order to meet its liquid-fuel requirements. Further petroleum products are produced through coal-to-liquid fuel and gas-to-liquid fuel technologies. The synthetic-fuel plants in South Africa contribute approximately 38% to final liquid-fuel demand (DME, 2009).

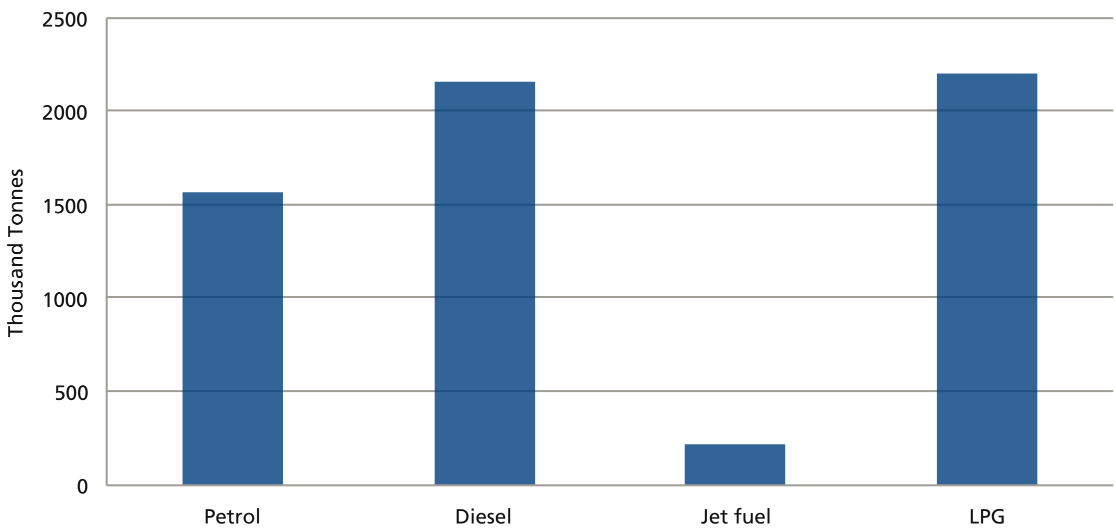


Figure 4: Petroleum product imports (SAPIA, 2010)

Consumption of petrol and diesel in South Africa has been growing fairly consistently since 1988. The effects of the economic recession can be seen below in figure 5 and figure 6, showing the start of a decline in the consumption of petroleum products. In some cases, such as diesel and jet fuel, this decline in consumption is quite drastic.

3 Mega-tonnes

[4]Land use, land-use change and forestry – defined by the United Nations Climate Change Secretariat as "a greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities" (UNFCCC, n.d.).

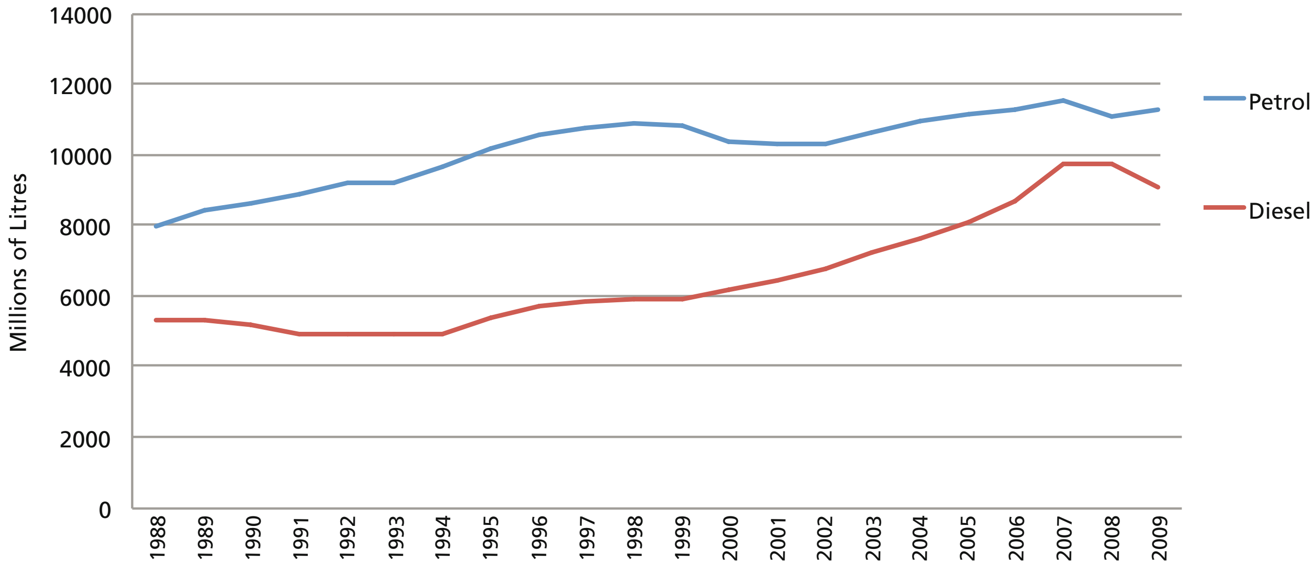


Figure 5: Consumption of petrol and diesel in South Africa since 1988 (SAPIA, 2010)

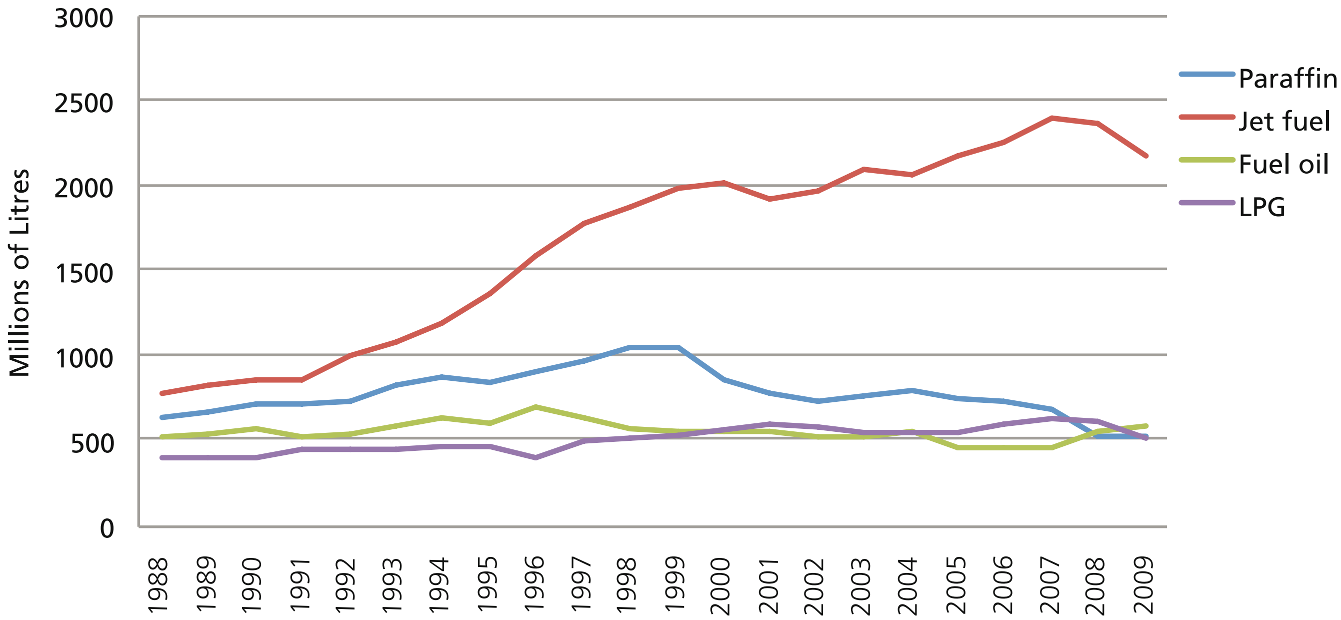


Figure 6: Consumption of petroleum products in South Africa since 1988 (SAPIA, 2010)

Rising prices also affect the level of consumption, and spikes such as the one seen in 2008 (shown in figure 7) are also likely to have contributed to the downturn in fuel consumption. The effects of more serious price increases that would be associated with peak oil are likely to be more noticeable.

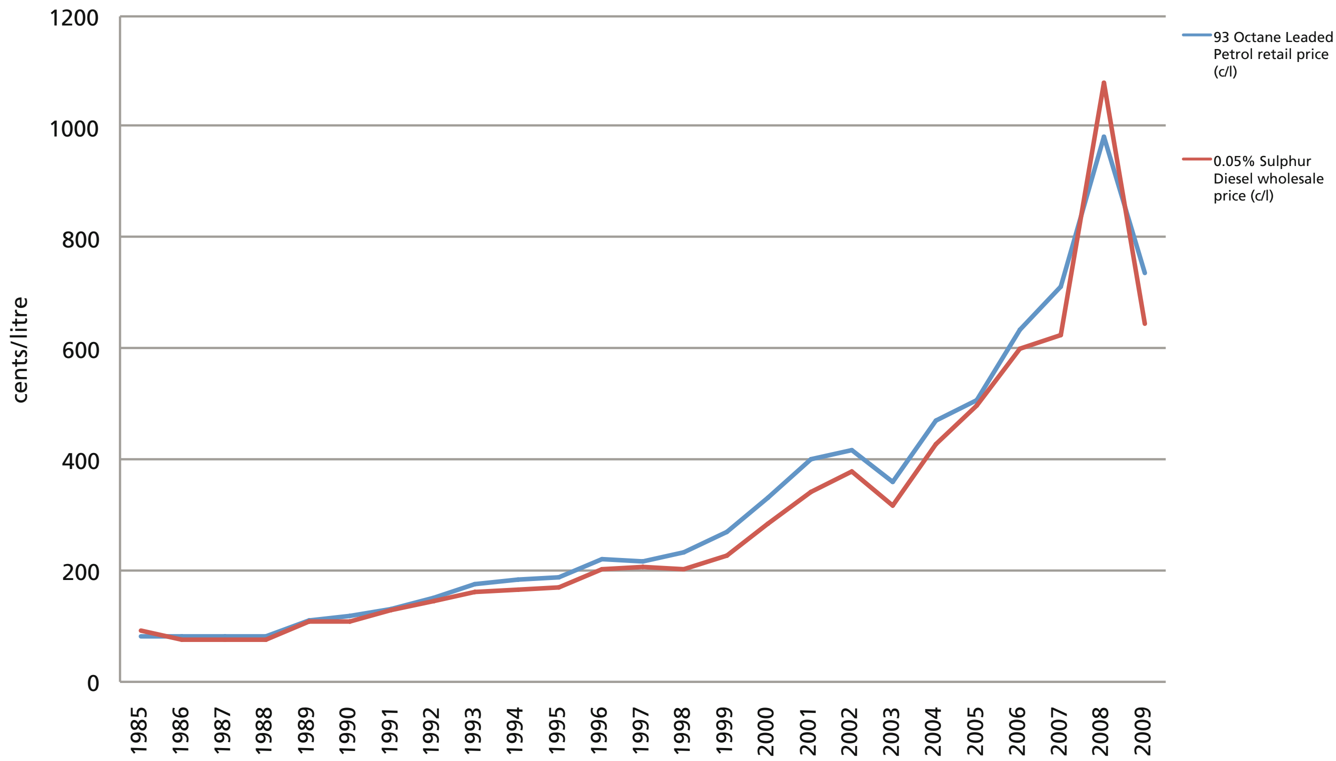


Figure 7: Fuel price in Gauteng province, measured annually on 30 June (SAPIA, 2010)

South Africa's dependence on imported fuel makes the country particularly vulnerable to global price shocks. South Africa's fuel prices are linked to international prices, and are therefore exposed to changes in the rand/US dollar exchange rate. The increasing price of imported crude oil (shown below in figure 8), peak oil effects and resulting price fluctuations are therefore of great concern.

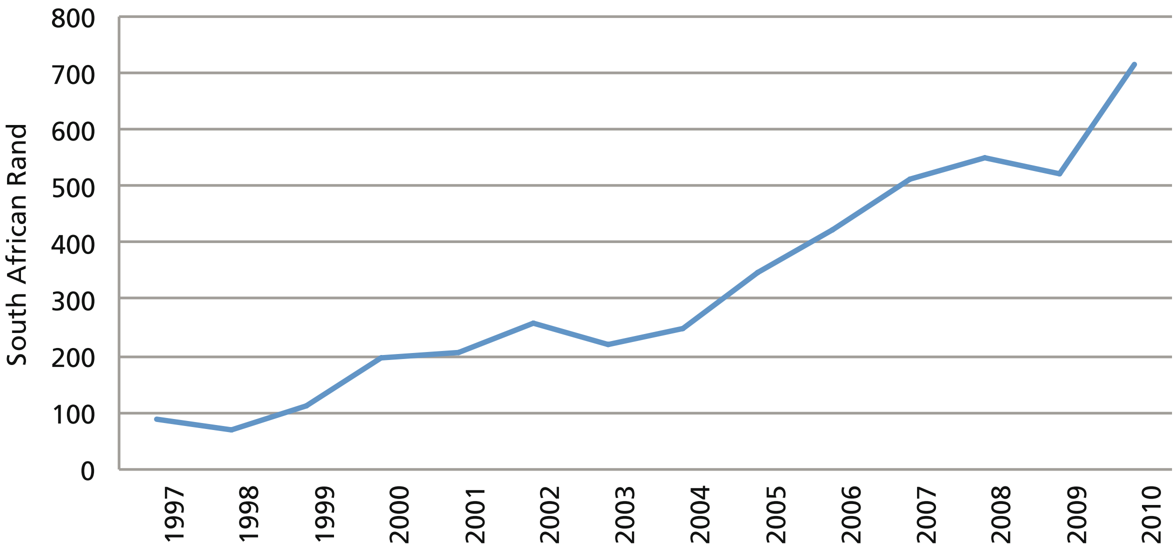


Figure 8: Average Brent crude price per barrel (ZAR) (SAPIA, 2010)*

***Prices shown are for the Gauteng province, but trends are indicative of fuel prices in the Western Cape.**

1.1.2 Electricity supply

South Africa has a single dominant electricity provider, Eskom, which is the seventh-largest electricity generator in the world. Eskom, a state-owned entity, is responsible for supplying 95% of electricity in South Africa and 45% of electricity in Africa. (GCIS, 2008) Eskom exports approximately 1 200 GWh per month to countries within Southern Africa as part of the Southern African Power Pool agreement. These countries include Namibia, Botswana, Lesotho, Swaziland, Mozambique and, occasionally, also Zimbabwe and Zambia. (DPE, 2010) South Africa also purchases hydro-electric power from Cahora Bassa power station in Mozambique.

The availability and relative affordability of coal as an energy source have made electricity generation heavily dependent on coal: Altogether 85% of all electricity generated by Eskom is from burning coal. Renewable energy plays a very small role in current electricity generation, accounting for only 2% of Eskom's output (see figure 9).

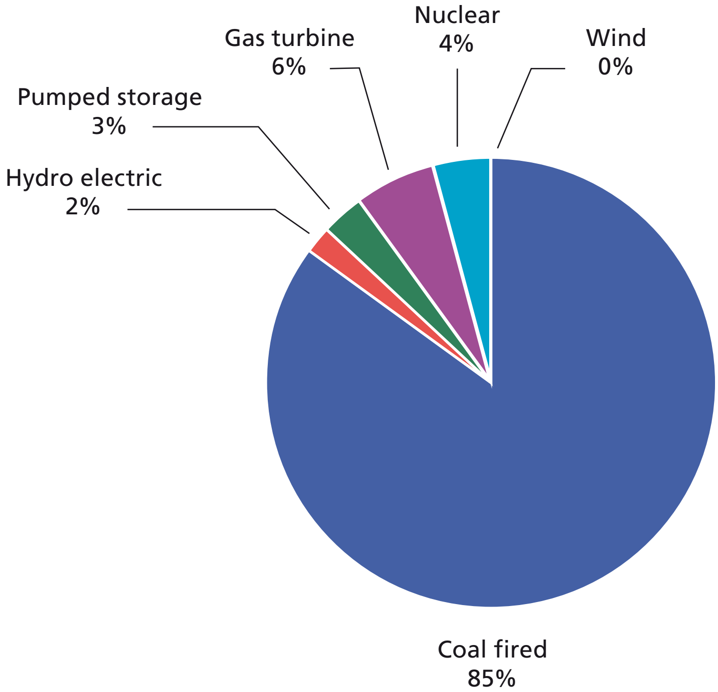


Figure 9: Eskom's power station net maximum capacity (Eskom, 2011a)

The majority of Eskom's power stations are located in the north-east region of South Africa. Koeberg Nuclear Power Station, which generates up to 1 800 MW, is the only power station of scale in the Western Cape. Therefore, transmission lines span the length and breadth of the country, totalling 28 790 km. Eskom's power infrastructure can be seen in figure 10.

Figure 10: Eskom power stations across South Africa (Eskom, 2008)

This extensive network results in significant transmission and distribution losses. During the 2010/11 financial year, Eskom reported technical losses from their distribution and transmission network of 5.68% and 3.27% respectively. The extent of this network also makes it vulnerable to theft, with losses of almost R3 million from conductor theft and more than R5 million from the theft of steel-tower members (pylon theft) having been reported by Eskom in 2010/11. (Eskom, 2011a) The transmission network consists of transmission lines of voltages ranging between 132 kV and 765 kV, and a network of 160 substations.

Table 2: Eskom's transmission and distribution equipment, 2011 (Eskom, 2011a)

Transmission lines (km)	28 790
Distribution lines (km)	46 712
Reticulation lines (km)	308 899
Underground cables (km)	11 018
Transformer capacity (MVA)	
• Transmission	130 005
• Distribution	102 053

1.1.3 Electricity supply shortages

Eskom undertook an intensive power station construction phase, which ran from the 1970s through to the 1990s. This construction drive has led to an oversupply of electricity. In the early 1990s, as Eskom started to realise the possibility of an oversupply, certain power stations were mothballed (put out of commission) and the construction of committed new projects was stopped. In order to consume the electricity oversupply, energy-intensive industries such as aluminium smelters have been actively encouraged, without any regard to energy efficiency.

In order to sell the electricity generated, the cost of electricity remained extremely low and, until recently, South African electricity prices have been among the lowest in the world, at R0.25/kWh. In fact, since 1987, the real price of electricity, expressed in terms of the consumer price index (CPI), has been declining (Steyn, 2006). The electricity price has only recently started to increase, with Eskom's application for a steep increase having been approved, and from 1 July 2009 to 31 March 2010 (i.e. nine months), a 31.3% price increase on the average standard tariff was approved. This has increased the average standard tariff from 25.24c/kWh to 33.14c/kWh. (NERSA, 2009) NERSA (National Energy Regulator of South Africa) has approved further price increases, which "will result in the average standard price of 41.57c/kWh, 52.30c/kWh and 65.85c/kWh for the 2010/11, 2011/12 and 2012/13 financial years respectively. This will result in a percentage price increase of 24.8% on the average standard tariff from 1 April 2010, followed by a further average increase of 25.8% from 1 April 2011, and an additional price increase of 25.9% from 1 April 2012" see table 3. (NERSA, 2010) .

Table 3: NERSA-approved revenues, standard average prices and percentage price increases for Eskom (NERSA,2010)

	2010/11	2011/12	2012/13
Allowed revenues from tariff-based sales (R'm)	85 180	109 948	141 411
Forecast sales to tariff customers (GWh)	204 551	210 219	214 737
Standard average price (c/kWh)	41.57	52.30	65.85
Percentage price increase (%)	24.8%	25.8%	25.9%
Total expected revenue from all customers (R'm)	90 927	116 152	148 378

Consumption levels have increased over the years, without any real motivation for energy efficiency or an expansion of electricity-generating infrastructure. In 2006, this was demonstrated when a technical fault was experienced in Koeberg Nuclear Power Station. The cross-country transmission lines were unable to manage the resulting demand, as they were inadequately maintained and upgraded, and the Western Cape experienced numerous blackouts. In 2008, South Africa experienced severe load shedding as the gap between supply and demand closed even further, and the reserve margin reached a low of 5.6%. With Eskom having experienced a peak demand of 35 850 MW in 2010, South Africa faces further supply shortages, as the reserve margin fluctuates very close to the minimum international standard of 15%. Mothballed power stations have been recommissioned, which has brought Eskom's capacity to 41 194 MW. Eskom has also been running energy efficiency and demand side management programmes, which have brought relief estimated at 354 MW. (Eskom, 2011a) The price increases mentioned above have been approved by NERSA in order to assist Eskom in funding an expansion of its generation capacity and transmission infrastructure.

In order to address Long Term electricity shortfalls, the National Department of Energy (DoE) has developed an Integrated Resource Plan. This plan outlines the DoE's proposed strategy for expanding current generation infrastructure and, to some extent, addresses the role of energy efficiency and demand side management (EEDSM) in reducing demand. The plan includes new construction of 9.6 GW nuclear, 6.3 GW coal, 11.4 GW renewables and 11 GW other resources (such as open/closed-cycle gas turbines). Committed construction projects (excluded from the previous figures) include the construction of Medupi and Kusile coal-fired power stations totalling 8.67 GW. Therefore, the Integrated Resource Plan continues South Africa's tendency of generating electricity from burning coal, with an expected 66% of power-generating capacity that will be derived from fossil fuels by 2030. The EEDSM programmes included in the plan enable savings of some 3.42 GW. (DoE, 2011)

1.1.4 Climate change concerns

Energy security issues alongside climate change concerns prompted National Government to conduct a Long Term Mitigation Scenario (LTMS) study in 2007 in order to inform future energy and development policy. It was determined that, under conditions of growth without constraints, national carbon emissions would almost quadruple by 2050, from 446 MtCO2-eq in 2003 to 1 640 MtCO2-eq in 2050. The energy sector accounts for most of these emissions, and it is estimated that, without constraints, energy related emissions would increase by 2.9% annually and reach 1 330 MtCO2-eq by 2050. (DEAT, 2007a) The electricity sector is a key contributor to carbon emissions in South Africa, and the current carbon emission factor for Eskom-generated electricity is 0.99 kg/kWh (Eskom, 2011a). The DoE's Integrated Resource Plan is expected to result in carbon emissions of 275 million tonnes per year by 2050.

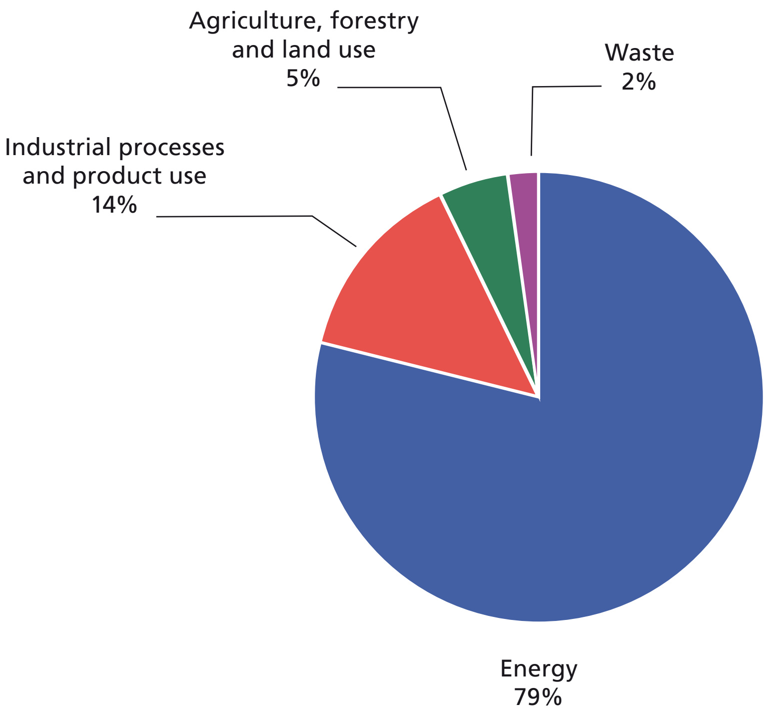


Figure 11: South African carbon emissions by sector (DEAT, 2000)

For further information about national policies and legislation relating to energy, see the following section, 1.1.5.

1.1.5 National energy laws and policies

Legislation/policy	Objectives
White Paper on Energy Policy, 1998	• Increasing access to affordable energy services • Improving energy governance • Stimulating economic development • Managing energy related environmental and health impacts • Securing supply through diversity
Integrated Energy Plan	Balancing energy demand with supply resources congruent with safety, health and environment considerations Acting as a framework within which specific energy development decisions can be made
National Energy Regulator Act (Act 40 of 2004)	Establishing a single regulator to regulate the electricity, piped-gas and petroleum pipeline industries. This regulator is known as the National Energy Regulator of South Africa, or NERSA. • NERSA has the mandate to undertake the functions of: • the Gas Regulator as set out in the Gas Act (Act 48 of 2001); • the Petroleum Pipelines Regulatory Authority as set out in the Petroleum Pipelines Act (Act 60 of 2003); and • the National Electricity Regulator as set out in the Electricity Act (Act 41 of 1987), as amended.
Integrated Resource Plan (IRP) for Electricity, 2010–2030	The IRP, promulgated in May 2011, seeks to determine the Long Term electricity demand, and details how this demand should be met in terms of generating capacity, type, timing and cost. The IRP is also required to consider various constraints and risks, such as: • reducing carbon emissions; • new technology uncertainties, such as costs, operability, and lead time to build; • water usage; • localisation and job creation; • Southern African regional development and integration; and • security of supply.
National Energy Act (Act 34 of 2008)	• Ensuring uninterrupted supply of energy to the Republic • Promoting diversity of supply of energy and its sources • Facilitating effective management of energy demand and its conservation • Promoting energy research • Promoting appropriate standards and specifications for the equipment, systems and processes used for producing, supplying and consuming energy • Ensuring collection of data and information relating to energy supply, transportation and demand • Providing for optimal supply, transformation, transportation, storage and demand of energy that are planned, organised and implemented in accordance with a balanced consideration of security of supply, economics, consumer protection and sustainable development • Providing for certain safety, health and environment matters that pertain to energy • Facilitating energy access for improvement of the quality of life of the people of the Republic • Commercialising energy related technologies • Ensuring effective planning for energy supply, transportation and consumption • Contributing to sustainable development of South Africa's economy

Energy efficiency	
NERSA's Regulatory Policy for Energy Efficiency and Demand side Management (EEDSM), 2004 and NERSA Consultation Paper: Revision of Regulatory Rules for EEDSM, including Standard Offer Programme, 2010	This policy intends to stimulate energy efficiency through (i) enabling regulations and institutional governance structures, and (ii) introducing targeted financial incentives (largely through the Standard Offer Programme). In addition to making tariff determinations and the promulgation of a standard offer, the regulator shall: • determine the generation-avoided cost in relation to the EEDSM intervention, so as to determine the level of standard-offer rebate; • ensure that the energy efficiency resource standard (EERS) funding provision is included in the multi-year price determination (MYPD); • introduce rules that will apply to licensees with regard to the EERS and the standard-offer methodology; • ring-fence the allowance for the EERS in the MYPD, and ensure that it is accessed by energy services companies (ESCOs)/licensees only, subject to the promulgated rules; • ensure that a cost recovery mechanism is in place for all disbursements by Eskom/ system operator pursuant to the EEDSM rules; • develop a reporting framework for EEDSM by licensees; • monitor and evaluate the achievement of EEDSM interventions by various ESCOs; • approve the basis for compensation for other EEDSM interventions, like residential load management and fuel switching; and • ensure sufficient communication and understanding of EEDSM among all stakeholders.
Energy Efficiency Strategy, 2005	Eight goals relating to social, environmental and economic sustainability: • Improving the health of the nation • Job creation • Alleviating energy poverty • Reducing environmental pollution • Reducing CO_2 emissions • Improving industrial competitiveness • Enhancing energy security • Reducing the necessity for additional power generation capacity The strategy sets a national target for energy efficiency improvement of 12% by 2015.
Renewable energy	
White Paper on Renewable Energy, 2003	Sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy. Four key strategic areas have been addressed, namely (i) financial instruments, (ii) legal instruments, (iii) technology development, and (iv) awareness raising, capacity building and education. A medium-term (10-year) target is then set of 10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro-energy. The renewable energy is to be utilised for power generation and non-electric technologies, such as solar water heating and biofuels. This makes up approximately 4% (1 667 MW) of the projected electricity demand for 2013 (41 539 MW).
Biofuels Industry Strategy, 2007	Presents the proposed South African biofuels industry draft strategy and further outlines Government's support and approach to addressing policy, regulations and incentives for biofuels.

Electricity	
Electricity Regulation Act (Act 4 of 2006)	Established a national regulatory framework for the electricity supply industry, and makes NERSA the custodian and enforcer of the national electricity regulatory framework. Also provides for licences and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated.
Revenue Application Multi-Year Price Determination 2010/11 to 2012/13	The MYPD is the application by Eskom to NERSA for funding or for the approval of tariff increases. Tariff increase approvals depend on the requirement and justification of funds for service delivery improvement, and are bound by NERSA's electricity pricing policy. Funds are also allocated through this mechanism for Eskom's Integrated Demand Management Programme.
Nuclear	
Nuclear Energy Act, 1999	To provide for the establishment of the South African Nuclear Energy Corporation Limited, a public company wholly owned by the state
National Nuclear Regulator Act (Act 47 of 1999)	To provide for the establishment of a National Nuclear Regulator in order to regulate nuclear activities
Environment	
National Environmental Management Act (Act 107 of 1998) and the National Environmental Management Amendment Act, 2003	One of the principles of this act recognises that sustainable development requires the consideration of all relevant factors, including the following: • That the use and exploitation of non-renewable natural resources are responsible and equitable, and take into account the consequences of the depletion of the resource • That the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised
National Environmental Management: Air Quality Act (Act 39 of 2004)	The object of this act is to protect the environment and enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and well-being of people.
Draft National Climate Change Response Green Paper	The climate change response objectives of the Green Paper is to: • make a fair contribution to the global effort to achieve the stabilisation of CO_2 concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climatic system; and • adapt effectively to and manage unavoidable and potential damaging climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
Draft Strategic Framework for Sustainable Development in South Africa, 2006	The purpose of this framework is to pronounce South Africa's national vision for sustainable development, and indicate its intended interventions to reorientate South Africa's development path towards sustainability. It is to be used by all social partners and all organs of state within the national, provincial and municipal spheres progressively to refine and realign their policies and decision-making systems in order to establish a coherent and mutually consistent national system aimed at promoting sustainable development.

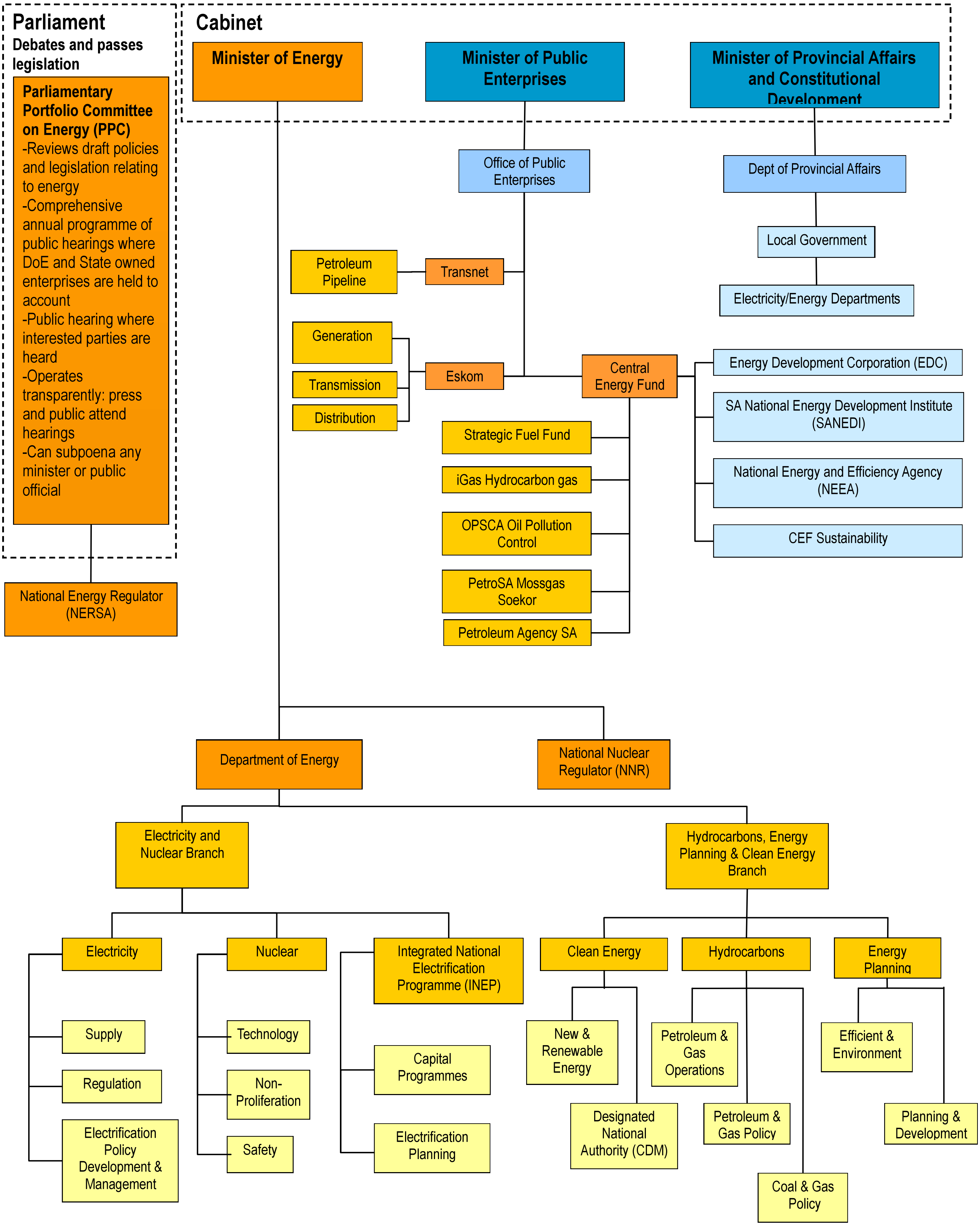


Figure 12: Institutional relationships in the South African energy sector (adapted from Ward, 2008)

1.2 The Western Cape energy picture

The Western Cape is one of nine provinces within South Africa. The province has six district municipalities, of which Cape Town is one (see figure 13).

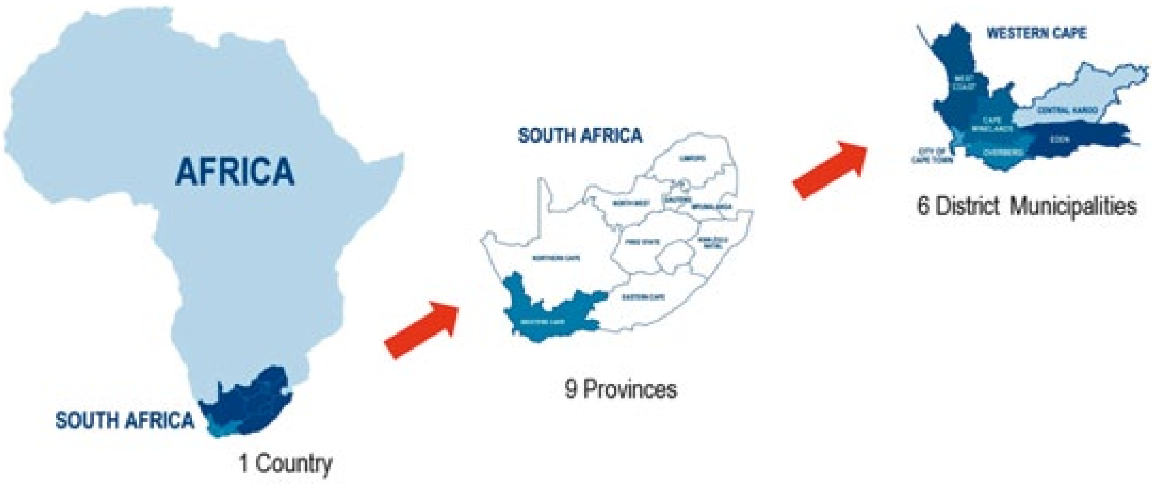


Figure 13: Location of the Western Cape (Wesgro, 2011)

The Western Cape consumes 11% of South Africa's energy, and in 2004, approximately 250 million GJ of energy was consumed across all sectors. The breakdown by sector for energy consumption in the Western Cape can be seen in figure 14. As is the case with South Africa as a whole, the industrial sector is responsible for the largest proportion of the Western Cape's energy consumption.

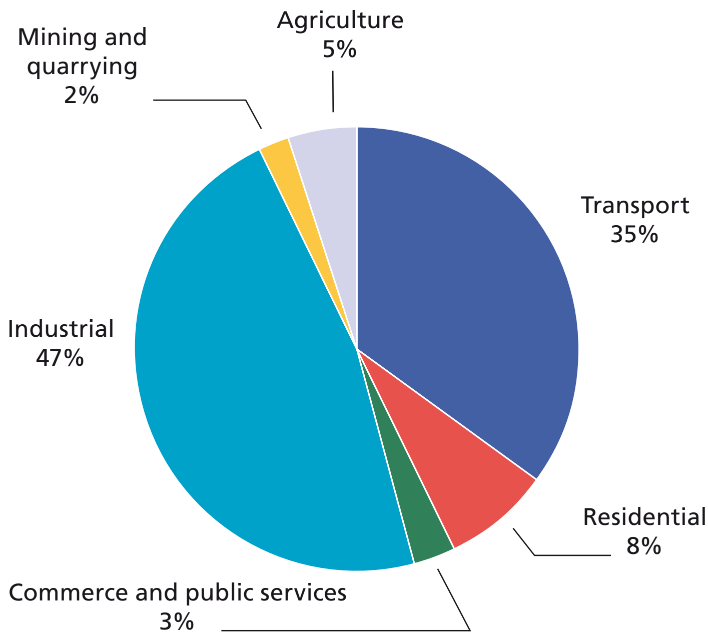


Figure 14: Western Cape energy consumption by sector (SEA,2004)

The Western Cape's share of national energy consumed in 2004 can be seen below in table 4. The role of the mining sector in the Western Cape is considerably smaller, as most of the mines in South Africa are found in the north-eastern provinces.

Table 4: Western Province share in total national energy demand (SEA, 2004)

Sector	Total (TJ)	% of national
Industry sector	116 171	10.0%
Mining and quarrying	4 194	3.0%
Transport sector	86 382	14.9%
Agriculture	12 604	10.3%
Residential	19 529	7.1%
Commerce and public services	8 872	9.7%
Total	247 752	10.6%

The carbon emissions resulting from energy consumption in the Western Cape can be largely ascribed to the carbon intensity of coal based electricity in South Africa.

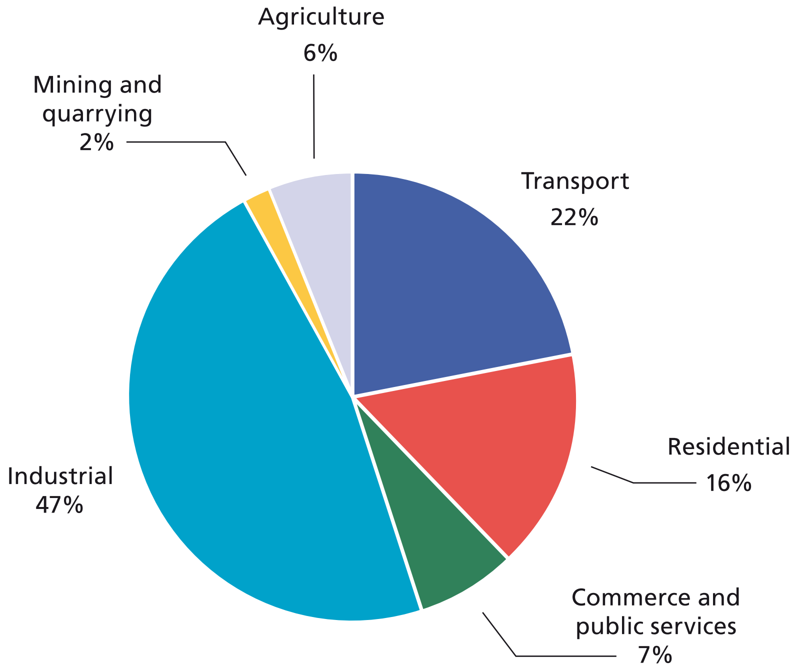


Figure 15: Western Cape carbon emissions by sector (SEA, 2004)

The carbon intensity of electricity is clearly demonstrated by electricity's contribution to total carbon emissions. While electricity is used to meet only 26% of the energy demand in the Western Cape, it generates 54% of all carbon emissions associated with energy consumption.

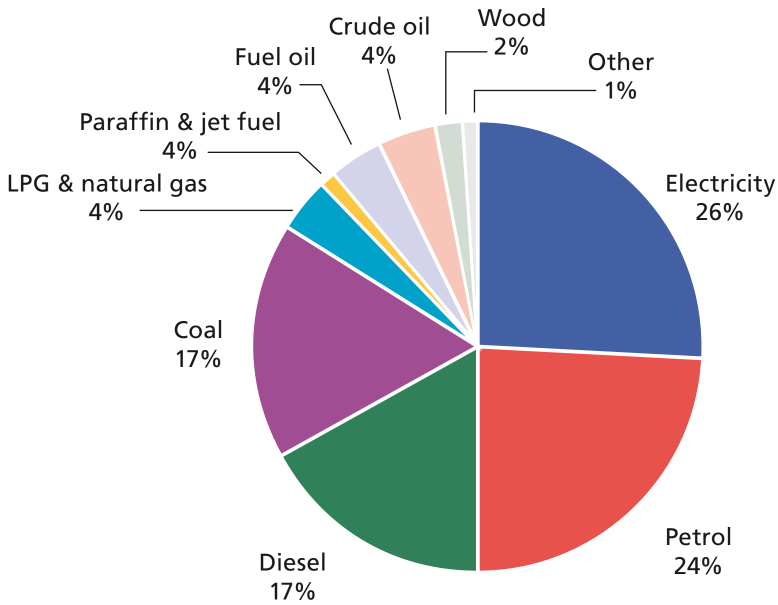


Figure 16: Western Cape energy consumption by fuel type (SEA, 2004)

Likewise, petrol and diesel, which account for 41% of total energy consumption, contribute only 25% of total carbon emissions.

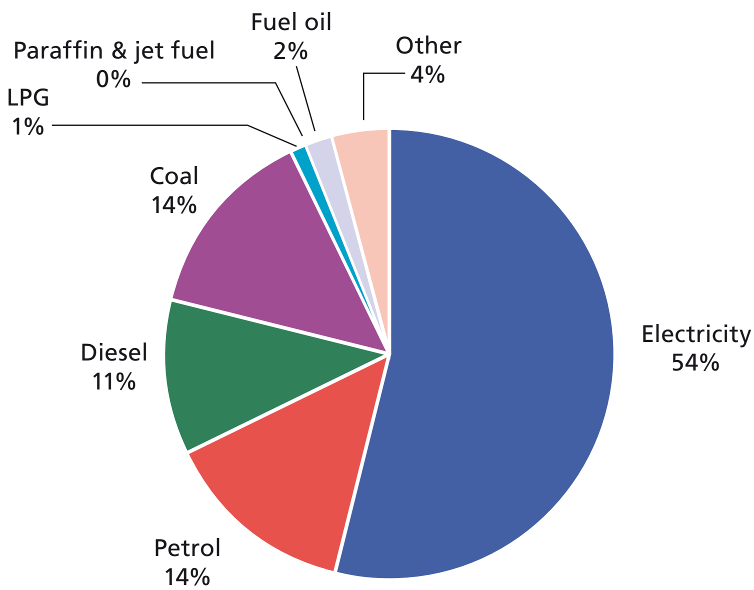


Figure 17: Western Cape carbon emissions by fuel type (SEA, 2004)

The Western Cape's economy largely depends on the finance, real estate and business services sector (see figure 18). The manufacturing sector is also important to the Western Cape's economy, and is a large consumer of energy, contributing to industry's consumption of 47% of total energy.

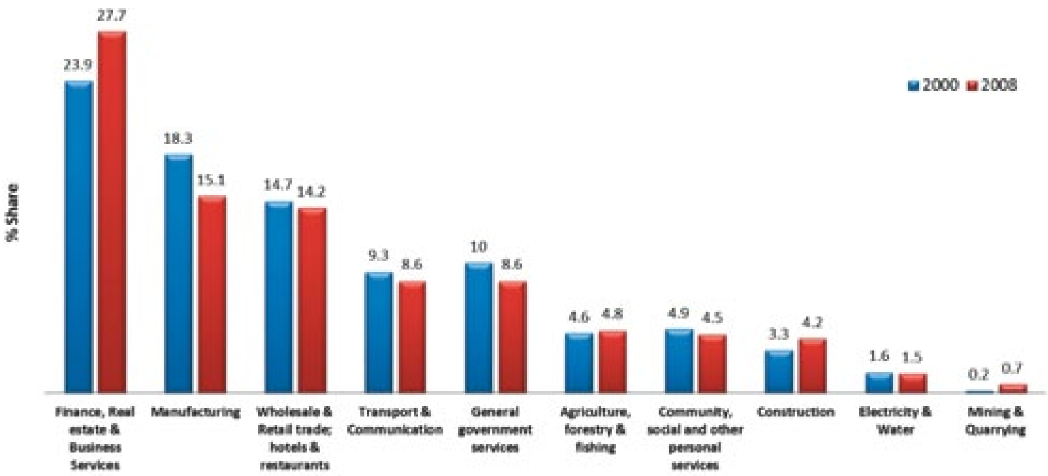


Figure 18: Breakdown of the Western Cape economy by sector (Wesgro, 2011)

2. The Cape Town energy picture

2.1 Methodology

As already mentioned, the majority of information contained in this report was sourced from a study entitled *Energy Scenarios for Cape Town: Exploring the implications of different energy futures for the City of Cape Town up to 2050*, which was commissioned by the City of Cape Town, and made possible by Denmark's Danida (Danish International Development Agency) programme and the British High Commission. Data collection was managed by Sustainable Energy Africa and the University of Cape Town. These data were then used to model various scenarios from 2007 to 2050 in order to develop Cape Town's 'Optimum energy Future scenario',. More information on these scenarios can be found in section 4.

Data were sourced from the City of Cape Town and Eskom. The quality of data obtained in this study was of a significantly higher standard than that contained in either of the City's 2003 or 2007 State-of-Energy reports, as researchers were able to disaggregate the energy consumption into sectors more accurately than in previous years.

Data were collected for the five sectors analysed within this project, namely:

- the residential sector – disaggregated according to electrified and non-electrified households and by income category;
- the commercial sector – including retail and office buildings, tourism activities, education facilities, hospitals and other non-industrial activities;
- the industrial sector – activities disaggregated into (i) textiles, (ii) food and beverage, (iii) non-food manufacturing sectors, and (iv) other;
- local government – covering all City of Cape Town municipal operations, including all public buildings, street and traffic lights, water and wastewater treatment, and the City's vehicle fleet; and
- the transport sector – covering both freight and passenger transport, although they were modelled separately. Passenger transport included both private vehicle travel and public transportation associated with bus, minibus taxi and train use. Freight transport covered rail and road-based transport.

[6] The term 'commercial buildings' is used as a sector definition, as it has been used in a number of building databases, both in South Africa and internationally. However, it can be misleading, as it is generally used to cover buildings that do not fall into the other sectors, resulting in buildings being included in the sector that might not usually be considered commercial.

The emissions profiles for the various sectors and fuel sources were calculated by relating the fuel source back to the emission factor associated with the relevant fuel source (see table 5).

Updated information on Cape Town statistics can be found in Section 6, but all information used and included in the body of this report for Cape Town was from 2007, wherever possible, to ensure compatibility.

2.2 Overview of Cape Town's energy supply and demand

Cape Town's energy supply picture largely mirrors that of the rest of the country, with significant dependence on imported petroleum products and coal-fired electricity generation. The total energy consumption for Cape Town in 2007 was 128 million GJ, making up around 5% of South Africa's total energy demand. The majority of energy consumed in Cape Town is through the use of liquid fuels, such as petrol and diesel; yet, the demand for electricity is also significant (see figure 19).

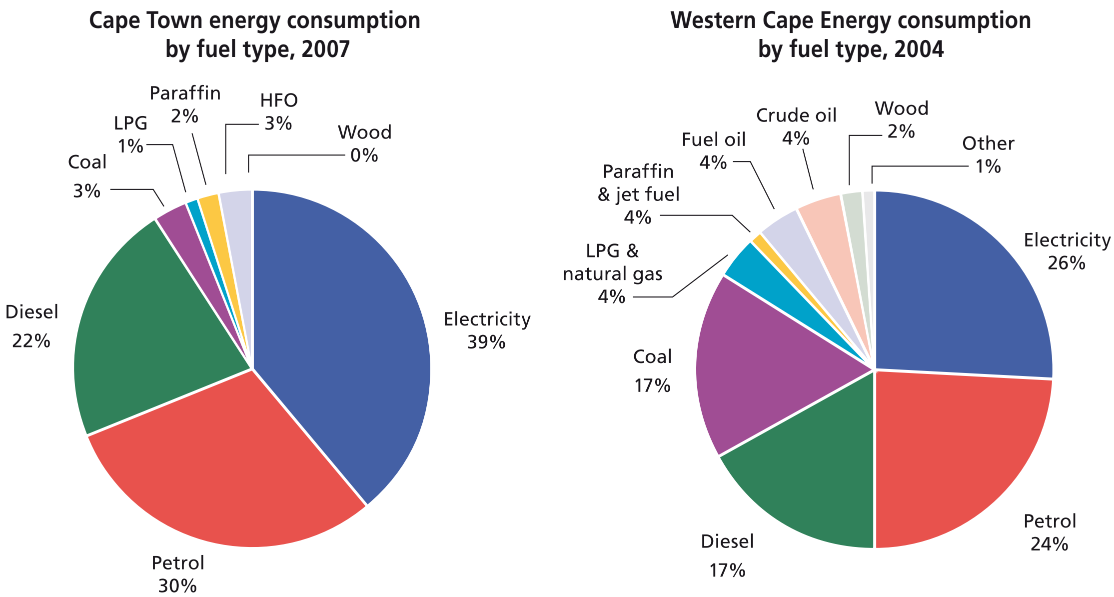


Figure 19: Energy consumption by fuel type in Cape Town, 2007, compared to Western Cape

The 2007 baseline energy picture for Cape Town is dominated by the transport sector, which consumes approximately 50% of all energy, followed by the residential (18%), commercial (17%), industrial (14%) and local government (1%) sectors.

South Africa's economy is very energy-intensive, as much of it centres on heavy industries, such as mining and smelting. Cape Town's industries are less energy-intensive: Cape Town uses 5% of national energy consumed to contribute 11.1% of the gross domestic product (GDP). This is particularly apparent in figure 20 below, which shows that the energy consumed by the industrial sector in Cape Town (14%) is considerably less than that of the Western Cape province (46%) or the country (41%). (Mining is included in industrial activities.)

*** Electricity generated at Cape Town's Koeberg Nuclear Power Station feeds directly into the national grid, and the City of Cape Town has no control over the source of electricity that it purchases from the grid. As a result, the City's electricity profile is deemed by convention to be the same as that of the rest of the country. The only way to select the source of electricity generation is through a power purchase agreement. Such power would then be for the City's own account, and could come at a relatively high cost, unless the independent power producer could generate electricity at a lower cost. Feeding all electricity generation into the national grid ensures that the cost of power production is spread over all electricity consumers. The same would apply for wind or solar power, which is why a renewable energy feed-in tariff (REFIT) is important – to spread the cost of renewable energy across all consumers.**

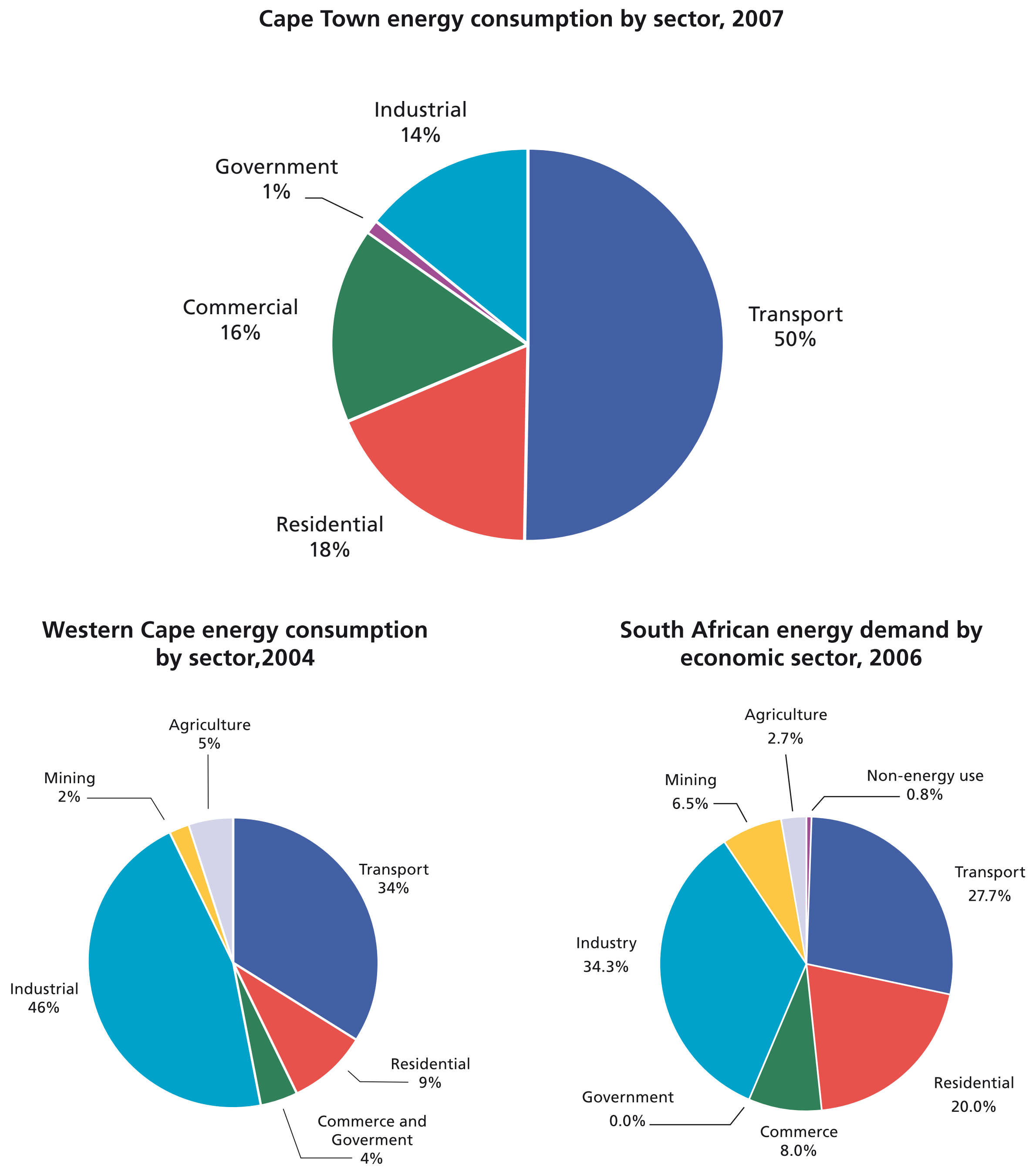


Figure 20: Energy consumption per sector in Cape Town compared to national and provincial energy consumption

Cape Town's economic structure differs significantly from that of the rest of the country: The city's economy is less dependent on the primary sector and, instead, is predominantly supported by the tertiary sector. The relative contribution of tertiary-sector services, including financial and insurance services, real estate, government and social services, can be seen in figure 21 below. It is therefore understandable that the active commercial sector in Cape Town consumes more energy proportionally (16%) than in the Western Cape (7%) or the country as a whole (8%), as many tertiary services form part of the commercial sector.

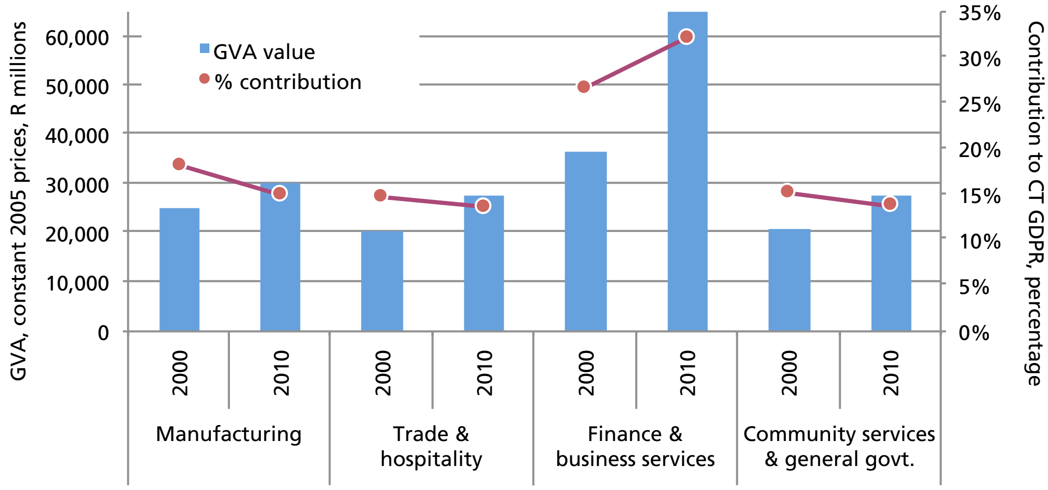
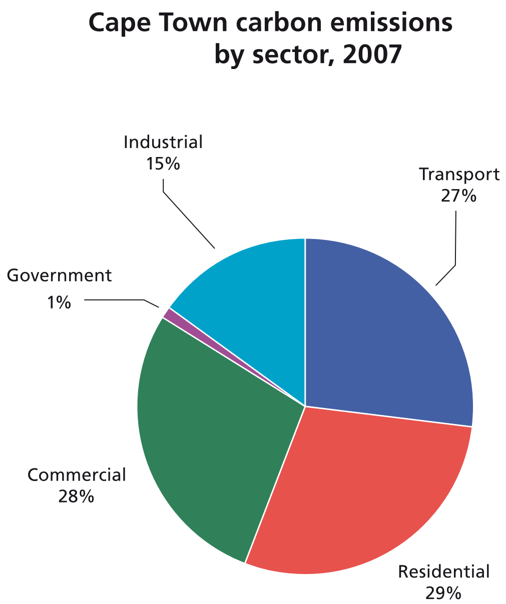


Figure 21: Economic contribution of industrial and commercial services (City of Cape Town, 2011)

Carbon emissions

Figure 22 shows the CO_2 emissions associated with each of the sectors in 2007. It should be noted that, although the transport sector consumes 50% of Cape Town's energy, it is responsible for only 27% of the associated carbon emissions. This is due to the fact that different emissions are associated with different types of fuels and, in particular, that South Africa's electricity is largely coal generated, which renders it very carbon intensive.



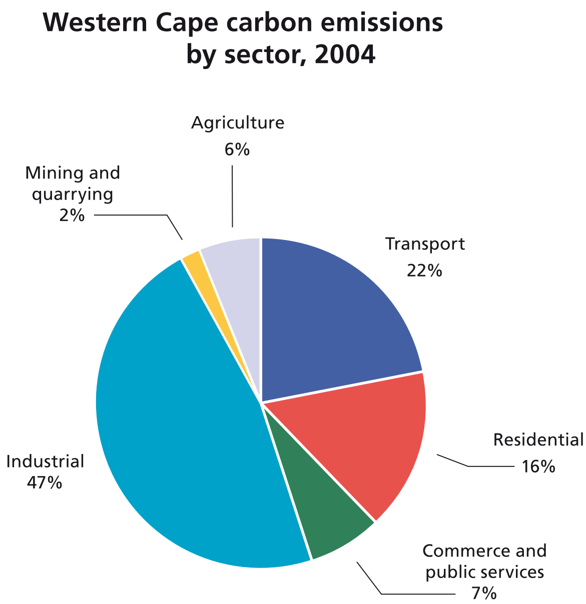


Figure 22: Carbon emissions per sector in Cape Town compared to Western Cape carbon emissions

Electricity intensive sectors' contribution to the carbon emissions of the city is also demonstrated by figure 23. The commercial and residential sectors account for 16% and 18% of total energy consumption respectively, but their carbon emissions are respectively 28% and 29% of the city's total. Figure 23 demonstrates that these two sectors together account for 83% of total electricity consumption. The carbon intensity of electricity generated in South Africa renders these two sectors responsible for a disproportionate amount of carbon emissions.

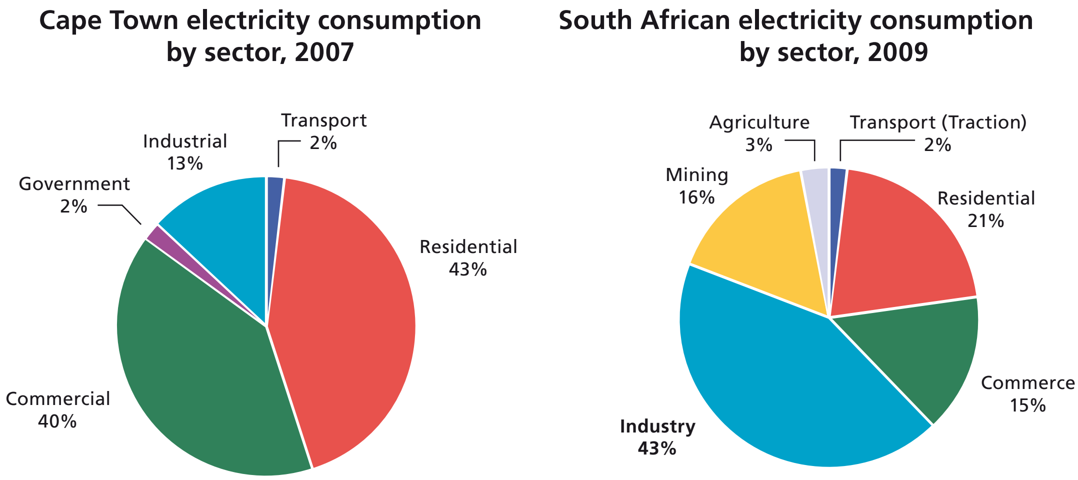


Figure 23: Cape Town electricity consumption by sector compared to South African electricity consumption

Table 5 below outlines the carbon emission factors that apply to various fuels, used to calculate the City's total carbon emissions. Electricity is therefore responsible for 72% of all carbon emissions relating to energy consumption by sector and for 54% of total carbon emissions, including carbon equivalents resulting from municipal waste, aviation fuels and maritime fuels).

Table 5: Carbon footprint comparison for Cape Town in 2003 and 2007

	2003			2007	
Fuel	**GJ**	**CO_2**	**Conversion factor**	**GJ**	**CO_2**
Electricity	38 835 284	11 256 863	0.3056	48 576 102	14 844 856
Paraffin	2 448 796	175 579	0.0717	2 830 399	202 939
LPG	684 970	43 153	0.063	1 750 168	110 260
Coal	3 831 352	361 680	0.0944	3 055 991	288 485
Petrol	40 687 369	2 815 566	0.0692	39 392 694	2 725 974
Diesel	20 127 757	1 487 441	0.0739	27 874 053	2 059 892
HFO	4 695 842	362 519	0.0772	4 116 143	317 766
Wood	920 417	-	0	49 574	-
Subtotal CO_2e (energy, excluding aviation and maritime)	**110 231 787**	**16 502 801**		**127 645 128**	**20 550 175**
Carbon/capita (energy only, but excluding aviation and maritime fuels)		5.23			5.88
Solid waste (landfill)		No data			2 665 110
Aviation fuels	Not calculated	Not calculated	0.072	16 082 323	1 153 103
Maritime fuels	Not calculated	Not calculated	0.078	38 237 320	2 990 158
TOTAL CO_2e				**181 964 771**	**27 358 547**
Carbon/capita					**7.82**

[8]The conversion factors used in the 2003 and 2007 calculations are taken from the Intergovernmental Panel on Climate Change (IPCC).

Electricity distribution in Cape Town

The City provides access to electricity for 75% of its residents; Eskom serves the remaining 25% (see figure 24 below). The parties indicated in the figure below pooled their resources, and managed to increase households' access to electricity in Cape Town from 87% in 1996 to 95% in 2005 (OECD, 2008:110). Maximum electricity demand in the City's distribution area is in the order of 1850MW.

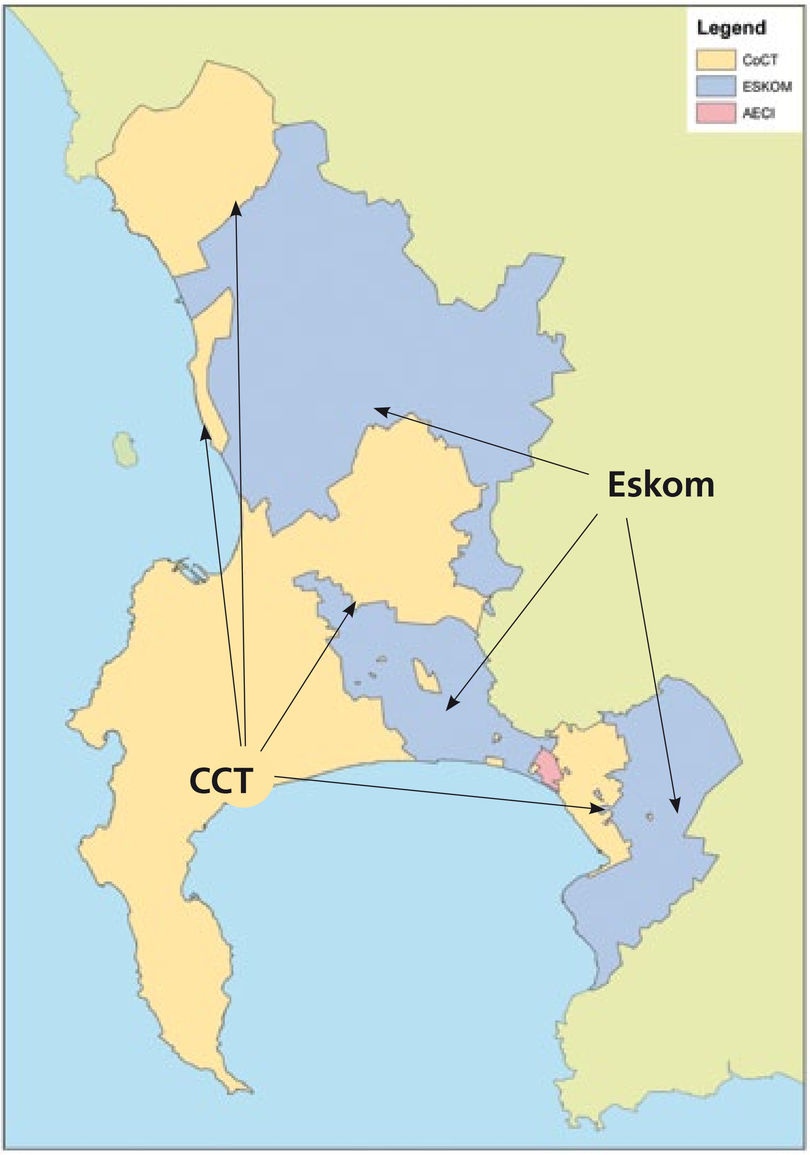


Figure 24: Electricity distribution map[10]

Eskom has had steep electricity tariff increases approved in order to be able to afford the generation expansion that is required to meet current and growing levels of electricity demand. The City, as a distributor, needs to pass on these costs to Cape Town consumers and, as such, electricity tariff increases will be experienced across Cape Town. These will effectively increase the average cost of electricity by 415% by the 2015/16 financial year (see figure 25). The price increases are expected to have a marked effect on electricity consumption patterns across all of Cape Town's sectors that rely on electricity.

[9]According to 2010 data of the City of Cape Town's Electricity Department.
[10]According to 2010 data of the City of Cape Town's Electricity Department.

Figure 25: Cape Town electricity tariff increase path, average c/kWh[11]

While the average price increase can be seen above, the actual price increase differs between the various tariff types. For an indication of domestic tariff increases in the 2011/12 financial year across the various tariffs, see table 6.

Table 6: City of Cape Town domestic electricity tariff increases, 2011/12

Domestic electricity tariffs (including VAT)			
Energy charges	**Current (2010/11)**	**New (2011/12)**	**% increase**
Lifeline charge 1: 0–50 kWh (c/kWh)	0.00c	0.00c	0%
Lifeline charge 2: 50–150 kWh (c/kWh)	61.45c	66.25c	7.8%
Lifeline charge 3: 150–450 kWh (c/kWh)	61.45c	80.34c	30.7%
Domestic low: Customers using 450–1 500 kWh/month (c/kWh)	88.20c	106.37c	20.6%
Domestic high: Customers using >1 500 kWh/month (c/kWh)	73.46c	91.17c	24.1%
Service charges			
Lifeline	Free	Free	-
Domestic low	Free	Free	-
Domestic high (R/day)	R3.88	R7.50	93.5%

[11]According to 2011 data of the City of Cape Town's Electricity Department.

3. Energy breakdown by sector

3.1 Residential

The residential sector accounts for 18% of total energy consumption, with an annual consumption of 23 486 363 GJ. The residential sector accounts for 43% of total electricity consumption within the city, and predominantly uses electricity as a fuel source. Paraffin, liquid petroleum gas (LPG) and wood are also used, although chiefly in lower-income households. Together, these alternative fuels account for only 9% of all energy consumption in this sector (see figure 26).

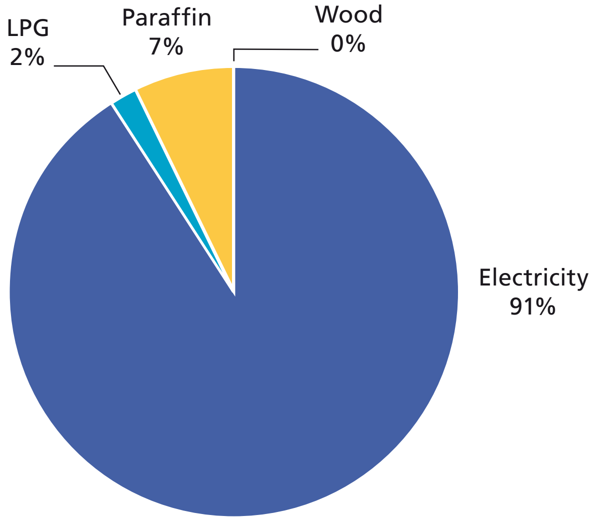


Figure 26: Energy consumption in the residential sector by energy source, 2007

In 2007, there were approximately 947 870 households in Cape Town (Stats SA, 2007). Some 64% of households in Cape Town live in either a house or brick structure on a separate stand or yard, or in a flat within a block of flats, while 22% live in an informal dwelling/shack (either in or not in a backyard). A notable trend over the period (2002–2008) is a slight increase in the number of informal dwellings. This trend is due to several reasons, such as a growing population (including in-migration), land scarcity and housing backlogs.

Table 7: Breakdown of households in Cape Town by income, 2007

Number of households	Total
Low-income	435 083
Medium-income	295 604
High-income	182 115
Very high-income	35 068
Total	**947 870**

Cape Town has a very broad range of income brackets, from the extremely poor to the very wealthy. The city has a Gini coefficient of 0.58, reflecting a high degree of income inequality. (City of Cape Town, 2010) A large proportion of Cape Town's residents live in informal housing, and it is estimated that 15% of all households are informal in nature.

Note: all 2007 data in this section is derived from the data gathered for the Energy Scenarios for Cape Town 2011 study by Sustainable Energy Africa and the Energy Research Centre at UCT.

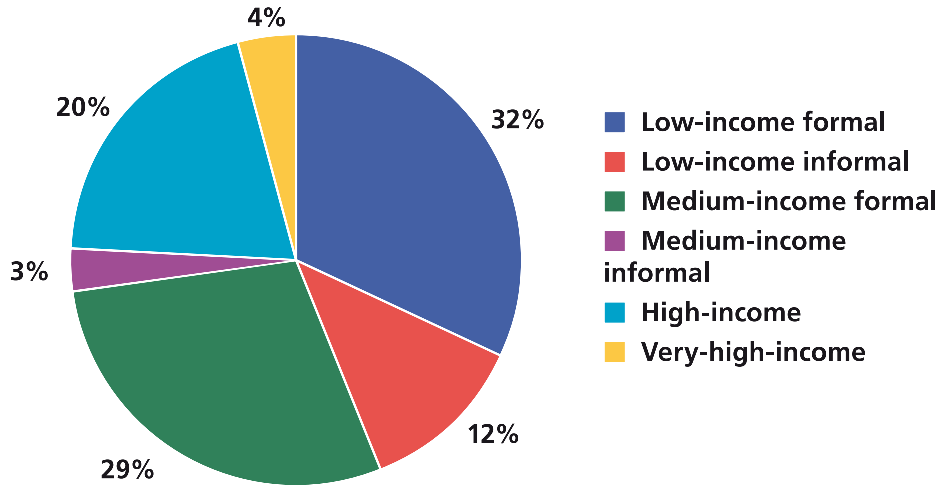


Figure 27: Cape Town household breakdown by income level, 2007

Figure 27 and figure 28 demonstrate the extent of the gap between affluent and poor in Cape Town. A total of 44% of Cape Town households that fall within the low-income bracket consume 24% of total residential energy – some may even spend more than 25% of their total monthly income on meeting their energy requirements. This highlights the extent of energy poverty in the city.

It also demonstrates the energy intensity of high and very high-income households, with the fairly small percentage of 24% of all households responsible for 43% of total energy consumed. This shows that significant energy efficiency gains are to be made within this affluent sector.

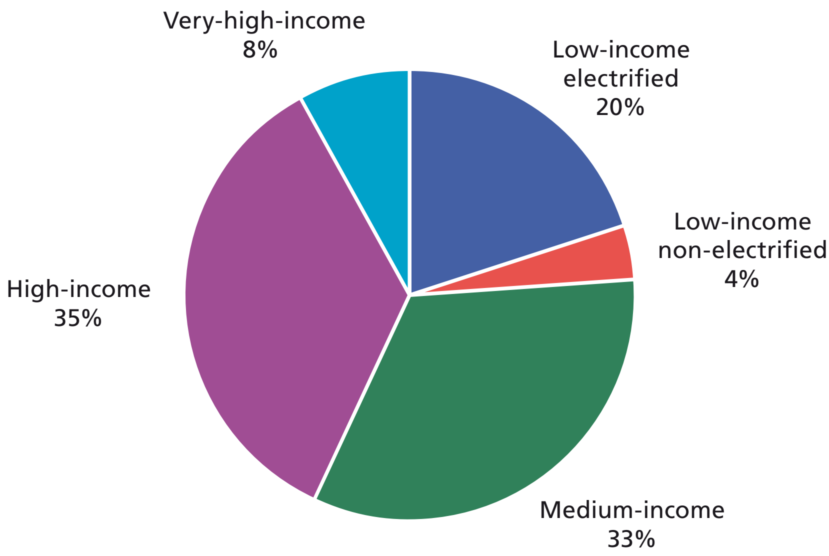


Figure 28: Cape Town residential energy consumption by income level, 2007

Income levels influence the type and extent of energy consumption by households. The energy consumption profile across various income levels varies dramatically. While most households in Cape Town are electrified (see figure 29), many households, particularly low-income households, depend very heavily on paraffin to meet their energy requirements.

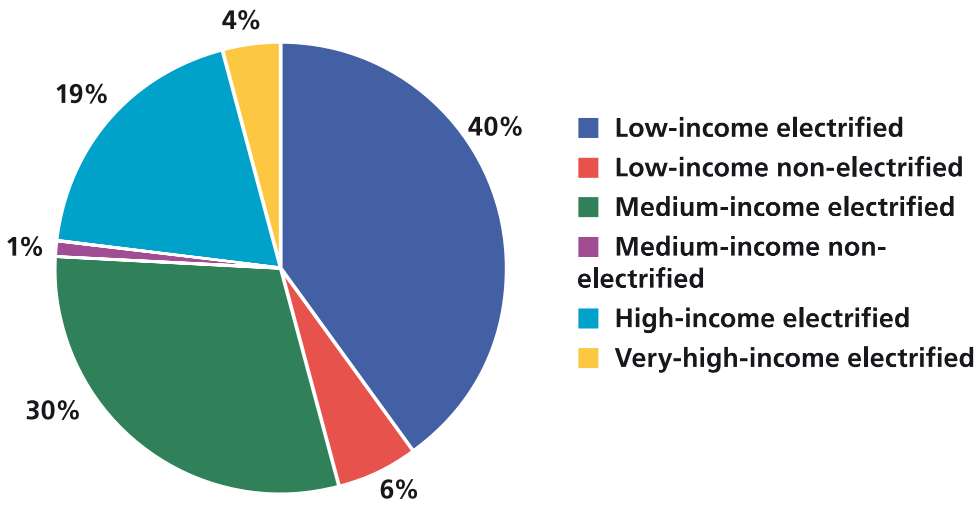


Figure 29: Breakdown of households with and without electricity, by income group, 2007

Table 8: Average electricity consumption for electrified households in each category[12], 2007

Household type	Number of households	Average kWh/month
Low-income	382 889	220
Medium-income	284 989	528
High-income	182 115	930
Very high-income	35 068	1 033

Figure 30 to figure 33 below show the type of energy sources used for various activities across the income brackets. It is evident that high to very high-income households rely almost entirely on electricity to meet all their energy requirements. Paraffin and LPG are used mostly in households who do not have electricity to heat water.

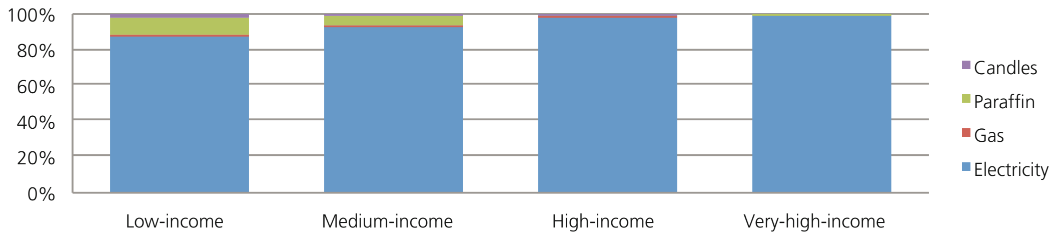


Figure 30: Lighting by fuel source and household income type in Cape Town

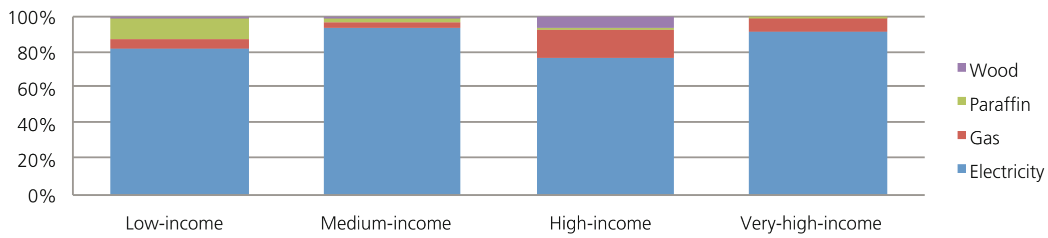


Figure 31: Cooking by fuel source and household income type in Cape Town, 2007

[12] Altogether 14% of low-income households and 4% of middle-income households are not electrified.

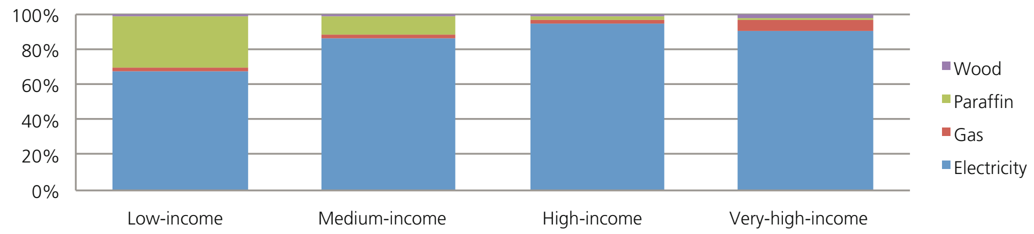


Figure 32: Space heating by fuel source and household income type in Cape Town, 2007

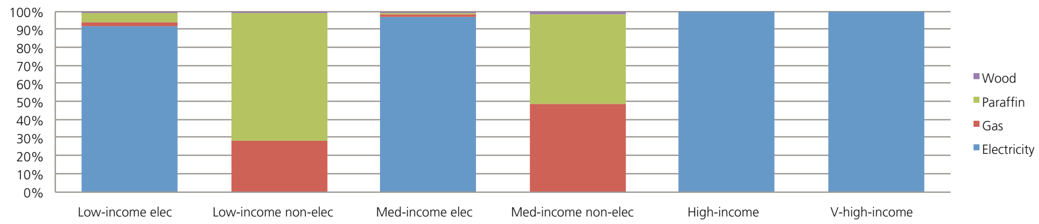


Figure 33: Water heating by fuel type and household income type for electrified and non-electrified households in Cape Town, 2007

3.2 Commercial

The commercial sector accounts for 16% of energy consumption in Cape Town, with an annual consumption of 20 724 597 GJ, of which 95.6% is consumed as electricity. This sector is responsible for 28% of total carbon emissions. The commercial sector includes retail and office buildings, tourism activities, education facilities, hospitals and other non-industrial activities.

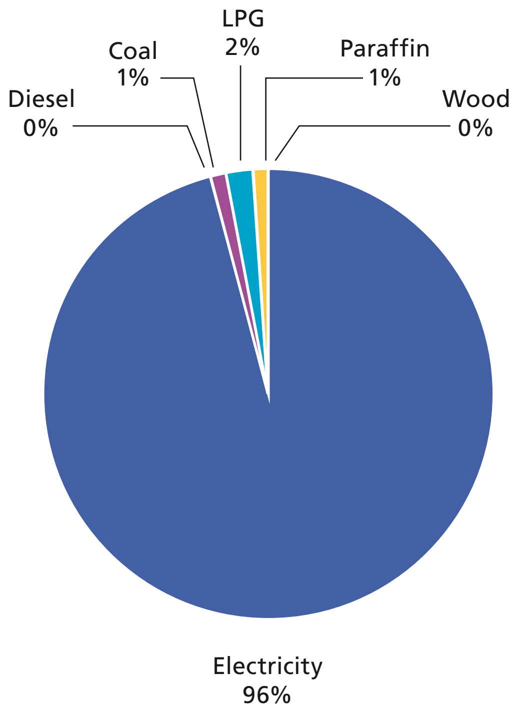


Figure 34: Energy consumption in the commercial sector by energy source, 2007

This report differs from previous editions in that it is the first to distinguish between energy consumed in the commercial and industrial sectors. However, there is still a lack of extensive data on the commercial sector, and more investigation is required in refining such information. The *Energy Scenarios for Cape Town* study made use of international practices in calculating energy consumption in commercial buildings. In figure 35, the proportion of energy consumption by each end use was taken from the United States Energy Information Administration's Commercial Buildings Energy Consumption Survey, based on end-use electricity consumption data for the climatic region that best matches Cape Town's climate.

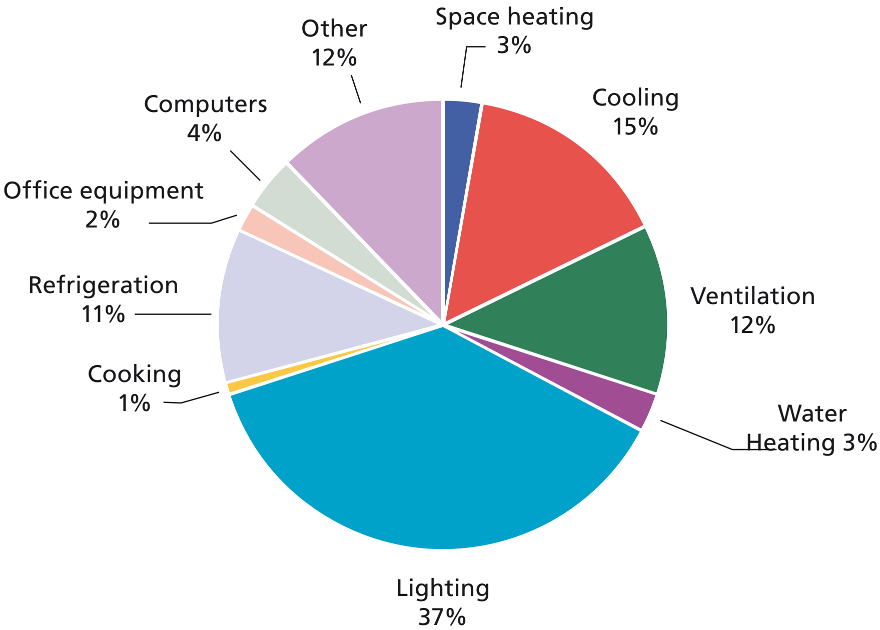


Figure 35: Electricity consumption by end use in the commercial sector of Cape Town

While electricity is the main source of energy used in the commercial sector, other fuel sources are also used. The typical uses for these fuels are shown below in table 9.

Table 9: Commercial-sector typical uses for various types of fuel

Fuel	Main building types	Typical uses
Diesel	Office, lodging, hospital, public assembly, education, food services, hotels	Electricity generation (back-up)
Wood	Restaurant, food sales, public assembly	Aesthetic heating, cooking
Coal	Hospitals, food services	Heating, cooking (boilers)
Paraffin	Lodging, offices, education, other	Cooking
Heavy fuel oil (HFO)	Education, hospital, other	Heating (boilers)
LPG	No data in the air pollution management database	Cooking in hotels, restaurants and hospitals, as well as some heating

3.3 Industrial

The industrial sector accounts for 14% of energy consumption, using 17 808 100 GJ per year, and is responsible for 15% of carbon emissions. The industrial sector is considerably more diverse in its fuel sources than the commercial sector, as can be seen in figure 36.

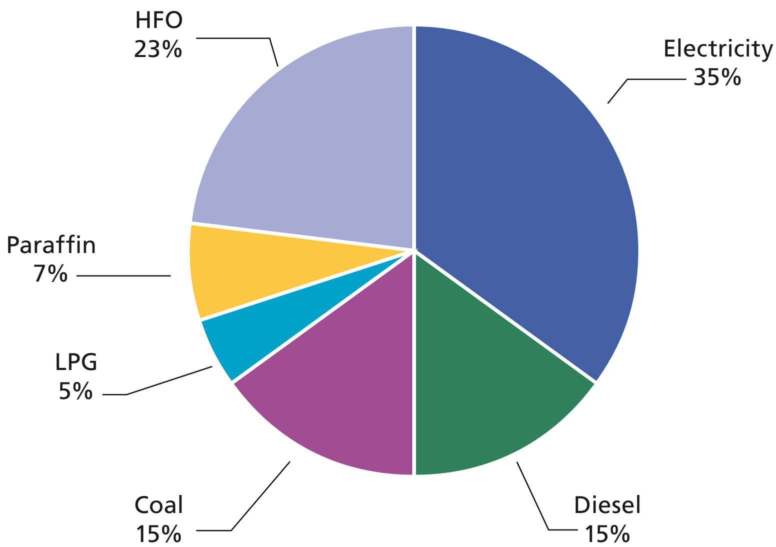


Figure 36: Energy consumption in the industrial sector by energy source, 2007

According to the *Energy Scenarios for Cape Town* study, the dominant industrial energy activities in Cape Town in 2000 were pulp and paper, food and beverage, textiles and other key industries, such as plastics, glass, cardboard, cement and metal works. Table 10 below shows the distribution of these subsectors of the industrial sector, namely food and beverage, textiles, non-food manufacturing and other. It is clear from the sample observed that the industrial sector predominantly operates in the food and beverage subsector, followed closely by textiles and non-food manufacturing.

Table 10: Nature of business in the Cape Town industrial sector[13] (City of Cape Town, 2007)

Nature of business	Percentage	Subsector
Bakery	4.94%	Food and beverage
Beverage/canner/bottler	1.23%	Food and beverage
Butcher	4.94%	Food and beverage
Commercial building	1.23%	Food and beverage
Food processing plant	18.52%	Food and beverage
Total: food and beverage	**30.86%**	
Manufacturing: Clothing	9.88%	Textiles
Manufacturing: Textiles	19.75%	Textiles
Total: textiles	**29.63%**	
Manufacturing: Non-food	19.75%	Non-food manufacturing
Manufacturing: Food	12.35%	Non-food manufacturing
Total: non-food manufacturing	**32.1%**	
Scheduled industries	4.94%	Other
Other	2.47%	Other
Total: Other	**7.41%**	
Total	**100%**	

[13]According to City of Cape Town's air pollution database, 2007 and energy consumption figures from the Electricity Department, 2007)

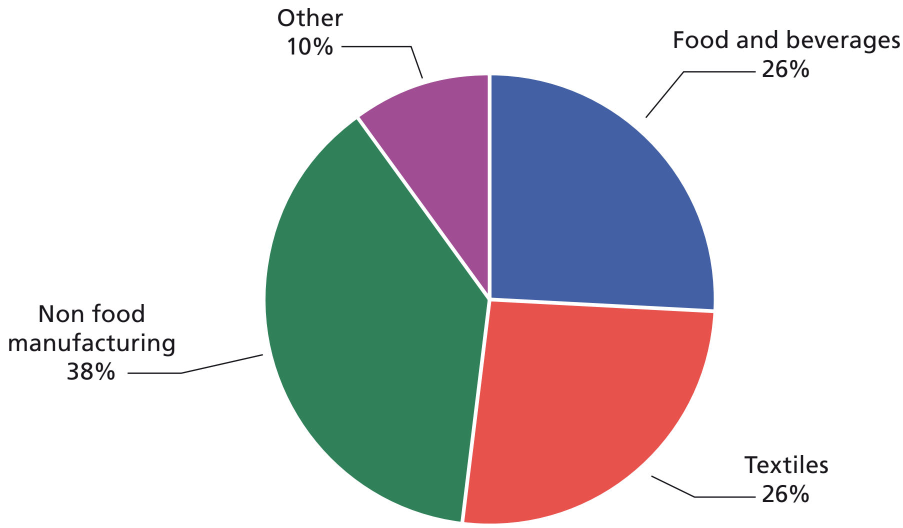


Figure 37: Energy consumption by industrial sub-sector, 2007

With the exception of the food and beverage sector, where electricity accounts for 5% of total energy consumption, electricity accounts for an average of 35% of industrial energy consumption. Table 11 below shows the breakdown of energy consumption per industrial subsector in GJ/year.

Table 11: Subsector proportion of total energy consumption, 2007

	Electricity (%)	LPG (%)	Paraffin (%)	Coal (%)	Diesel (%)	HFO (%)	Total (GJ)
Textiles	10	9		20	2	50	4 946 781
Food and beverage	5	9	11	14	22	32	5 033 467
Non-food manufacturing	54		9	15	23		6 680 963
Other	97			3			1 860 352
TOTAL (GJ)	6 205 371	856 366	1 201 682	2 781 510	2 693 120	4 068 975	808 099

3.4 Transport

Transport accounts for 50% of total energy consumption in Cape Town, totalling 64 355 254 GJ, and is responsible for 27% of total carbon emissions. The majority of transport is powered by fossil fuels: Petrol and diesel account for 99% of total energy requirements. City growth, poor public transport provision and the location of informal settlements far from the city centre have resulted in long daily commutes (averaging 27 km) and heavy congestion in all modes of transport.

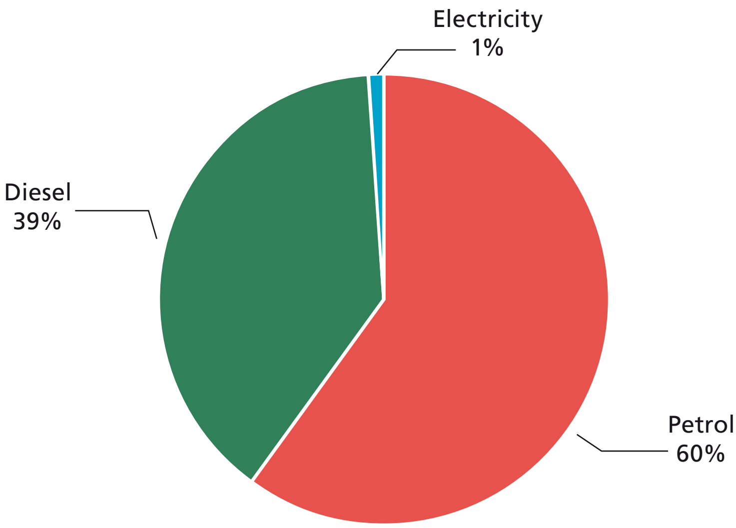


Figure 38: Energy consumption in the transport sector by energy source, 2007

The city's transport sector is divided into freight and passenger transport, with the latter accounting for the majority (87%) of energy consumed.

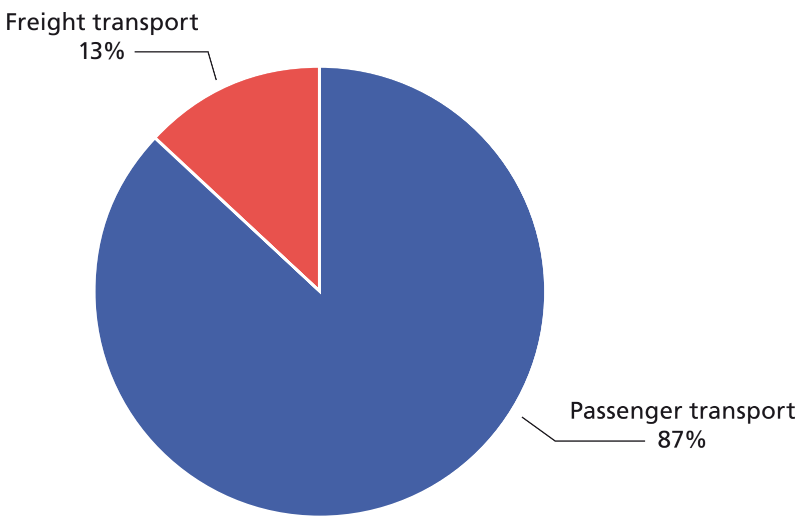


Figure 39: Energy demand by passenger and freight transport subsectors, based on diesel, petrol and electricity consumption, 2007

3.4.1 Passenger transport

The transport modal share shown in figure 40 highlights the heavy dependence on private vehicles for passenger transport in Cape Town. It is anticipated that the continued development of a sustainable transport system will promote a shift away from private vehicle use. For example, the City of Cape Town launched phase 1a of the bus rapid transit (BRT) system on 9 May 2011. Already during the week 6–12 June 2011, over 40 000 passengers were reported to have used the service. The entire roll-out of all four phases of the BRT project is therefore expected to have a very significant impact on the modal split in the city.

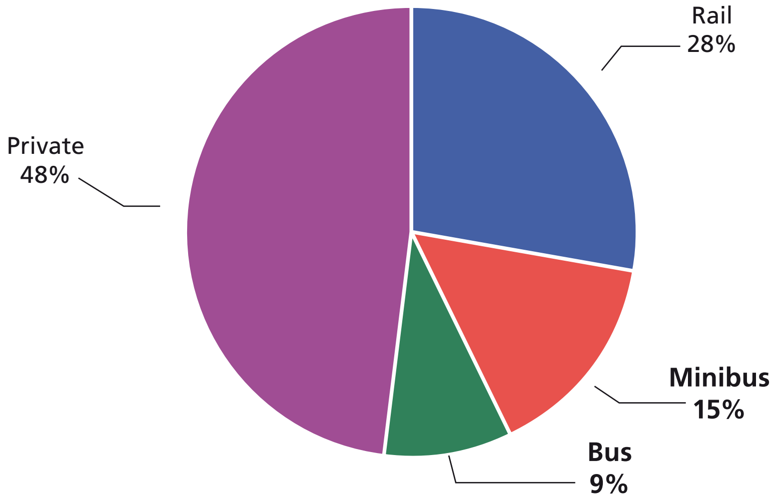


Figure 40: Transport modal share in terms of passenger kilometres in Cape Town, 2007

The city has an extensive yet ageing aboveground rail system in comparison to other South African cities. Rail use is declining, largely due to competition from minibus taxis and from a lack of expansion in infrastructure. Bus use has also decreased in favour of minibus taxis; yet, the current development and construction of the BRT system is expected to reverse this trend. Non-motorised transport, such as walking and cycling, makes up only 2% of total transport in Cape Town.

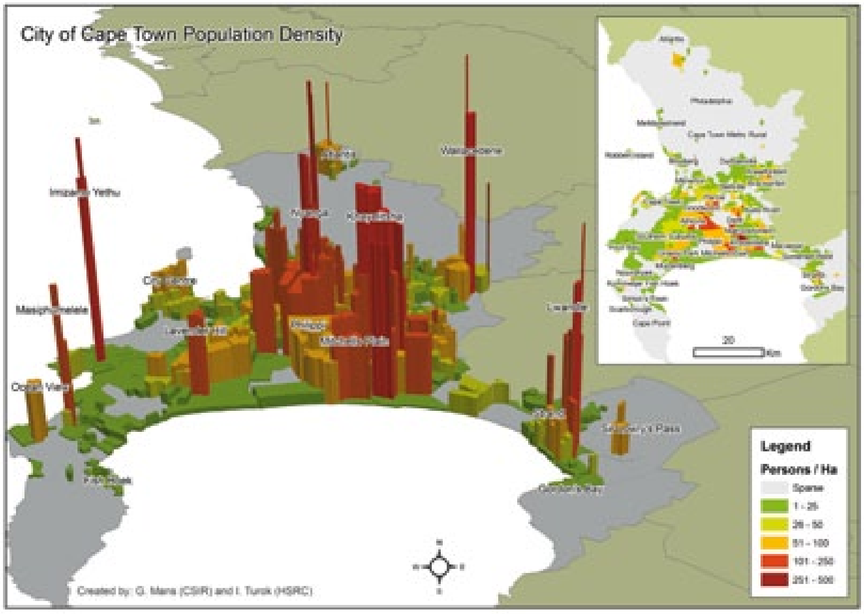


Figure 41: Population density per square kilometre by suburb, 2001 (Turok, Sinclair-Smith and Shand, 2010)

[14]According to the City of Cape Town's MyCiTi Integrated Rapid Transit Project Data Overview dated 27 June 2011.

Apartheid's legacy is clearly visible in the structure of the city. 'Group area' removals during apartheid have resulted in very low population densities close to the city centres, which were historically white group areas, and high density areas on the outskirts of the city, where informal settlements are growing rapidly (see figure 41). The layout of the city has therefore resulted in very poor residents being required to spend relatively large amounts of money on transportation in order to access urban goods. This can be seen in figure 42, which shows that over 35% of households earning less than R1 000 a month spend more than 20% of their income on transport.

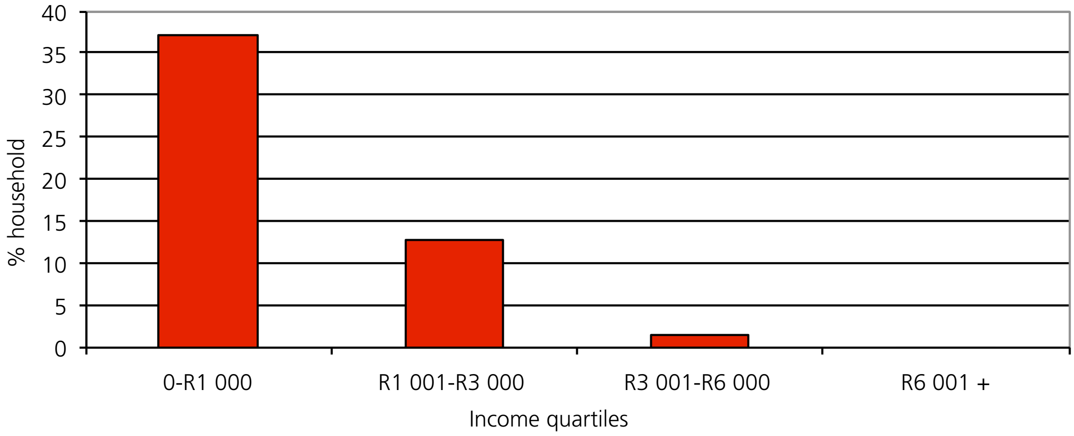


Figure 42: Percentages of households, by income bracket, that spend more than 20% of their income on public transport (DoT, 2005)

Improved access to public transport will help reduce the financial burden on the poor in the outlying areas of the city, but will also help shift transport use from a very expensive mode – private vehicles – to more economically efficient modes. Figure 43 shows that private car use is more than three times more expensive per passenger kilometre than any other form of transport. This implies that 50% of the city's residents are using the most expensive means of transport. Moreover, the fact that the current road infrastructure is adequate further encourages travel by private car.

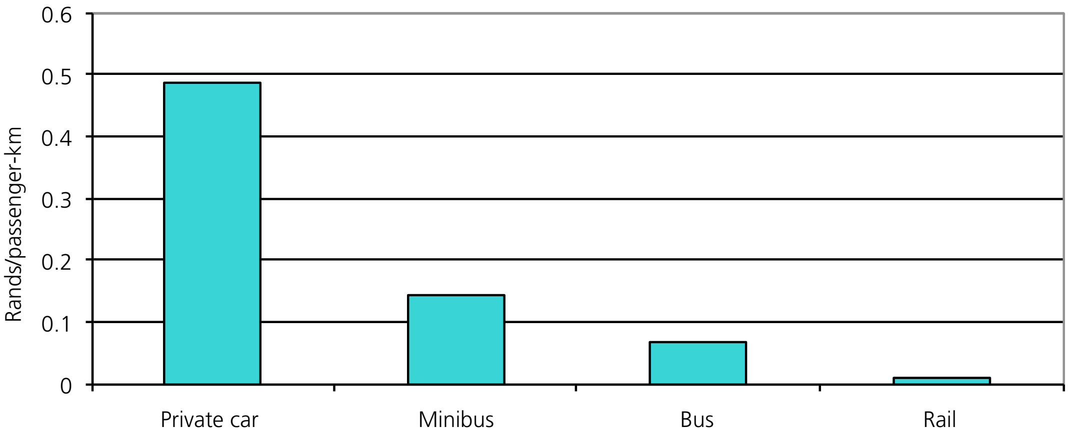


Figure 43: Relative cost of different modes of travel in rand/passenger kilometre

[15] Source: Lisa Kane using National Household Travel Survey, 2005 (national Department of Transport) data

3.4.2 Freight transport

Very little information is available on freight transport in Cape Town. However, no City or national regulation supports the use of rail-based over road-based freight transport. In the absence of such regulations, the trend has been towards road-based freight instead of rail. This causes damage to road infrastructure, which would be avoided with rail-based freight transport.

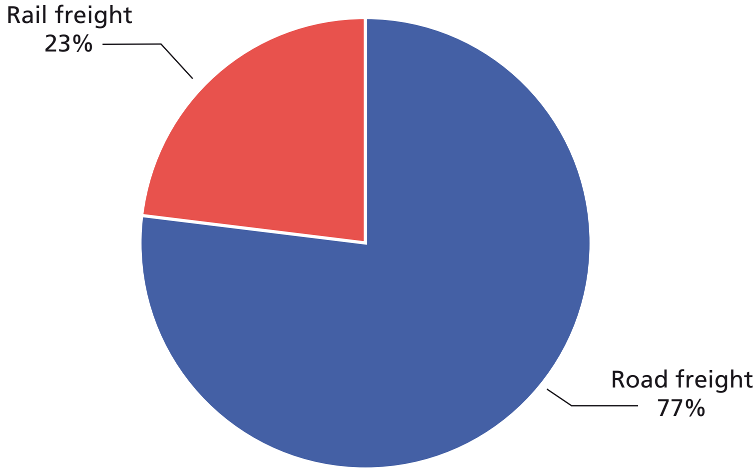


Figure 44: Freight breakdown according to transport mode for Cape Town based on energy consumed/tonne kilometre, 2007

3.5 Local government/authority

The City of Cape Town, as local government/authority, is assessed as an individual sector. It is the single biggest user of energy in Cape Town, consuming 1% of total energy (1 681 813 GJ), and is responsible for 1% of carbon emissions. The City controls or has a direct impact on a host of functions and activities in Cape Town. It is responsible for providing services to the population of 3.7 million people in Cape Town, and has just over 25 000 employees. The City consumes 1.6 million GJ every year, with its main energy sources being electricity, petrol and diesel (see figure 45).

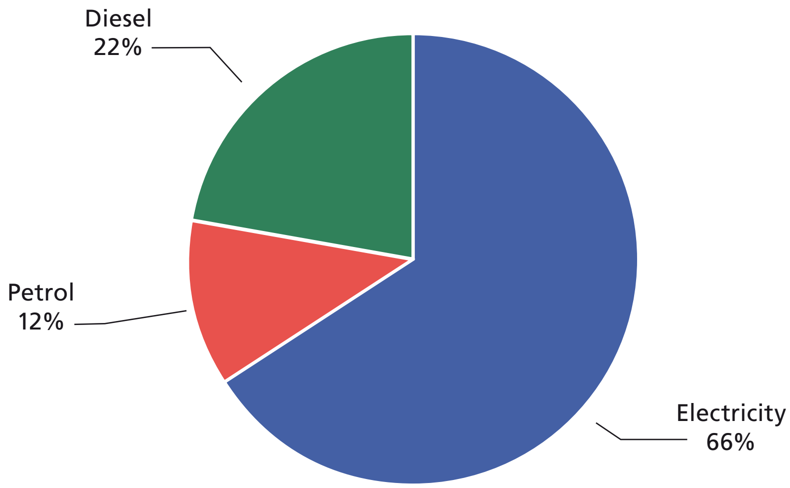


Figure 45: Energy consumption in the local government sector by energy source, 2007

[16]According to wastewater electricity accounts for 2007/8.
[17]According to summary of electricity sales for 2006/7.

The main energy consuming aspects of the City of Cape Town's functions are:

- the City's vehicle fleet (both petrol and diesel). An estimated 6 000 vehicles are owned and operated by the City, including heavy trucks, waste removal vehicles and passenger vehicles;
- electricity for the City's offices, depots and other public buildings;
- electricity for street lighting and traffic signals within the Cape Town area; and
- electricity for wastewater treatment and bulk water supply.

The relative consumption of each of the abovementioned aspects is shown in figure 46, table 12 and table 13 below.

Table 12: Electricity consumption in City of Cape Town operations, 2007

Operation	kWh/annum
Wastewater treatment works	81 650 000
Street lighting	91 752 080
Traffic signals	10 110 924
Bulk water supply	41 404 828
Buildings	41 404 828
Total	**266 322 660**

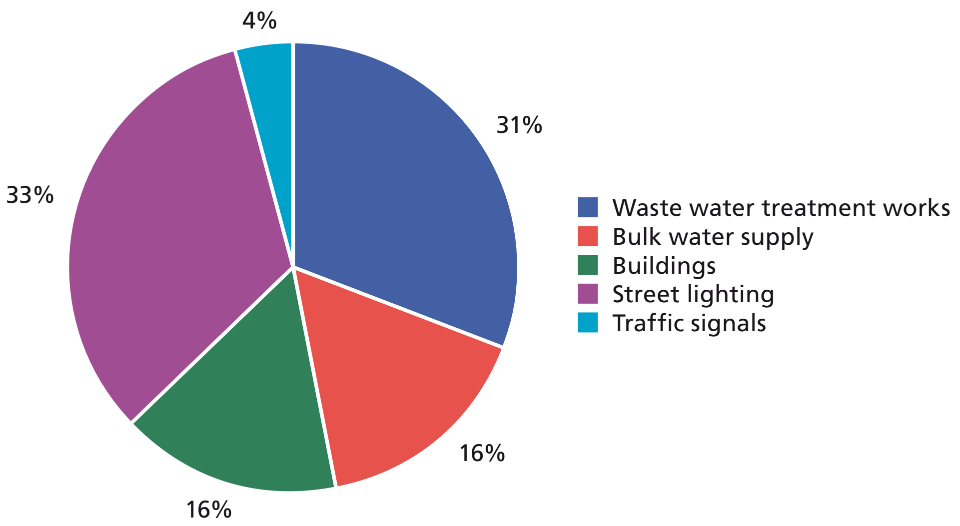


Figure 46: City of Cape Town electricity consumption by City operations, 2007

Table 13: Fuel consumption in City of Cape Town operations, 2007

Vehicle fleet	Diesel (litres/annum)	Petrol (litres/annum)
Special Technical Services vehicle fleet (includes solid waste and general City vehicles)	8 647 829.21	5 470 697.23
Electricity Department vehicle fleet	1 137 996	714 902
Total	**9 785 825.21**	**6 185 599.23**

[17]According to wastewater electricity accounts for 2007/8.
[18]According to summary of electricity sales for 2006/7.
[19]Remainder (31%) from total municipal use split between bulk water and buildings.
[20]Remainder (31%) from total municipal use split between bulk water and buildings.
[21]According to fuel and on-board computers management key performance indicators 2007/8.

4. Cape Town's optimum energy future

The *Energy Scenarios for Cape Town* study commissioned by the City in 2009 is similar to the national LTMS study commissioned by the National Department of Environmental Affairs and Tourism in 2007 (see section 1.1.4). A large part of the Cape Town study focused on collecting data on current energy consumption, much of which are presented in section 2. Information on the methodology used to determine the data is found in section 2.1.

The main aim of the Cape Town study was to model current energy consumption patterns into the future to determine the impact of current growth rates in the city on future energy consumption, and to model carbon emission levels of various trajectories. The study looks at various scenarios up until 2050 to determine the effect of various energy related interventions or global events (such as peak oil) on energy consumption in Cape Town. In addition, the study examines the relative cost of the different interventions, as well as the associated job creation potential.

The study aimed to develop an 'optimum energy future' scenario, in which:

- it is acknowledged that the city's economy is robust amidst a carbon constrained world;
- energy costs for the city are optimised;
- energy service provision is not compromised;
- employment creation is maximised;
- opportunities for the development of energy related industries are maximised; and
- the city's carbon profile is in line with national and international standards and obligations.

4.1 Scenarios

Three main scenarios were investigated in this study.

- Business as usual
- This scenario modelled energy consumption and its implication for the future based on current growth trends.
- Long term Mitigation Scenario study applied at a local level
- This scenario modelled the national LTMS study (see section 1.1.4) scaled down to a Cape Town level.
- Optimum energy future
- This scenario aimed to model the effect of various energy interventions that reduce energy consumption and minimise carbon emissions, without compromising energy services or service delivery.

The effects of the following factors on the above scenarios were also considered:

- Carbon tax
- Peak oil

4.1.1 A 'business as usual' scenario

This scenario assumed that current energy consumption trends will continue unabated into the future. If current trends continue, energy consumption will continue to grow, as will the associated carbon emissions. Based on this scenario, figure 47 illustrates that energy consumption is expected to quadruple by 2050 from 2007 consumption levels. The first column in figure 47 represents the year 2007, which corresponds with the breakdown by sector shown in figure 20.

[22]**According to City of Cape Town Electricity Department fuel consumption records 2007/8.**

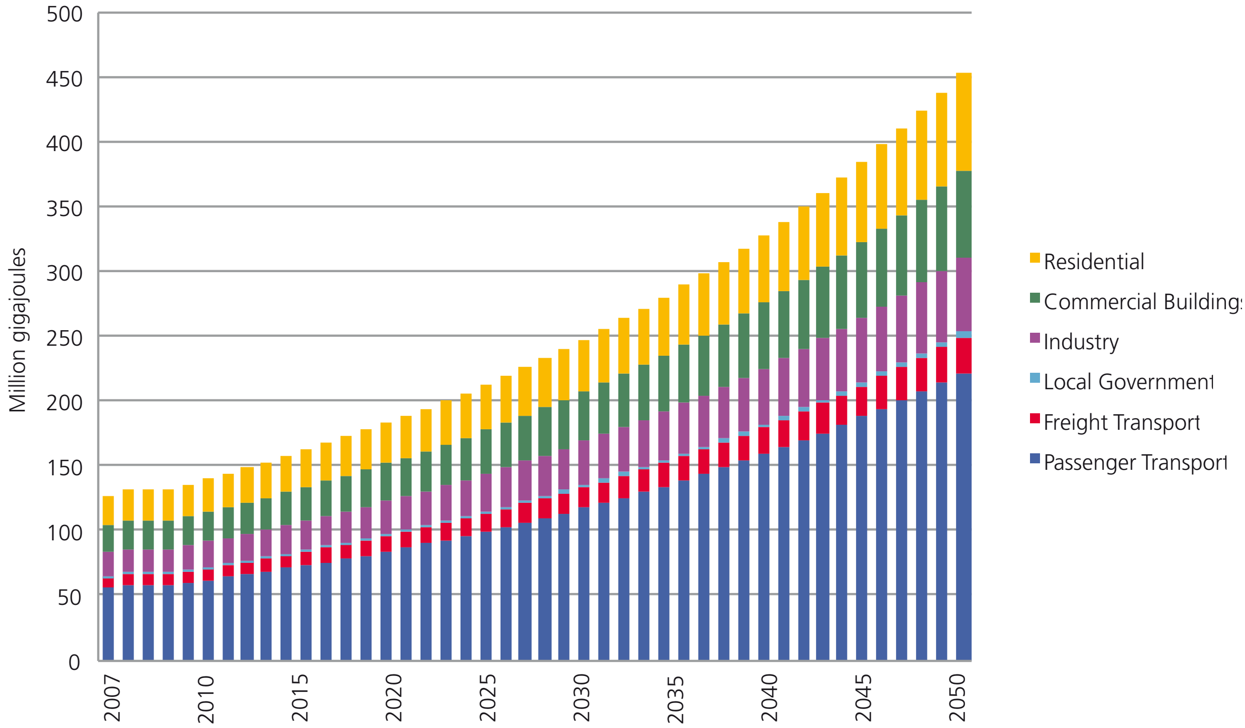


Figure 47: Growth in energy consumption per sector for 'business as usual' scenario

Likewise, the column for 2007 in figure 48 corresponds with the carbon emissions by sector shown in figure 22. Under a 'business as usual' scenario, carbon emissions will almost triple by 2050. This growth is untenable, given national and international pressures to reduce carbon emissions.

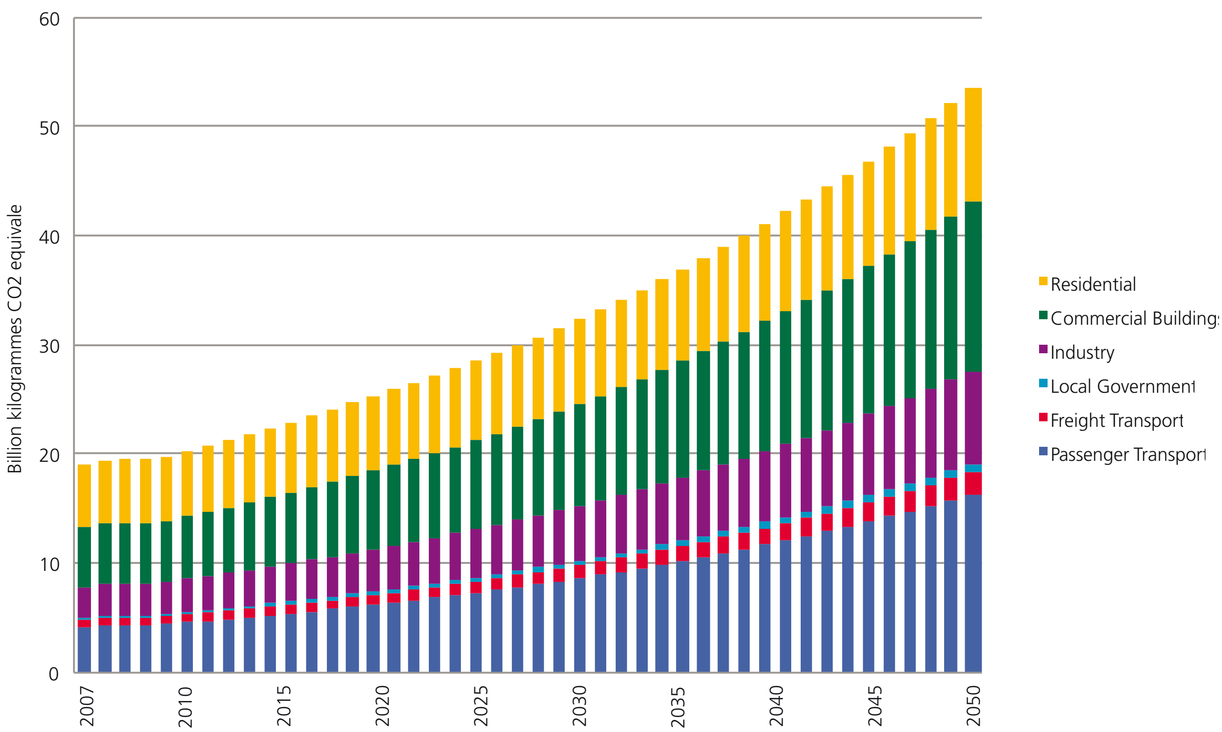


Figure 48: Growth in carbon emissions per sector for 'business as usual' scenario

4.1.2 Cape Town's optimum energy future overview

The core motivations for the optimum energy future, and the set of interventions associated with it, are embodied in the following key issues:

- Key issue 1: Continuing with a 'business as usual' scenario poses significant risks, including:
  - o vulnerability in a carbon constrained future;
  - o peak oil vulnerability;
  - o high energy expenditure for the city's residents;
  - o an increasingly inefficient economy;
  - o reduced jobs in the energy sector; and
  - o losing any marketing advantage related to being a green city.
- Key issue 2: The overall cost of a low-carbon future to the city's residents is slightly higher than that of the 'business as usual' scenario, mainly due to the costs associated with substantial public transport infrastructure. However, the efficiency gains and economic benefits resulting from the interventions far outweigh the extra cost.
- Key issue 3: The cost of an electricity supply mix that includes a strong component of renewable energy is higher than that of a 'business as usual' (mainly coal based) scenario, though not significantly.
- Key issue 4: Nuclear is part of the national LTMS mix, but needs to be approached with caution: Construction delays, long lead in times and large cost overruns are very common for nuclear projects. There is also a lot of public contention around nuclear energy.
- Key issue 5: All electricity efficiency interventions that are recommended for implementation in the residential, commercial, industrial and local government sectors are financially sensible, and pay themselves back over the lifespan of the intervention. This leads to a more efficient economy.
- Key issue 6: The high renewable energy supply component associated with a robust future will result in significant increases in jobs created, although this will require the proactive development of a renewable energy industry to maximise jobs in Cape Town.

The modelled scenarios are shown below in figure 49, where the energy required in Cape Town is seen to be significantly lower if following an optimum energy future than a 'business as usual' approach. The optimum energy future also uses less energy than the LTMS.

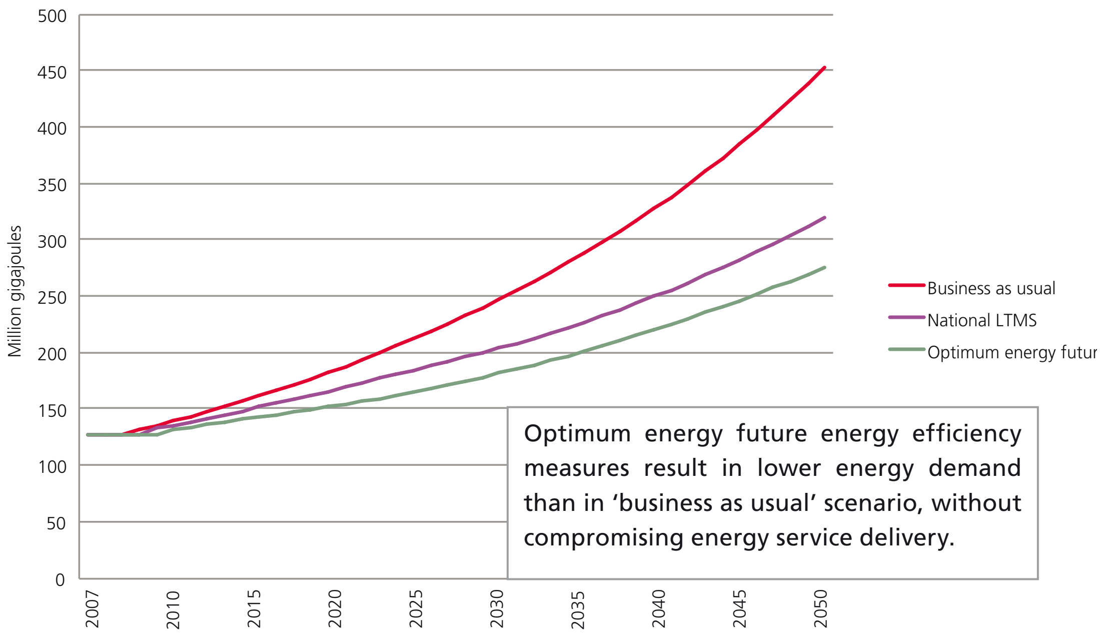


Figure 49: Energy consumption for 'business as usual', Cape Town optimum energy future as well as national Long Term Mitigation Scenario (LTMS)

[23]The national Long Term mitigation scenario is one where the interventions specified in the national LTMS study are mirrored in the Cape Town energy demand and supply interventions.

The effect of reduced energy consumption on carbon emissions is shown in figure 50 below. It is evident that favouring a more efficient energy future can cause carbon emissions from energy consumption to be halved by 2050. This will help reduce Cape Town's contribution to climate change, and also help Cape Town remain globally competitive in a carbon constrained future.

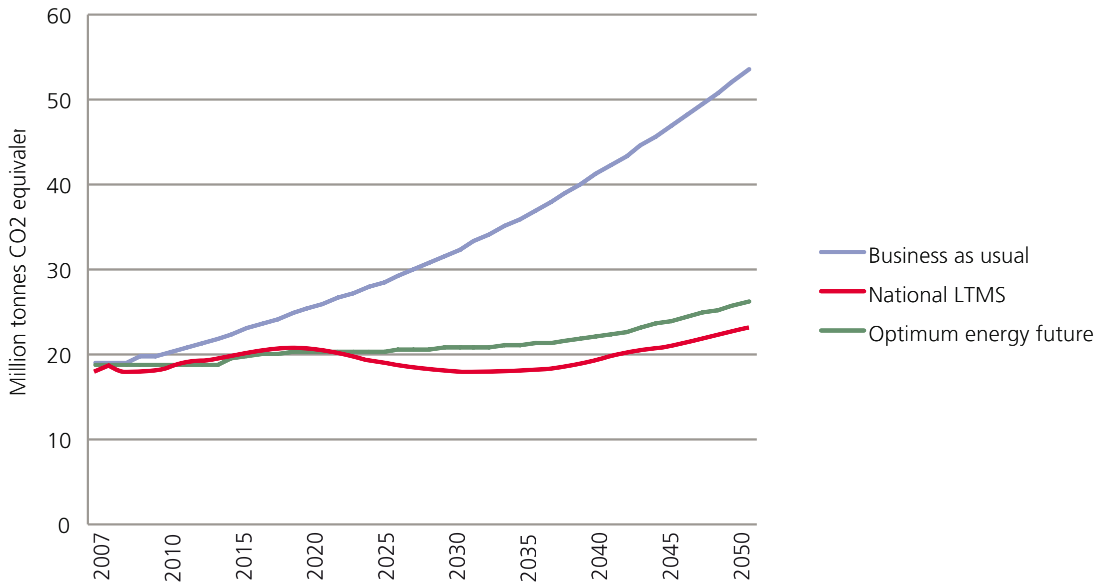


Figure 50: Carbon profiles for 'business as usual', Cape Town optimum energy future and national Long Term mitigation scenario

A key finding from the *Energy Scenarios for Cape Town* study is that the total costs associated with the optimum energy future is only slightly more expensive than that associated with a 'business as usual' approach. This can be seen below in figure 51. However, it is important to note that the optimum energy future scenario is only more expensive because it includes the cost of transport infrastructure, which are enormous. If transport costs are excluded, the optimum energy future is less expensive to Cape Town's economy than following the 'business as usual' approach. This is important, as funding assistance for expensive public transport interventions is often appropriated by national government, and Cape Town would therefore not need to bear the full cost.

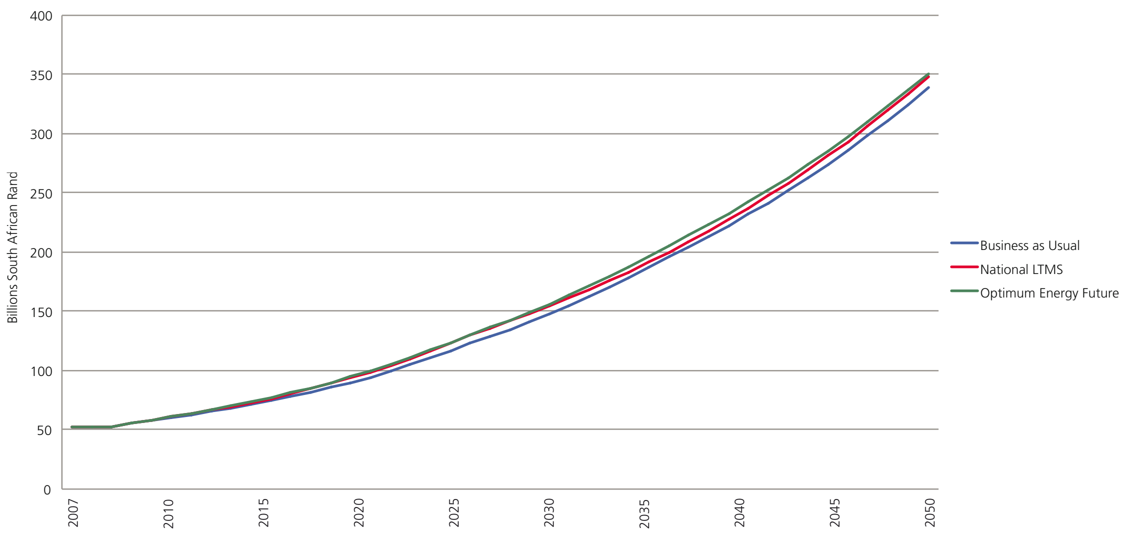


Figure 51: Total costs for 'business as usual', Cape Town optimum energy future and national Long Term Mitigation Scenario

4.2 Optimum energy interventions

The optimum energy future consists of three main focus areas, which all contribute to a reduction in carbon emissions. These are (i) electricity efficiency, (ii) transport efficiency, and (iii) renewable electricity supply. Their relative contributions to reducing carbon emissions can be seen in figure 52. The optimum energy future modelled various interventions for each of these three areas.

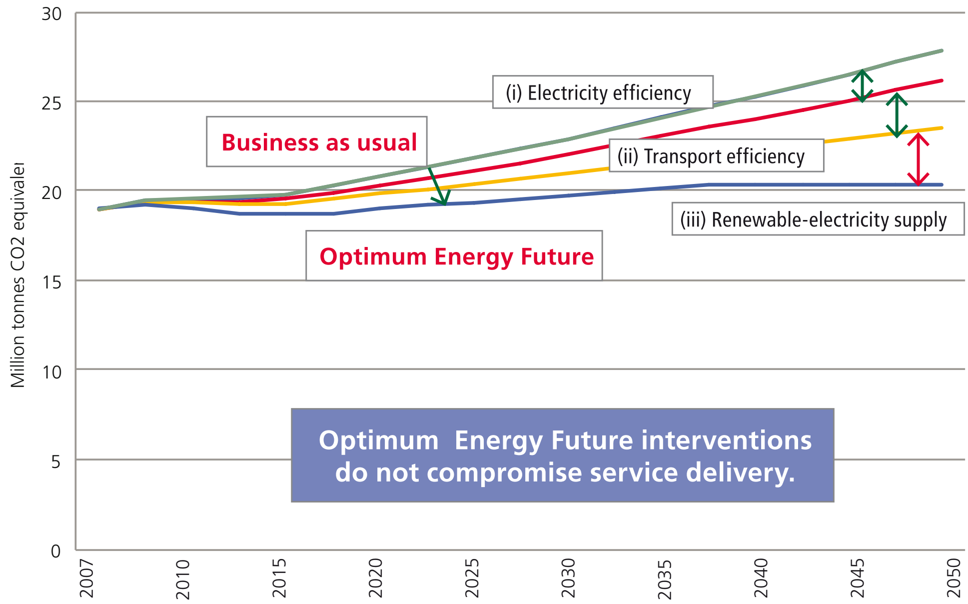


Figure 52: Route from a 'business as usual' future to an optimum energy future, up until 2015

4.2.1 Electricity efficiency interventions

In order to reduce electricity consumption, the interventions in table 14 were identified and included in the optimum energy future model. When combined, these interventions reduced carbon emissions from the 'business as usual' level, as shown in section 1 of figure 52.

Table 14: Electricity efficiency interventions included in optimum energy future for each sector modelled

Sector	Interventions for Cape Town
Residential	Energy efficient lighting in low, medium, high and very high-income households
	Energy efficient water heating technologies implemented in medium, high and very high-income households – either solar water heaters or heat pumps Geyser blankets and efficient showerheads in medium, high and very high-income households
Commercial	Efficient heating, ventilation and air conditioning (HVAC) systems in new and existing buildings
	Efficient water heating technology (either solar water heaters or heat pumps) in new and existing buildings
	Efficient lighting implemented in new and existing buildings
Industrial	Efficient machine drives installed, where feasible
	Efficient HVAC systems implemented
	Energy efficient lighting options implemented to replace conventional inefficient (incandescent) lighting
Local government	Government buildings • Efficient lighting • Efficient HVAC systems
	Street lighting – replacement of mercury vapour lamps with high pressure sodium lamps
	Traffic lights – replacement of incandescent and halogen lamps with LED (light emitting diode) lamps

Many of these projects, especially those within the residential, commercial and industrial sectors, are not under local government control. However, the City would be able to play a facilitation role in order to assist the various sectors to become as efficient as possible. Most of these interventions make financial sense, as the savings from off-set electricity costs often result in fairly short payback periods. The projects with the highest financial savings can be seen below in figure 53, where mid-income to high-income water heating, lighting and commercial lighting interventions are seen to have enormous saving potential.

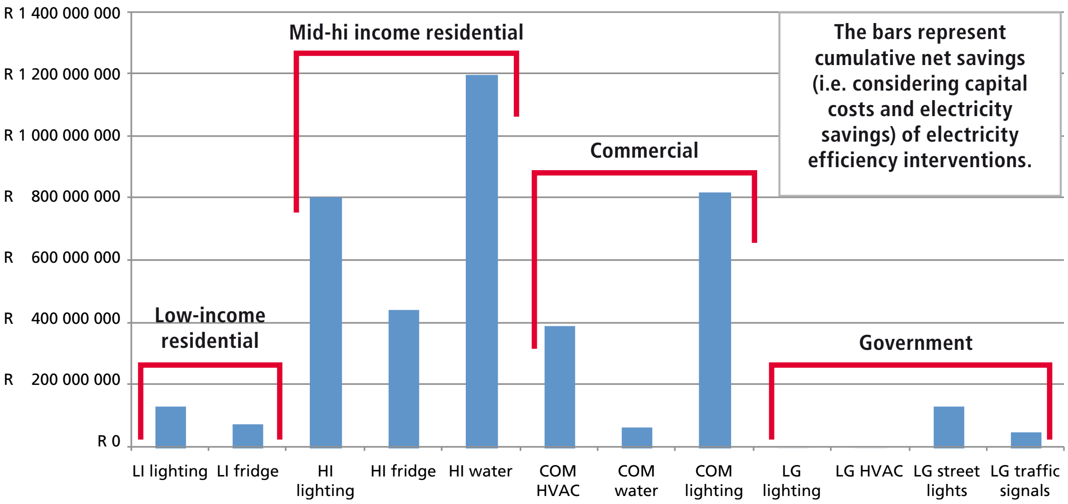


Figure 53: Cumulative savings from electricity interventions up to 2025

The potential savings in local government projects are considerably smaller than in other sectors, but it is important for government to lead by example. After all, reducing electricity consumption in the public sector releases funds, which can then be used for other services. Likewise, even though the savings in the low-income residential sector are considerably smaller than in the other sectors, the savings are accompanied by considerable quality of life improvements, which would benefit the city's poorest residents and would help reduce monthly expenditure on energy for those who are often living in energy poverty.

4.2.2 Transport efficiency interventions

In order to reduce the amount of energy consumed by the transport sector, and to reduce the associated carbon emissions shown in section 2 of figure 52, the following interventions were included in the optimum energy future model.

Table 15: Transport efficiency interventions included in optimum energy future for the transport sector modelled

Sector	Interventions for Cape Town
Local government	Vehicle fleet – improved fuel efficiency through the purchase of more efficient diesel and petrol options, and the implementation of behavioural changes to support further fuel efficiency
Freight transport	Shifting freight transport from road-based to rail-based transport
Passenger transport	Improved fuel efficiency of private vehicles, and the inclusion of hybrid and electric vehicles in the private vehicle mix
	Improved public transport vehicle efficiency, including a shift to diesel minibus taxis and more fuel efficient (Euro IV) buses
	A modal shift from private vehicles to public transport

[24] A European Union emission standard that was introduced in January 2005. A Euro IV vehicle produces less harmful emissions than a pre-Euro IV vehicle.

These interventions, especially the shift from private vehicles to public transport, require enormous upfront capital to fund, and the City may struggle to find sufficient funding if National Government's funding assistance is not adequate. The benefits of improved public transport infrastructure in Cape Town extend beyond energy savings, as current public transport is inadequate. Extending the BRT system even further and investing in the current rail system will help improve air quality in Cape Town, allow the urban poor to access urban goods more affordably, and help reduce congestion on city roads.

4.2.3 Renewable energy supply interventions

The energy mix of electricity generated in South Africa is almost entirely determined at national level, and is subject to national regulations. NERSA is the issuing body for generating licences, and the DoE is tasked with developing the integrated resource plan, which is South Africa's energy generation plan until 2030. Therefore, the City of Cape Town has limited authority to generate extensive amounts of electricity. However, the City does have an interest in the proportion of renewable energy included in the national energy mix, particularly in electricity generation, as, currently, electricity contributes extensively to Cape Town's carbon emission profile. The City is further limited in its ability to buy electricity from independent power producers, as the Municipal Financial Management Act and the Municipal Systems Act determine financial governance in the City as well as regulate the creation of public/private partnerships. While important for preventing corruption within local government, these acts are interpreted as restricting the City's authority to purchase electricity, forcing it to buy energy at a potentially higher rate than Eskom's.

The optimum energy future scenario provides an ideal mix in electricity supply for Cape Town – a mix that would help reduce carbon emissions associated with electricity consumed, while recognising that much of the generation would likely need to be driven at a national level. Some projects can be driven at a local level, and these are largely related to electricity generation opportunities in the City's own operations. Alongside many other renewable energy opportunities that can be driven at a local level, one option available to the City is energy generation through solid waste, as the City owns and manages various landfills around Cape Town. While projects to harness this energy potential have been investigated, there are currently no functioning projects that are able to generate electricity from municipal waste. According to the optimum energy future, this area could generate up to 3% of the energy mix by 2050, and the City will be investigating this further.

The energy mix modelled in the optimum energy future is shown below in table 16 and figure 54.

Table 16: The electricity supply mix for the optimum energy future

Electricity supply	2020 (%)	2050 (%)
Municipal waste	1%	3%
Solar thermal electricity	0%	8%
Wind	9%	26%
New nuclear	2%	9%
New fossil base (coal)	4%	48%
New gas turbines (peak)	2%	4%
Existing hydro	2%	2%
Existing gas turbines (peak)	3%	0%
Existing fossil base (coal)	75%	0%
Existing nuclear	2%	0%

This energy mix proposes significantly less coal than is currently proposed by National Government, and increases the proportion of wind and solar over new coal and new nuclear.

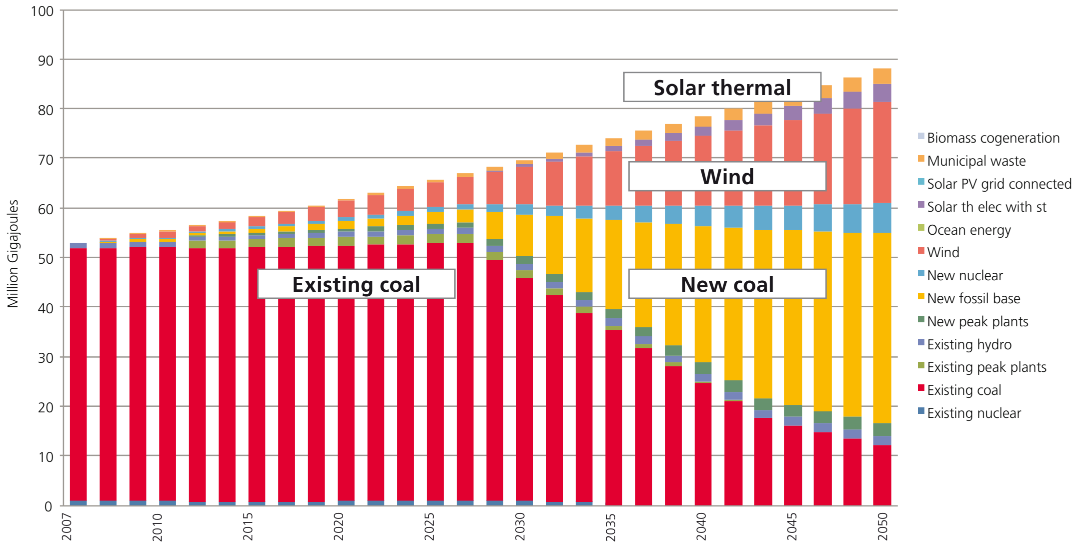


Figure 54: Cape Town optimum energy future supply mix (new coal, new nuclear and renewables)

National electricity supply plans, which have been approved in 2011 in the Department of Energy's Integrated Resource Plan 2010-2030 (IRP), will continue South Africa's dependence on fossil fuels for meeting the electricity demand. According to the IRP, coal and other fossil fuel sources will make up 67% of electricity energy generated in 2030. Nuclear will contribute 19%, with renewables other than hydro making up 9% of total electricity energy generation. In the optimum energy futures scenario, shown above, renewables in the form of wind, ocean, biomass, municipal waste and various solar technologies contribute 24% by 2030. Following an optimum energy future will therefore increase the contribution of renewable energy to Cape Town's electricity supply mix while simultaneously reducing the dependence on fossil fuels in a carbon constrained future.

4.3 Effects of carbon tax and peak oil

The optimum energy future would result in significantly reduced carbon emissions, and would also reduce reliance on oil through transport efficiency interventions. National Government is currently investigating the introduction of a carbon tax. If Cape Town pursues a low-carbon future, the detrimental implications of a carbon tax will be less than half by 2050. This will help minimise disturbances to Cape Town's economy.

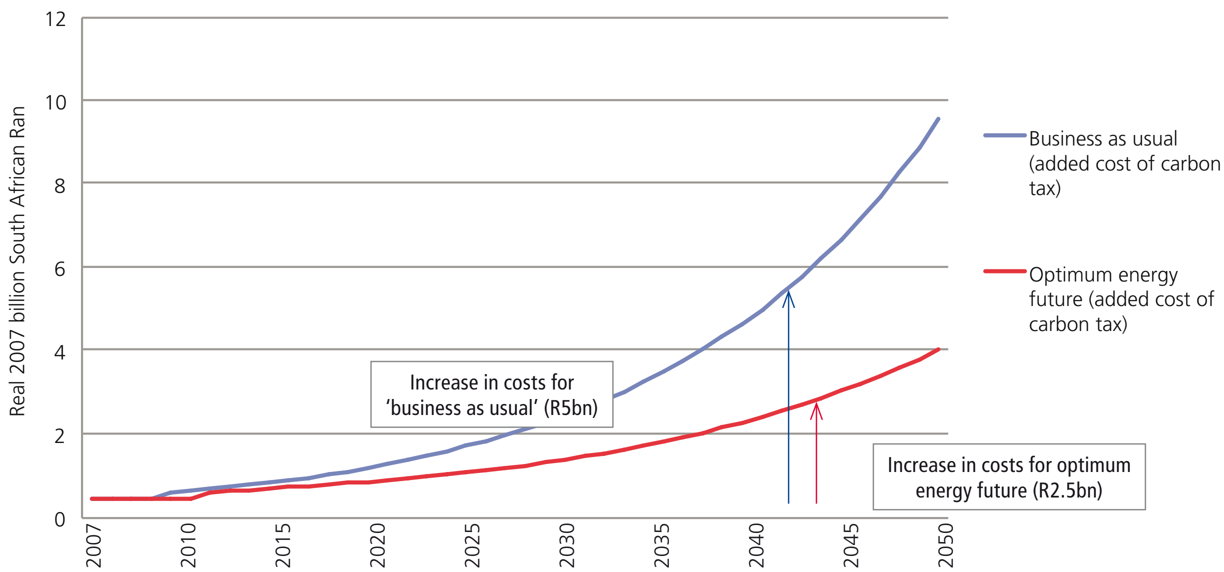


Figure 55: Impact of a carbon tax (R100 per tonne escalating) on total cost of energy in Cape Town

Similarly, improving the efficiency of Cape Town's transport sector as well as other sectors that largely depend on imported oil and petroleum products helps to minimise the effects of peak oil. The impact of an increase in oil price can be seen in figure 56. The costing information used in this graph (as an illustration of the estimated impact rather than an accurate prediction of the peak oil future) shows that there is a significant increase in the cost of the energy system associated with peak oil – between 50% to 100% by 2050. This would be devastating to the economy.

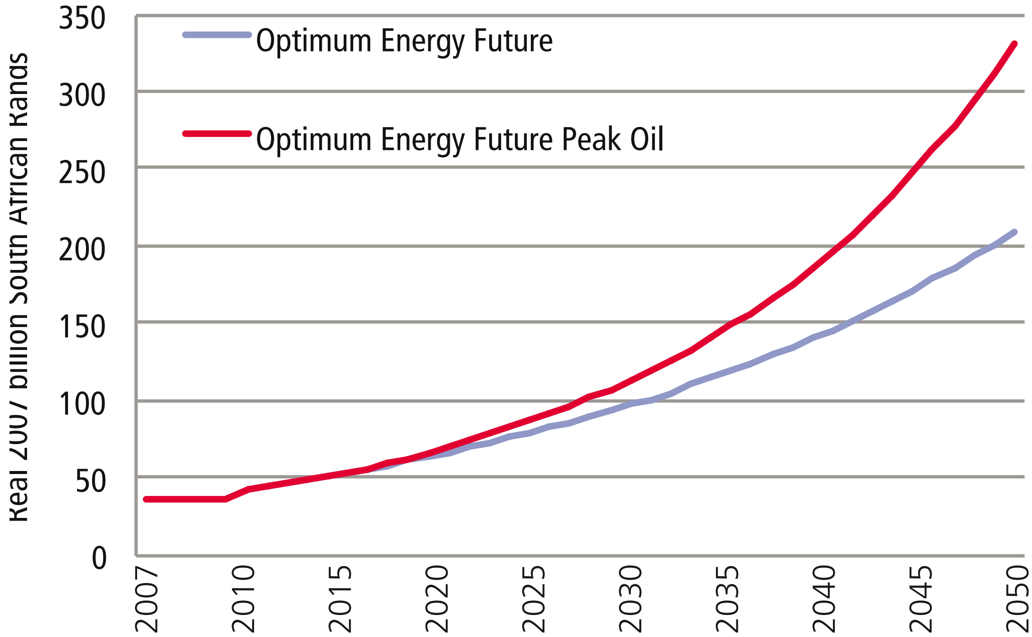


Figure 56: Total cost (demand and supply) of Cape Town optimum energy future scenario, with and without peak oil cost implications for passenger transport

5. City of Cape Town policy and regulatory framework

The City of Cape Town understands the central role that energy plays in a city's economic development, social welfare and environmental sustainability. It also recognises that the global and local energy crises, which are clearly marked by rapidly increasing oil prices and South Africa's electricity supply shortages, have ushered in a new era, which requires the City to take a central role in managing Cape Town's energy future. In addition, the threat of climate change means that industrialised countries in the developing world, such as South Africa, will in the near future be required to meet carbon reduction targets. As most energy is consumed in cities, city governments bear the responsibility of leading the way in reducing carbon emissions. Lastly, the City needs to take proactive adaptation action to protect its economy, infrastructure and vulnerable communities from climate change impacts through the development of adaptation and climate-proofing strategies.

The City formally adopted the Integrated Metropolitan Environmental Policy (IMEP) in 2001 as an overarching environmental policy that placed sustainable development, an integrated environmental plan, the well-being of people as well as the natural resources on which they depend at the very top of the agenda. During 2008, the City reviewed the IMEP, and is in the process of recommitting itself to a future of strong sustainability.

Throughout the IMEP review process, a number of key issues emerged, including:

- the need for environmental accountability and commitment across City line functions;
- the need for coordinated and integrated approaches to effect positive change with regard to complex issues;
- the need for an increased commitment to resource conservation and resource efficiencies; and
- the need for the City as an organisation to lead by example.

The 2003 and 2007 editions of the State of Energy Report have provided valuable information on the city's energy consumption patterns. The quality of data in this version of the report is however of a significantly higher standard, as the process of data collection was much more thorough. More information on the methodology can be found in section 2.1. The City's Energy and Climate Change Strategy of 2006 (in draft format since 2003) sets out the vision, objectives, targets, measures and projects for all City energy activities.

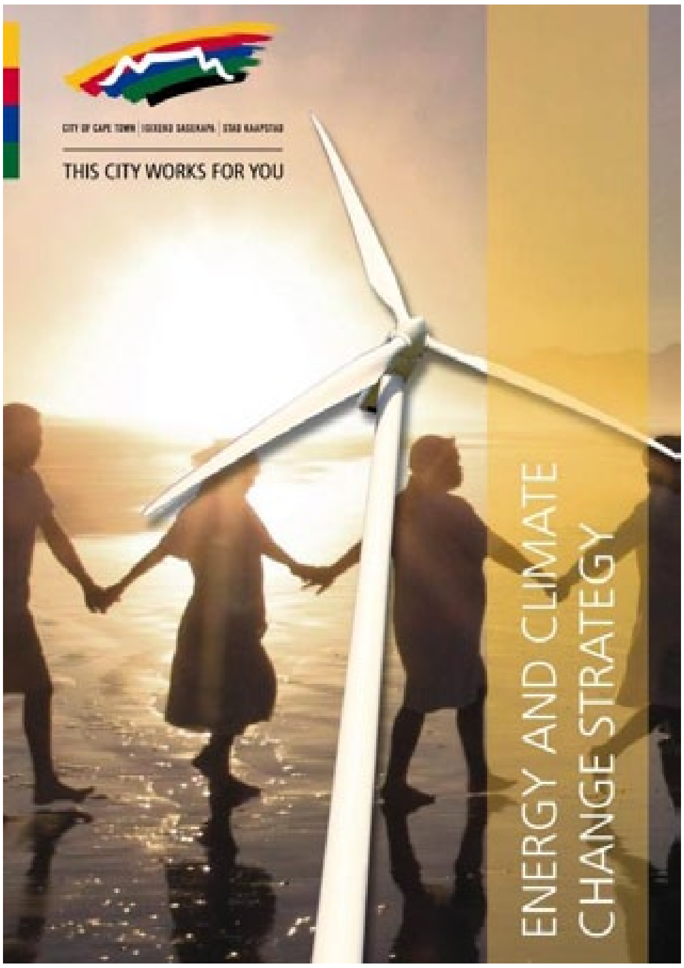


Figure 57: Front cover of the City of Cape Town's Energy and Climate Change Strategy

In 2008, the City made "Energy for a sustainable city" one of the priority strategic focus areas of its Integrated Development Plan, which sets Long Term goals for Cape Town up to the year 2020. To drive this focus area, the Mayoral Committee determined that an Energy and Climate Change Committee of 11 councillors should be established (in terms of section 80 of the Municipal Systems Act). This committee has been supported by an Executive Management Team Subcommittee on Energy and Climate Change, and three cross-cutting work streams that address energy security, adaptation and awareness respectively (see figure 58).

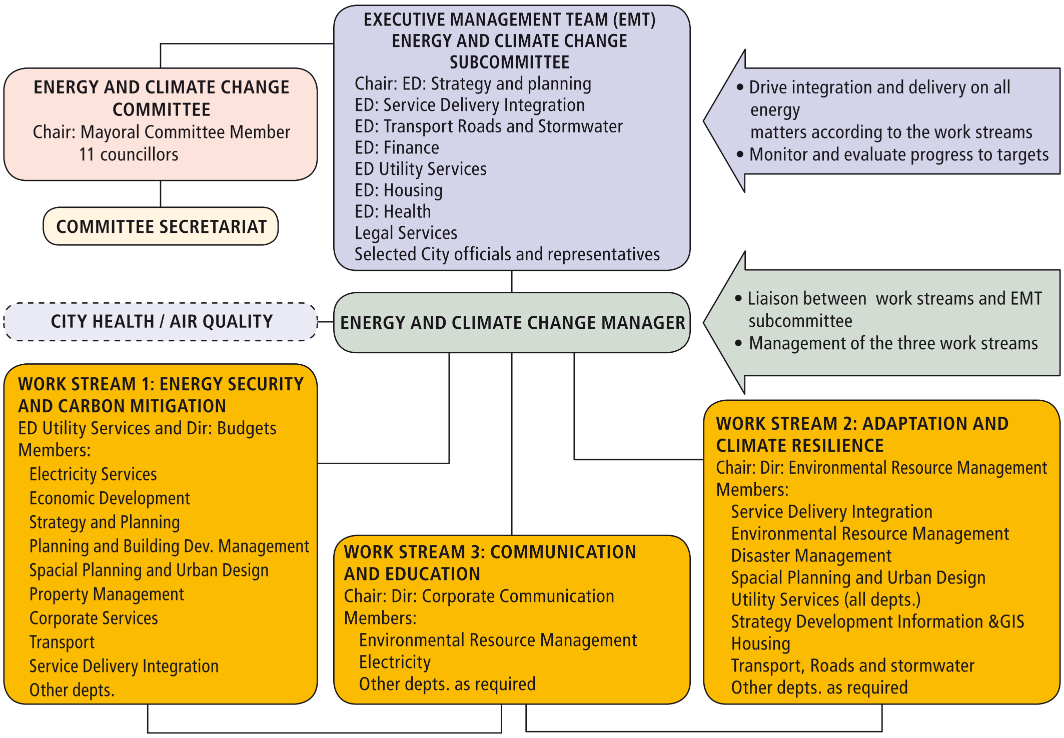


Figure 58: City institutional set-up to address energy and climate change

The formation of the Energy and Climate Change Committee has helped to initiate the development of an Energy and Climate Action Plan (the Action Plan). The Action Plan comprises both existing and proposed City energy and climate change projects across all directorates and departments. Projects identified in this process have been prioritised according to the overarching goal of energy security, with first-level and second-level criteria (not in hierarchical order) (see figure 59).

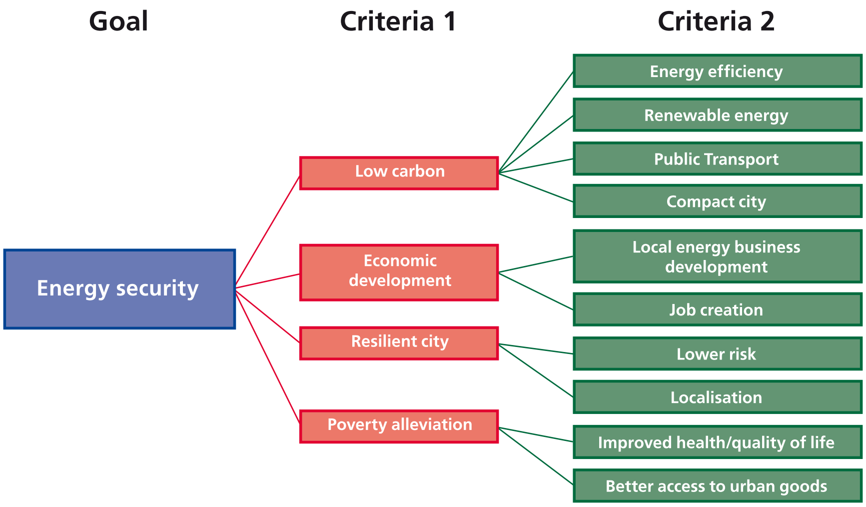


Figure 59: Overall goal and prioritisation criteria for the Energy and Climate Action Plan

In order to achieve energy security in Cape Town while supporting the first- and second-level criteria, ten objectives were created, along with an overall objective of improving capacity in energy and climate change within the City. These objectives can be seen in table 17 below. More information on these objectives and the programmes within which they are pursued is available in the report Resilient Cape Town: Cape Town's Plan for Energy and Climate Change.

Table 17: Energy and climate change objectives as per the Action Plan

Objective 1	Citywide: 10% reduction in electricity consumption on unconstrained growth by 2012
Objective 2	Council operations: 10% reduction in energy consumption by 2012
Objective 3	10% renewable and cleaner energy supply by 2020; all growth in electricity demand to be met by cleaner/renewable supply, among other sources
Objective 4	Build a more compact, resource-efficient city
Objective 5	Develop a more sustainable transport system
Objective 6	Adapt and build resilience to climate change impacts
Objective 7	Improve the resilience of vulnerable communities
Objective 8	Access climate finance
Objective 9	Enable local economic development in the energy sector
Objective 10	Raise awareness and promote behaviour change through communication and education programmes (driven by objectives 1–9)
Overall management	Recruit staff; undertake research and development; establish data management system; conduct monitoring and evaluation; update plan annually

The Energy and Climate Action Plan is reviewed annually. In addition, a Climate Change Think Tank has been established as a collaborative project between the City of Cape Town, academics and specialists to address climate change related issues in Cape Town.

6. Recent Cape Town statistics

To ensure consistency and compatibility between various data sources, all information in the main body of the report was from 2007, wherever possible and unless otherwise stated. More recent information is available about living and economic conditions in Cape Town, and these are shown below in table 18.

Table 18: Recent Cape Town demographic and economic statistics

Demographics		Year
Population (total)	3.82 million (estimate)	2011
Number of households	1,103,182 (estimate)	2011
Population growth rate	3% (estimate)	2010
Economy		
GDP (constant 2005 prices)	R201,590 Million	2010
% unemployed	25.80%	2010

7. References

City of Cape Town. 2006. Economic and Human Development (EHD) Strategy, Part 1: Context and Framework. Cape Town.

City of Cape Town. 2010. State of Cape Town Report. Cape Town

City of Cape Town. 2011. Cape Town's Economy: A brief overview (August 2011) fact sheet. Cape Town

Department of Environmental Affairs and Tourism (DEAT). 2000. South Africa's Greenhouse Gas Inventory 2000. Pretoria.

Department of Environmental Affairs and Tourism (DEAT). 2007a. Long Term Mitigation Scenarios: Strategic Options for South Africa. Pretoria.

Department of Environmental Affairs and Tourism. 2007b. Long Term Mitigation Scenarios: Technical Appendix. Pretoria.

Department of Energy (DoE). 2011. Integrated Resource Plan for Electricity, 2010-2030, Revision 2, Final Report. Pretoria.

Department of Minerals and Energy (DME). 2009. South African Energy Balance, 2006. Pretoria.

Department of Public Enterprises (DPE). 2010. National Assembly, Questions for Written Reply, Question Number 522. Pretoria.

Department of Transport (DoT). 2005. Key Results of the National Household Travel Survey; The First South African National Household Travel Survey 2003. Pretoria

Eskom. 2008. Infrastructure map. [Online] Available: http://www.eskom.co.za/content/2008EskomPoster.jpg.

Eskom. 2011a. Integrated Report, 2011. Johannesburg.

Eskom, 2011b. Financial Instruments for Large Power Users. Johannesburg.

Government Communication and Information System (GCIS). 2008. South African Yearbook 2008/09. Pretoria.

National Energy Regulator of South Africa (NERSA). 2009. In the matter regarding Eskom Price Increase Application 2009. [Online] Available: http://www.nersa.org.za/Admin/Document/Editor/file/Electricity/PricingandTariffs/Eskm%20Current%20Price%202009-10.pdf.

National Energy Regulator of South Africa (NERSA). 2010. NERSA'S Decision on Eskom's Required Revenue Application - Multi-Year Price Determination 2010/11 to 2012/13 (MYPD 2). [Online] Available: http://www.eskom.co.za/content/MediaStatementMYPD2.pdf.

Organisation for Economic Cooperation and Development (OECD). 2008. Territorial Review. Cape Town, South Africa. Paris

SASOL. 2010. Annual review and summarised financial information 2010. Johannesburg.

South African Petroleum Industry Association (SAPIA). 2010. 2010 Annual Report. Johannesburg.

Statistics South Africa (Stats SA). 2007. Community Survey (Revised Version) Pretoria

Steyn, G. 2006. Investment and Uncertainty: Historical experience with power sector investment in South Africa and its implications for current challenges. Management Programme in Infrastructure Reform and Regulation (MIR), Graduate School of Business, University of Cape Town.

Sustainable Energy Africa (SEA). 2006. Energy Profile and Scenarios for the Western Cape. Cape Town.

Sustainable Energy Africa (SEA). 2006. State of Energy in South African Cities. Cape Town.

Sustainable Energy Africa (SEA). 2007. Energy Profile and Scenarios for the Western Cape: Demand side Report. Cape Town.

Sustainable Energy Africa, University of Cape Town. 2011. *Energy Scenarios for Cape Town*: Exploring the implications of different energy futures for the City up to 2050. City of Cape Town.

Turok, Sinclair-Smith and Shand. 2010. Environment and Planning A 2010, volume 42, page 2295 Cape Town [Online] Available:

http://www.envplan.com/abstract.cgi?id=a42424

United Nations Framework Convention on Climate Change (UNFCCC). N.d. Glossary of climate change acronyms. U.w. 'LULUCF'. [Online] Available: http://unfccc.int/essential.background/glossary.

Ward, S. 2008. The New Energy Book. Sustainable Energy Africa: Cape Town.

Wesgro. 2011. The Western Cape Investment and Trade Promotion Agency. Presentation by Nils Flaaten. Cape Town.

8. List of abbreviations used

BRT	bus rapid transit
CO_2	carbon dioxide
CPI	consumer price index
Danida	Danish International Development Agency
DoE	Department of Energy
EEDSM	energy efficiency and demand side management
EERS	energy efficiency resource standard
ESCO	energy services company
GDP	gross domestic product
GHG	greenhouse gas
HFO	heavy fuel oil
HVAC	heating, ventilation and air conditioning
IMEP	Integrated Metropolitan Environmental Policy
IPCC	Intergovernmental Panel on Climate Change
LED	light emitting diode
LPG	liquid petroleum gas
LTMS	long term mitigation scenario
Mt	mega-tonnes
MYPD	multi-year price determination
NERSA	National Energy Regulator of South Africa

Acknowledgements

The production of this report would not have been possible without the contribution and support of a number of key people and institutions.

The report was prepared by Vivienne Walsh, Sarah Ward and Hilton Trollip from the City of Cape Town Energy and Climate Change Unit, Environmental Resource Management Department. The authors would like to thank participating representatives from many departments across the City of Cape Town, who provided input and comments into the report.

The input and guidance of Mark Borchers, Andrew Janisch, Zanie Cilliers, Lize Jennings and Stefan Wiswedel from Sustainable Energy Africa (SEA) were extremely valuable, and the work done by SEA and the University of Cape Town's Energy Research Centre in the *Energy Scenarios for Cape Town* study provided the foundation for the information and conclusions contained in the report.

This study was done within the Cape Town Climate Change Think Tank, a collaboration of Cape Town academics and specialists addressing the pressing climate change issues which the city confronts. We are extremely grateful to DANIDA and the British High Commission for funding the study.

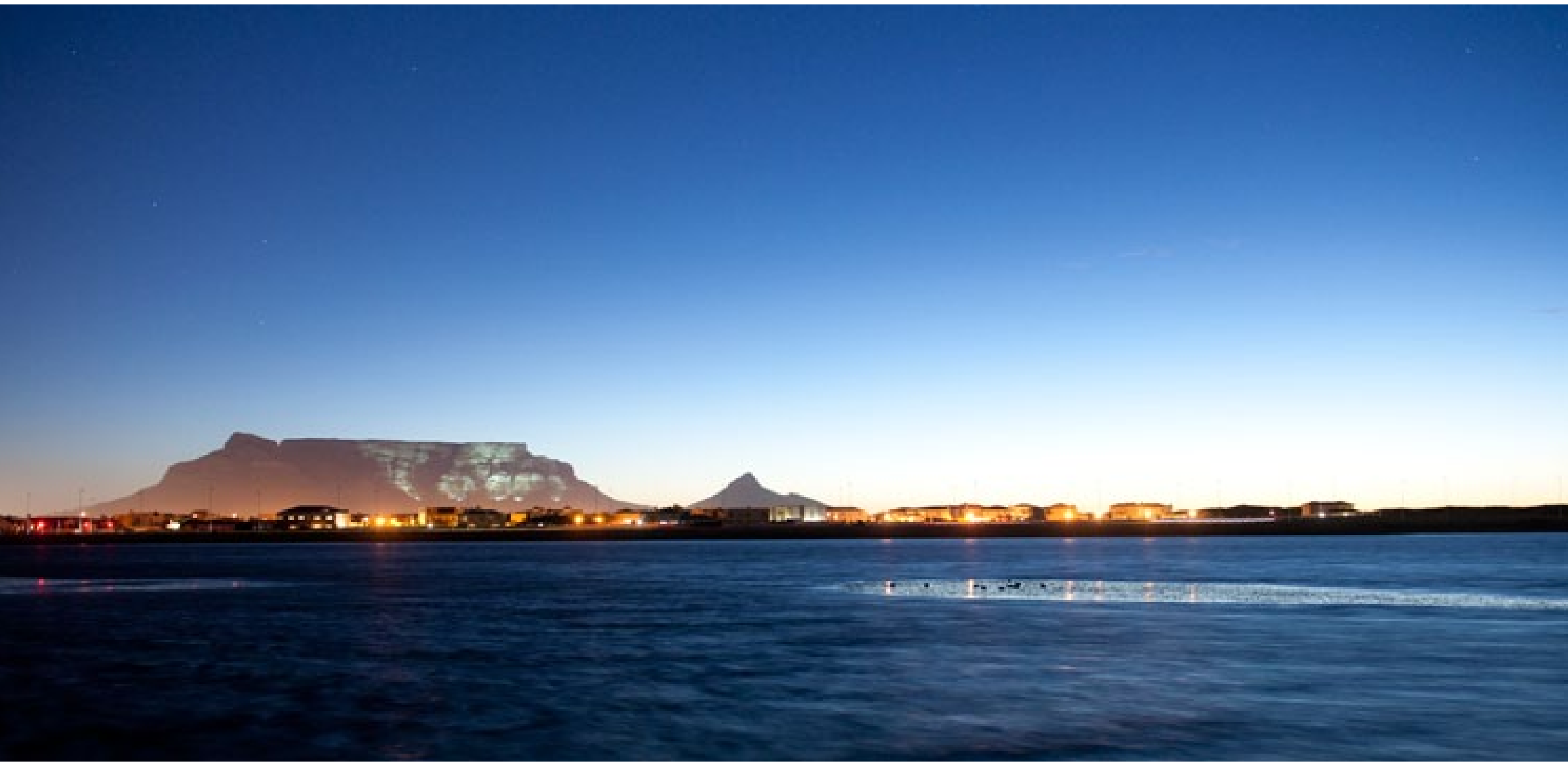
Thank you to Duven Diener for the graphic design and layout, his attention to detail and his patience with the process and to Bruce Sutherland for the cover pictures.

For further information contact:

Environmental Resource Management
City of Cape Town
7th Floor, 44 Wale Street
Cape Town

Tel: +27 21 487 2319
Fax: +27 21 487 2578
Email: enviro@capetown.gov.za

Or visit our website at
www.capetown.gov.za/environment



MEMBER CLIMATE SMART CAPE TOWN

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

THIS CITY WORKS FOR YOU