"Energy for Large Cities"
World Energy Council Study

Cape Town Energy Case Study

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1. INTRODUCTION

This report forms part of the study undertaken by the World Energy Council entitled "Energy for Large Cities" as Cape Town has been included as a case study city. This study will be reported on at the World Energy Congress in Montreal in September 2010.

The report gives a broad overview of the energy picture in South Africa, which incorporates energy supply and consumption information, as well as green house gas emissions. This provides a context for a more detailed investigation into the energy picture within the City of Cape Town. The development of national and local policies, strategies and legislation are discussed and a detailed outline of the City's Energy and Climate Action Plan is given, which shows how the City is tackling energy security issues and mitigating carbon within its overall development goals.

2. SOUTH AFRICAN ENERGY PICTURE

2.1. Energy supply and consumption

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, and it is estimated that there are a further 31 billion tonnes of recoverable coal resources remaining. (GCIS, 2008) It is this abundance of coal that has resulted in the current energy picture in South Africa, shown in Figure 1 below.

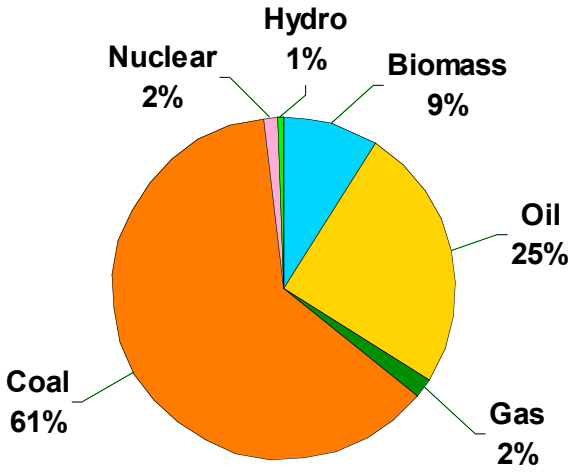


Figure 1. South African energy mix (Ward, 2008)

The availability and relative affordability of coal as an energy source has made electricity generation heavily dependent on coal; 88% of electricity is generated through burning low grade coal, 6% through nuclear power and 2.3% is generated by hydroelectric stations and pumped storage stations assist with load management. (GCIS, 2008) The environmental costs of burning coal to generate electricity have not been factored into the price of electricity. This, together with the abundance of coal, has resulted in electricity in South Africa being amongst the cheapest in the world. This has led to inefficient energy use, and the value added to the economy per unit of energy is lower than in many other countries. Figure 2 illustrates the energy intensity of South Africa's economy; South Africa used more than double the amount of energy as Germany in 2006 to generate the same economic effect.

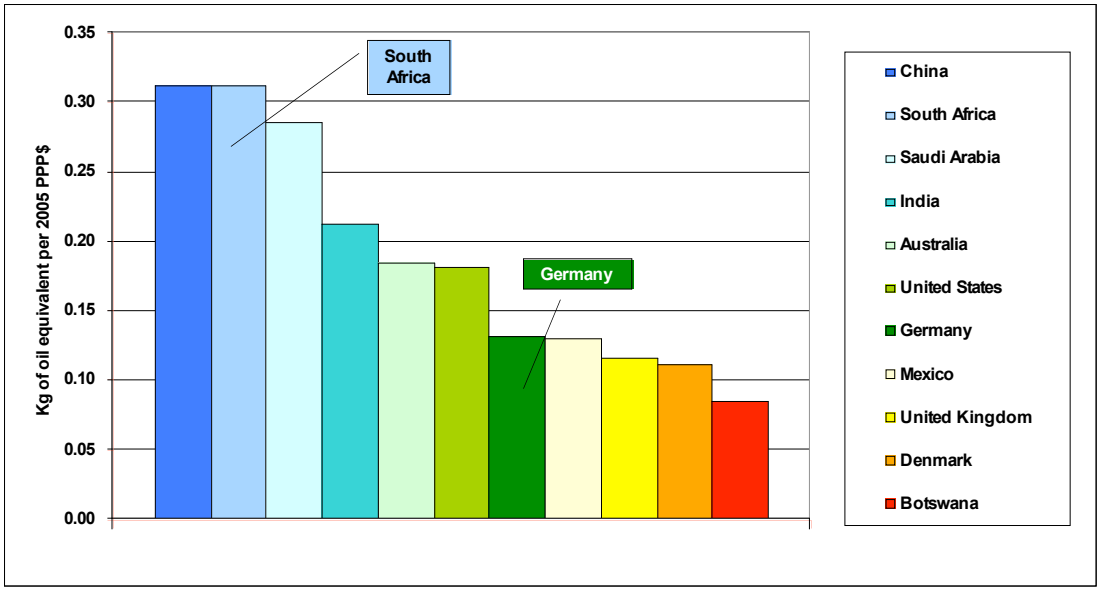


Figure 2. Energy consumed per unit of GDP, 2006, (Source: World Bank)

South Africa has one dominant energy provider, Eskom, which is the 7th 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 200GWh per month to countries within southern Africa as part of the South African Power Pool Agreement. These countries include Namibia, Botswana, Lesotho, Swaziland, Mozambique and occasionally Zimbabwe and Zambia. (DPE, 2010) South Africa also purchases hydro-electric power from Cahora Bassa power station in Mozambique.

Eskom does not have exclusive generation rights, but "has a practical monopoly on bulk electricity" (GCIS, 2008.) Eskom's generation infrastructure is ageing and is inefficient. Generation capacities are not expected to meet demand in coming years, as reserves have dropped well below the internationally accepted level of 15%, and demand is expected to meet supply levels in 2011, see Figure 3.

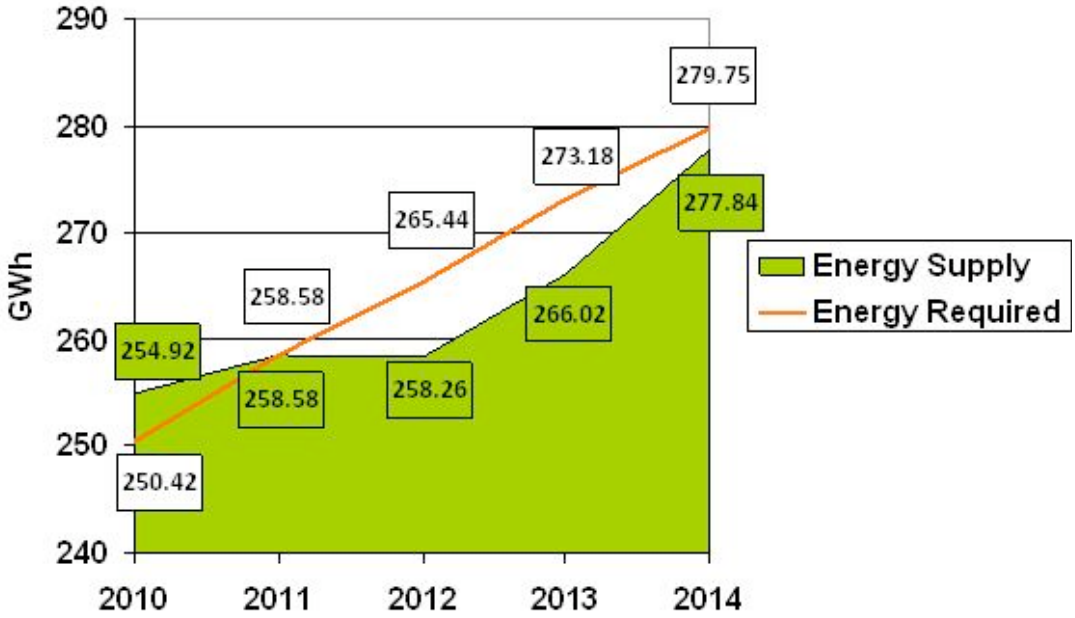


Figure 3. Energy requirements and supply limitations for South Africa (National Energy Response Team, NERT 2010)

Eskom's response to the energy security threat has been to build two coal power stations, which are under construction; Medupi and Kusile. A pumped storage facility, Inqula, is being constructed with a planned capacity of 1,352MW (Source: Eskom) and Eskom has announced three electricity tariff increases, which will result in electricity being almost double the current price by 2013. Current Eskom infrastructure can be seen in Figure 4.

Figure 4. Power stations and national grid in South Africa (Source: Eskom, 2010)

The Department of Minerals and Energy (DME) published a Nuclear Energy Policy for the Republic of South Africa in June 2008. South Africa intends to increase the generation of nuclear powered electricity, with an aim of increasing the energy mix to ensure energy security, mitigate climate change and to promote economic and technological growth. (DME, 2008) Eskom Generation Group has identified four potential locations for nuclear power on the South African coast (namely Brazil, Schulpfontein, Bantamsklip and Thyspunt) through its Nuclear Siting Programme. The Pebble Bed Modular Reactor (PBMR) is a nuclear reactor project based in Pretoria. The project has been shelved for the immediate future as funding has not been secured.

South Africa meets 95% of its oil requirements through imports from the Middle East and Africa. Further petroleum products are produced through coal to liquid fuel and gas to liquid fuel technology. (GCIS, 2008) The dependence on imported fuel makes South Africa particularly vulnerable to global price shocks. (CCT, 2008c) Peak oil effects and resulting price fluctuations are therefore of great concern.

2.2. South African green house gas emissions

Coal is a dirty fuel, which releases vast amounts of CO_2 and other green house gases and pollutants during combustion. Low electricity prices and an energy intensive industrial sector have resulted in high CO_2 and CO_2 equivalent emissions per capita compared to other

countries, both developed and developing. This is due to the high CO_2 coefficient associated with producing electricity from coal. This can be seen in Table 1, where electricity produces 3 times more CO_2 per GJ than any other energy source.

Energy Source	Coefficient
Electricity	0.3056
Paraffin	0.0717
LPG	0.063
Coal	0.0944
Petrol	0.0692
Diesel	0.0739
HFO	0.0772
Wood	0

Table 1. CO_2 coefficients (tonnes/GJ) (CCT, 2003a)

Energy security issues, together with concerns over climate change, 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 the conditions of growth without constraints national green house gas (GHG) emissions would almost quadruple by 2050, from 446 $MtCO_2$-eq in 2003 to 1640 $MtCO_2$-eq in 2050. The energy sector accounts for most of the GHG emissions and it is estimated that without constraints energy-related emissions would increase by 2.9% annually to reach 1330 $MtCO_2$-eq in 2050. (DEAT, 2007b)

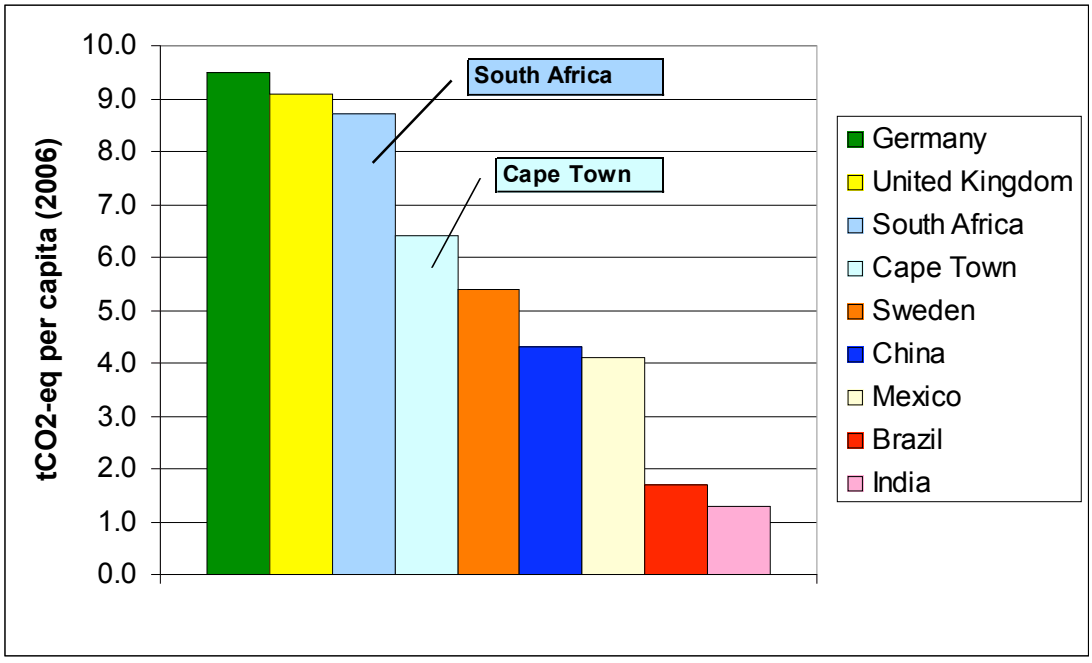


Figure 5. Global CO_2 emissions per capita, 2006 (Source: World Bank)

Both national and local governments have developed legislation and policies to mitigate climate change, information about which can be found in Sections 5.1 and 5.2 respectively.

3. CAPE TOWN SIZE, DEMOGRAPHICS AND ECONOMICS

The City of Cape Town (CCT) municipality is situated on a peninsula in the south west of South Africa. It has an area of 2,499km^2 and a coastline spanning 294km. The city is in the Western Cape Province and at the latest census (2001) it held 65% of the province's population. There are 3.4 million living in Cape Town, with an overall population density of

12.28 people/ hectare. The city is developing at an average rate of 1 232 hectares per year, and there is a need for 15 000 to 18 000 new households every year (CCT, 2009a). There are currently roughly 1 000 000 households in the city, and 133 600 of these are comprised of informal dwellings (Graham 2010). The city has a housing backlog of approximately 330 000 units. Population densities are highest in low-income residential areas, and informal settlements, like Khayelitsha, have more than 150 people to a hectare. (Turok & Sinclair-Smith, 2009)

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 (historically white group areas) and very high density areas on the outskirts of the city, where informal settlements are growing rapidly.

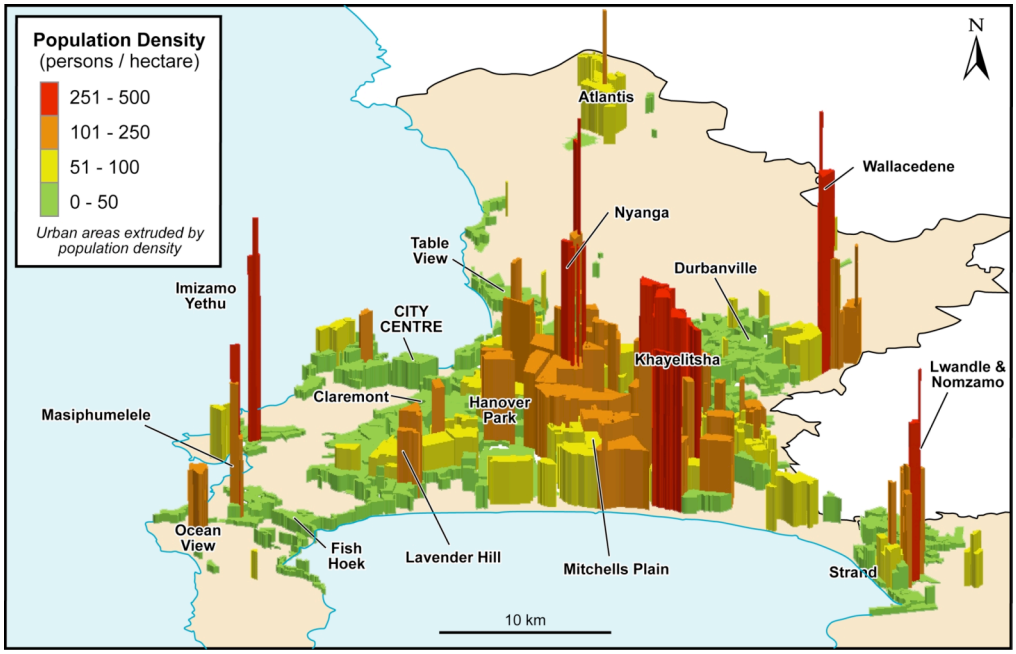


Figure 6. Population density per square kilometre by suburb, Source: Turok & Sinclair-Smith, 2009

Between 1996 and 2001 Cape Town's population has grown fairly rapidly with an increase in population of 330 000 people, at an annual average growth rate of 2.58%. (CCT Census; 1996 and 2001) Population growth projections are at 4% per year. Formal settlement growth is increasing by 1.7% a year, but informal dwelling growth by 13% per year. (CCT, SDI and GIS)[3] Informal dwellings include back yard shacks, and the nature of informal settlements makes it hard to establish population size and growth accurately.

The Cape Town metropole constitutes the second largest economy in terms of gross domestic product (GDP) in South Africa, contributing 11.1% to the national GDP and accounting for 76% of provincial turnover (CCT, 2009a.) The city's economy is heavily reliant on the tertiary sector, (finance and business services, trade, catering, accommodation etc) which contributes 58% to the gross geographic product (GGP). The secondary sector, (manufacturing, electricity, water, construction etc) contributes ±40% to the GGP. The tertiary sector and the secondary sector provide 55% and 43% employment opportunities, respectively (CCT, 2003a.) The primary sector does not make a significant contribution to the GGP or on employment opportunities (CCT, 2008a.) Unemployment levels in the city are high, particularly amongst communities in informal settlements. Unemployment in the city has grown from 13% in 1997 to almost 23% in 2004, with a drop in 2005 to 20,7% (CCT, 2006a).

[3] SDI and GIS – Strategic Development Information and Geographic Information System department

The Democratic Alliance (DA) has been the governing party in Cape Town since 2008, and in 2009 the DA took over from the African National Congress (ANC) as the provincial government. Since 2004 there have been a lot of changes in City government, which has led to high levels of uncertainty, resulting in poor progress with implementing policy.

4. CAPE TOWN ENERGY PICTURE

4.1. Energy supply and consumption

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 the City of Cape Town in 2007 was 128 million GJ (CCT, 2010), and energy consumption per capita in 2004 was 44GJ/capita (SEA, 2006.) Much of Cape Town's energy is consumed as electricity, see Figure 7. The South African economy is an energy intensive one, as much of it centres around industries such as mining and smelting. Cape Town's industries are not as intensive, using 5% of the energy consumed to contribute 11.1% of the GDP.

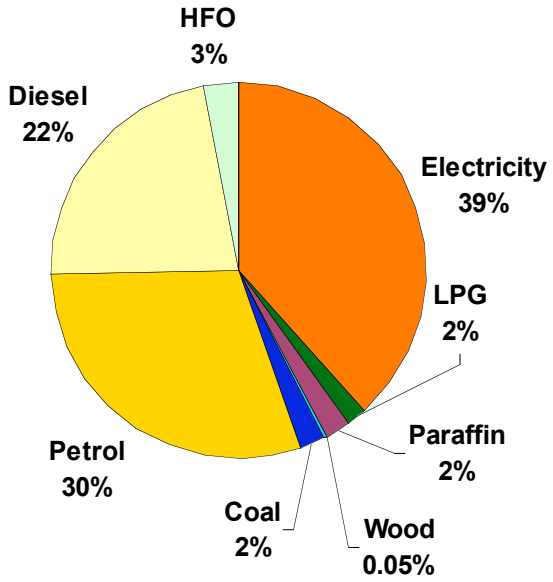


Figure 7. Energy consumption by energy source for 2007 (CCT, 2010)

The City of Cape Town receives a very small percentage of its electricity from renewable sources. The only wind farm in South Africa is situated close to Cape Town, and the City buys all the electricity produced by the wind farm through a power purchase agreement. It has a generation capacity of 5.2MW, and hydro-electric power is used to manage the province's peak demands through a pumped storage installation.

The City produces very little of its own electricity, and so most of the electricity requirements are met through purchasing electricity from Eskom. Cape Town electricity distribution within the metropolitan area is split between the City (75%) and Eskom (25%), as is shown in Figure 8 below. Eskom supply areas consist of predominantly low income households. (CCT, 2006b) Unlike many cities across the world, The City of Cape Town has very little independence in terms of electricity supply, and is very reliant on national production.

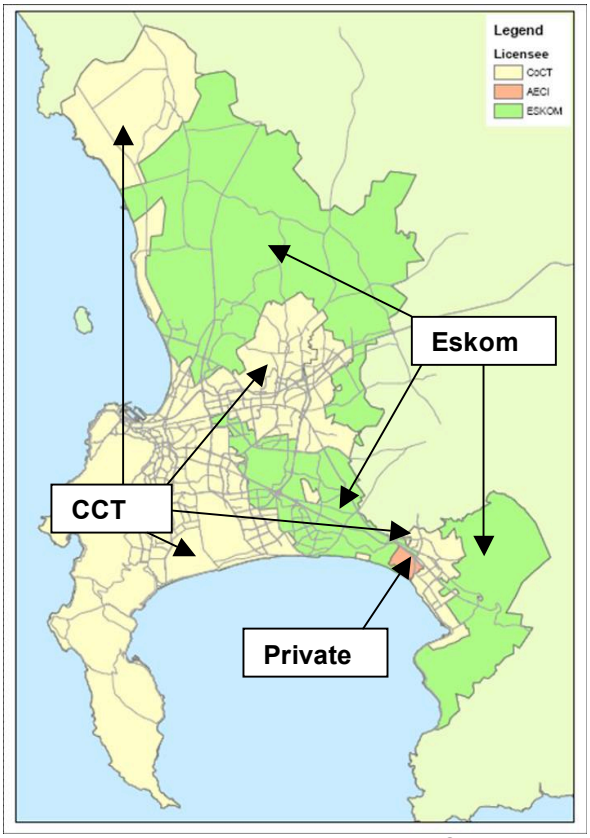


Figure 8. Electricity distribution map (Source: Electricity Department, CCT, 2010)

Energy security is of great concern in Cape Town. Between 2006 and 2008 Cape Town experienced extensive load shedding. Most of the electricity used in Cape Town is produced in the north east of South Africa, and transmission lines span about 1600km. This results in enormous inefficiencies, and up to 17% of energy is lost in transmission. There are also enormous maintenance costs involved. Because of Cape Town's remoteness from generation, the city is often the first to experience load shedding, and the social and economic impact of this has made energy security a priority.

4.2. Sectoral consumption

4.2.1. Residential energy consumption

The residential sector accounts for around 18% of total energy consumption using 24 million GJ in 2007 (CCT, 2010), and the consumption of energy differs dramatically depending on the level of income for the household. A low-income household could spend up to 25% of their monthly income on meeting their energy requirements, with most of the energy required for cooking. Mid to high income households typically spend 3-5% of their monthly income on energy, with the majority of the energy being used in water heating.

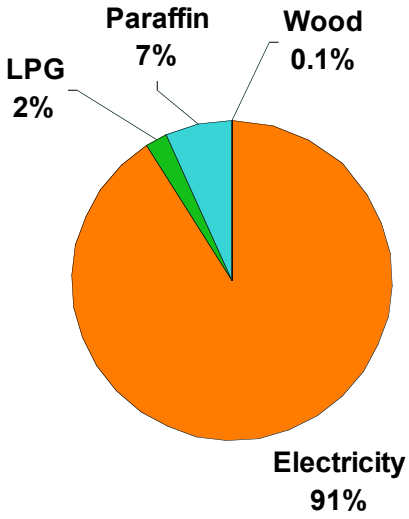


Figure 9. Energy consumption by source in the residential sector, 2007 (CCT, 2010)

Most households within Cape Town have access to electricity, which makes up 91% of all residential energy consumption. Paraffin is used extensively within low income households (including those that are electrified) for cooking, lighting and heating, as shown in Figure 10.

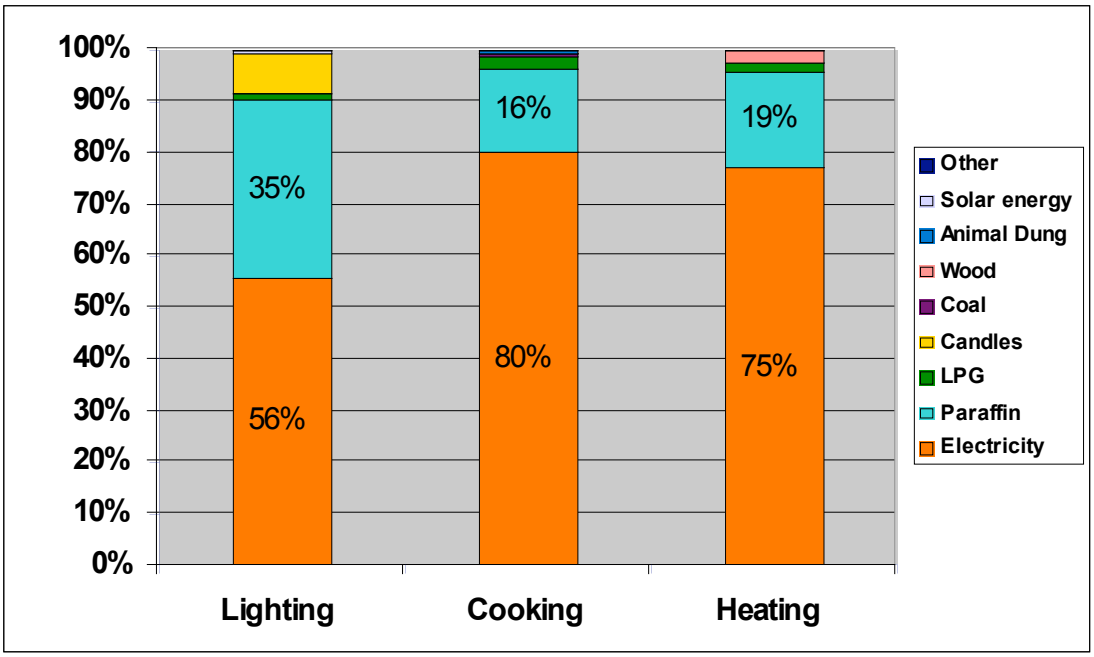


Figure 10. Energy mix in households, 2004 (SEA, 2006)

4.2.2. Industrial and commercial energy consumption

Industry and commerce consumed 39 million GJ in 2007, and industry accounts for 46% of consumption and commerce for 54% (CCT, 2010.) Local government accounts for 1% of total consumption, and used 1.7 million GJ in 2007.

A recent study of 31 015 commercial customers provided an electricity consumption breakdown which is shown in Figure 11 (Marklew, 2010). Most electricity in the commercial sector is used for lighting and cooling. Secondary industries' energy requirements vary considerably, as types of industry ranges from oil refineries to metal plating and textile factories. 10% of the city's total electricity consumption is used on the 40 largest

commercial and industrial companies, who consumed 1 092GWh of a total of 10 612GWh in 2009.

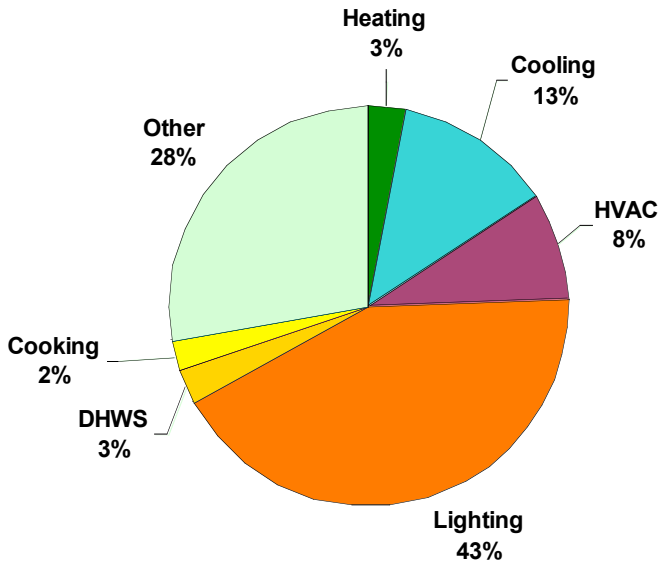


Figure 11. Electricity consumption in the commercial sector (Marklew, 2010)

There is an active informal sector which has a considerable economic impact, providing 12% of GGP and 18% of total employment. Detailed information regarding energy consumption in this sector is, however, not available.

4.2.3. Transport

Transport accounted for 50% of total energy consumption in 2007, totalling 64 million GJ. The majority of all transportation is powered by fossil fuels, as petrol provides 59% and diesel 39% of total energy requirements. (CCT, 2010) City growth, poor public transport provision and the location of informal settlements far from the city centre have resulted in long daily commutes, and all modes of transport are subject to heavy congestion.

The modal split across the City is 44%:48%:8% (private: public: walk/other.) There is evidence that public transport has been losing ground against private vehicle usage in the city. A Household Interview Survey carried out by the City of Cape Town Transport Branch staff in August 2004 to establish commuter travel patterns confirmed the change in travel pattern from public transport to private transport. The study reflected an increase in private vehicle usage of approximately 4% over 13 years from 1991 to 2004.

The city is heavily dependent upon road based transportation, as the railway infrastructure is not sufficient to meet demand; only 4 out of the 17 rail service lines offered are currently meeting demand levels. Over 1,1 million passenger trips are made in the City of Cape Town by rail, bus and minibus-taxi per day (this excludes metered taxi). Rail accounts for 53% of daily public transport trips, minibus-taxi 29%, and bus 18% (Current Public Transport Record 2004/2005.) Rail usage is declining, largely due to competition from minibus taxis and from a lack of expansion in railway infrastructure. Bus usage has also decreased in favour of minibus taxis, but the current development and construction of the Bus Rapid Transport system is designed to reverse this trend (CCT, 2009b).

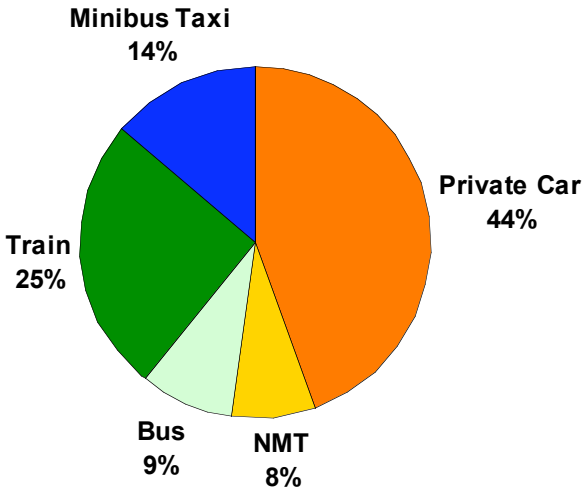


Figure 12. Transport modal split, 2004/2005, (CCT, 2006c); (NMT: Non Motorised Transport)

4.3. Green house gas emissions

An LTMS study is being carried out for the City of Cape Town. Like the rest of South Africa the majority of Cape Town's carbon emissions are associated with its electricity consumption (electricity generated in the north east of the country and used in Cape Town is of course calculated in the city's carbon footprint). Burning low grade coal to generate electricity contributes to most of the city's CO_2 emissions, Figure 13. Transport uses almost half of energy resources, but is only responsible for around 29% of CO_2 emissions (oil having a lower carbon coefficient), see Figure 14.

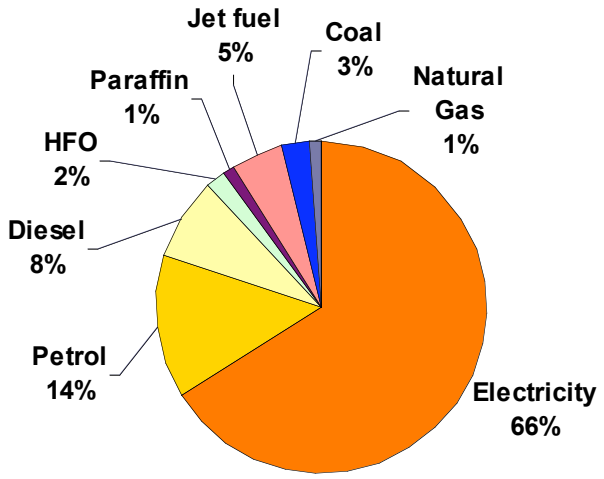


Figure 13. Cape Town carbon emissions by energy source (CCT, 2008b)

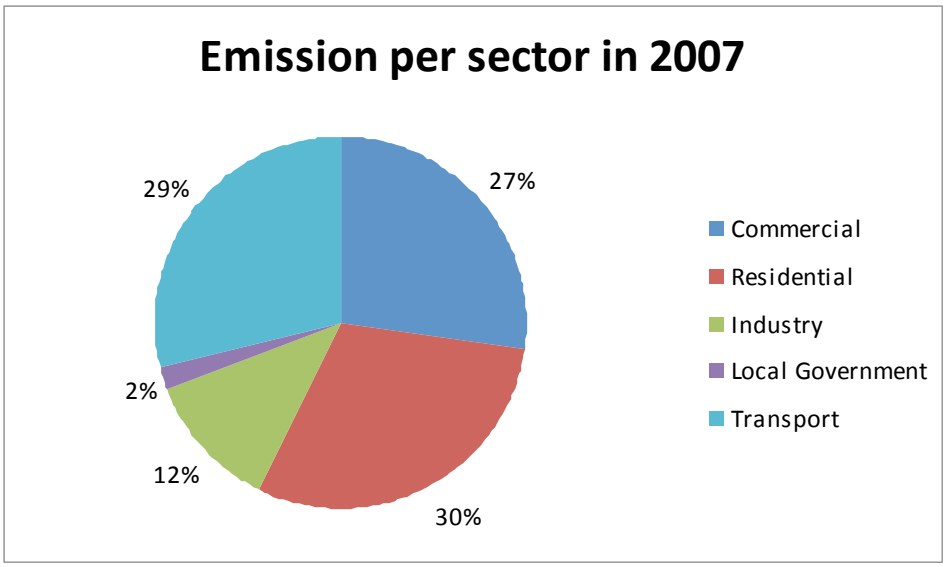


Figure 14. Emissions produced by sector (CCT, 2010)

For the 2007/08 City of Cape Town 'State of Environment' report, 2006 levels of CO_2 and CO_2 equivalents were calculated by adding up emissions produced through the use of electricity, petrol, diesel, paraffin, LPG, jet fuel, heavy fuel oil and coal. Additionally, emissions from landfills and wood burning accounted for approximately 1% of the total. Figure 15 below shows the increase in tCO_2-eq produced per capita from 2002 to 2006. (CCT, 2008b) The current LTMS study will provide better data.

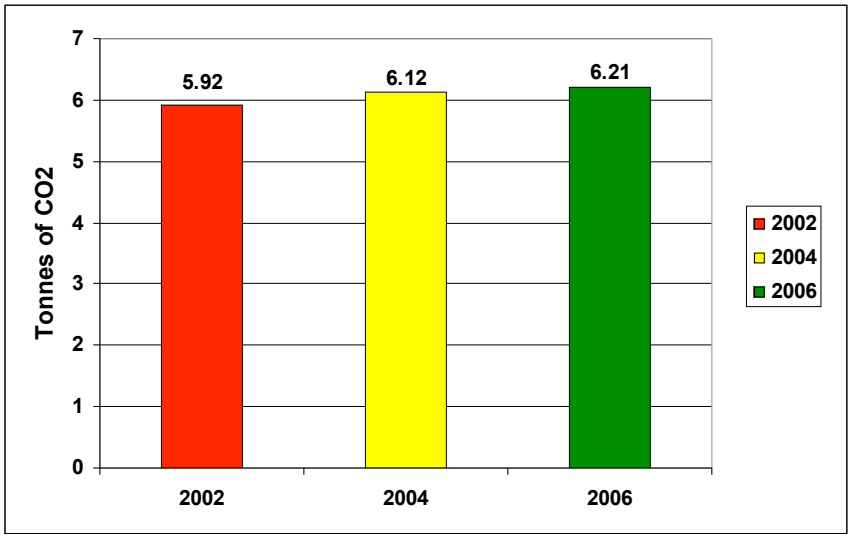


Figure 15. Per capita CO_2 and CO_2 equivalent produced by Cape Town (CCT, 2008b)

Methane

The Athlone waste water treatment works (AWWTW) processes residential and industrial waste from the surrounding areas. Biogas produced from primary digesters in the water works includes approximately 65% methane, and this is currently vented into the atmosphere without flaring. The result is that $50tCO_2$-eq of tonnes is being released into the atmosphere every day. (AGAMA, 2008) The potential exists to use this methane to heat the digester and still have enough energy to generate 6.9GWhe/a.

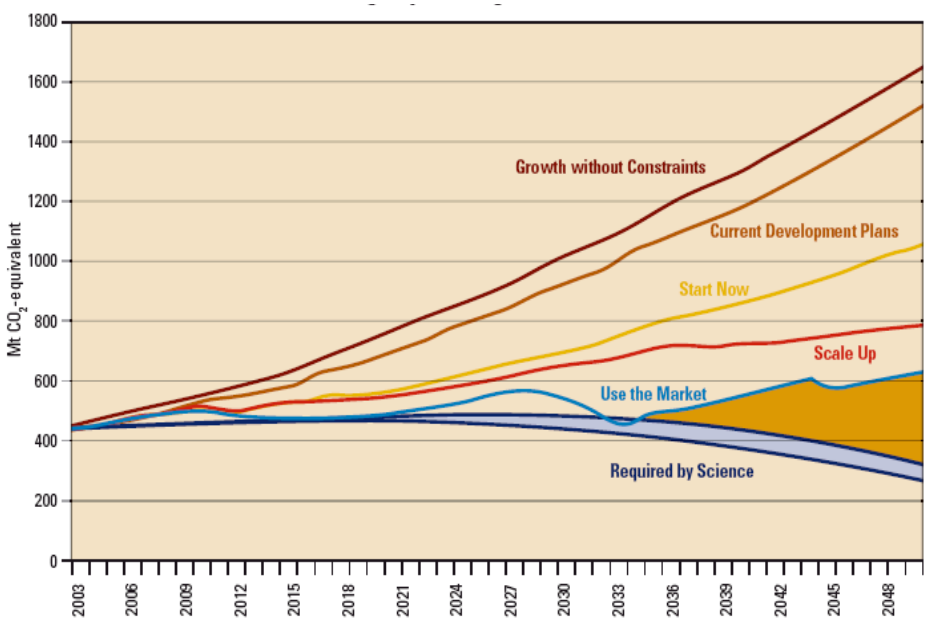
Methane quantities vented from landfills around Cape Town are not accurately known, but City departments are investigating the possibility of flaring the methane, with an ultimate aim of electricity generation.

5. POLICIES

5.1. National policy

South Africa has recognised the need to address the issue of climate change, and the Long Term Mitigation Scenario (LTMS) study mentioned in section 2.2 was initiated as a result. "The purpose is to outline different scenarios of mitigation action by South Africa, to inform long-term national policy." (DEAT, 2007a)

The LTMS has defined certain scenarios within South Africa, with an aim of identifying what mitigating actions are required to achieve what is required by science, see Figure 16. Several targets have been set by government, see Table 2, and the City of Cape Town's targets are set to comply with, and potentially exceed, what is required nationally.



Start Now	Suggests actions that save money over time.
Scale Up	Suggests further extension of the actions in Start Now, but adding more wedges with positive cost.
Use the Market	Additional to or replacing the first two options, suggests tax and incentive packages.

Figure 16. Emission forecast for growth without constraints and for what is required by science (DEAT, 2007a)

The 'Start Now', 'Scale Up' and 'Use the Market' measures are all necessary interventions if South Africa is to reduce emission levels. The area highlighted orange in the graph above is unachievable with current technologies, and it is expected that inventions and options available from 2030 onwards will be able to help in achieving what is required by science.

National policies aim to increase energy efficiency and to reduce total energy demand by 12% by 2015. There are plans to diversify the source of energy production, with an aim of increasing energy security. However the initial investment costs associated with setting up renewable energy suppliers together with the abundance and low cost of fossil fuels, particularly coal, have resulted in smaller incremental steps towards renewable energy development. South Africa's total electricity consumption for 2008 was around 224 000GWh, and the goal is for "10 000 GWh (0.8 Mtoe) of renewable energy [to contribute] to final energy consumption by 2013." (DME, 2003) It is estimated that only 1% of this will come from wind, the rest from biomass and landfill gas projects, and most of the projects will not be in the Western Cape area. However, after 2013 the Department of Energy's projection states that

the majority of new renewable energy will have to come from wind power. In the medium and long-term solar thermal, solar photovoltaic and wave energy will also play a significant role. (CCT, 2006b)

Sector	Energy Demand Reduction by 2015
Transport	9%
Residential	10%
Commerce and Public buildings	15%
Industry and mining	15%
Overall	12%

Table 2. Energy Demand Reductions Required by Sector in South Africa by 2015

South Africa announced its commitment to addressing CO_2 emissions at the start of the United Nations Conference on Climate Change (UNFCCC) in Copenhagen this year. "CO_2 emissions are to peak between 2020 and 2025; CO_2 emissions reduced to 34% below expected levels by 2020 and 42% by 2025" (using a business-as-usual trajectory as a baseline.) These targets are conditional on the receipt of funding, technology transfer, and capacity building.

The National Energy Regulator of South Africa (NERSA) has been established to oversee the electricity, piped-gas and petroleum pipeline industries. Within the electricity industry NERSA is responsible for regulating licensing and compliance, pricing and tariffs, electricity infrastructure planning and regulation reform. NERSA is developing the Power Conservation Programme (PCP). The PCP will make energy conservation mandatory, and will target the biggest electricity consumers. The details of the programme are yet to be finalised, but the intention is to begin with the top 500 electricity users in South Africa, which will need to reduce consumption by 10% or face penalties.

Funds have been made available for energy efficiency measures and campaigns. Eskom has been appointed a Demand Side Management (DSM) budget of R5 billion to spend over three years. This has been raised through electricity tariffs collected nationally. National Treasury allocated R1.5 billion to energy efficiency and DSM measures in 2009, as well as R250 million for projects such as the rollout of compact fluorescent light bulbs, the retrofitting of government buildings and street illumination. (National Treasury, 2010) A portion of this funding is for municipalities to implement energy efficiency measures

A detailed description of all national policies and laws relating to energy can be found in Appendix A.

5.2. Local policy

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 the local energy crises, clearly marked by rapidly increasing oil prices and by South Africa's electricity supply shortages, have brought in a new era which requires that the City take a central role in managing its 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, the 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 wellbeing of people and the natural resources on which they depend at the very top of the agenda. During 2008, the City reviewed 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 in 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 City's Energy and Climate Change Strategy of 2006 sets out the vision, objectives, targets, measures and projects for all City energy activities. It is based on the State of Energy Report of 2003, which maps out Cape Town's energy profile, and also on issues such as the city's energy security, residents' access to energy services and vulnerability to climate change impacts.

Alongside this, the City developed the Framework for Adaptation to Climate Change in the City of Cape Town (FAC_4T). In 2008, the City made "Energy for a sustainable city" one of the priority strategic focus areas of its Integrated Development Plan (IDP), 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 is supported by an Executive Management Team Subcommittee on Energy and Climate Change, and three crosscutting work streams, which respectively address energy security, adaptation and awareness, see Figure 17.

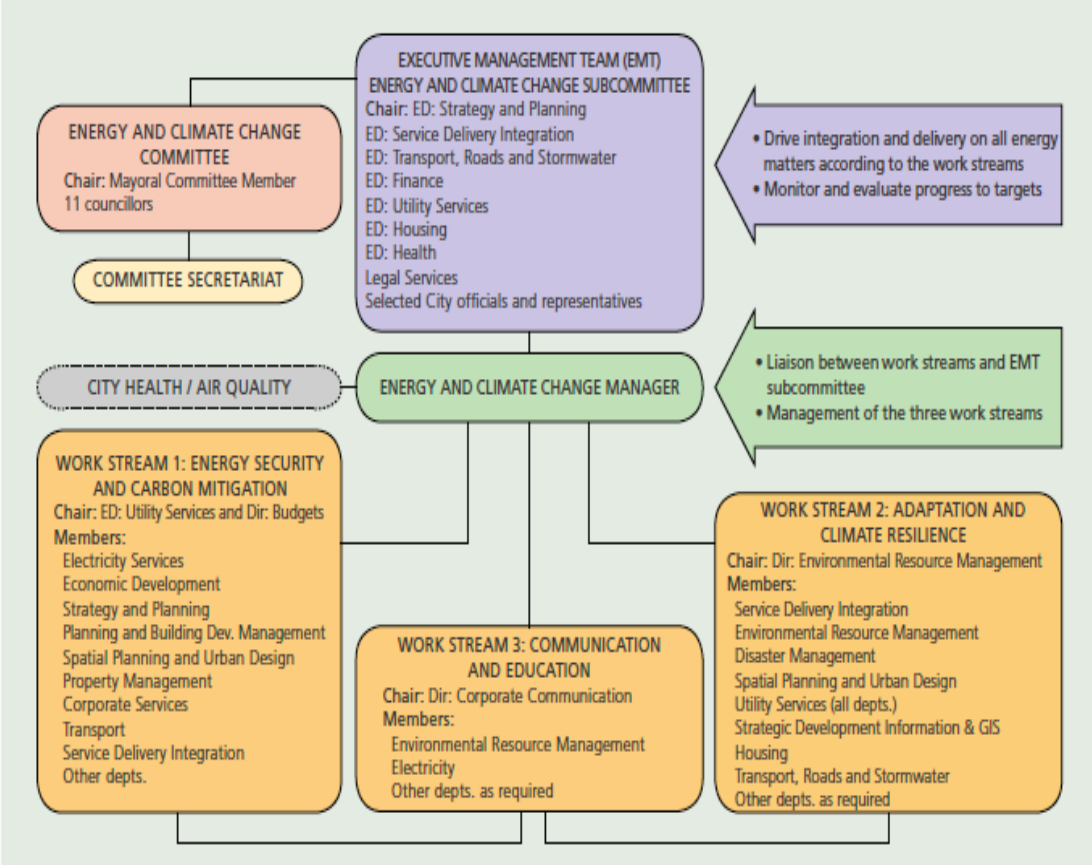


Figure 17. CCT institutional setup to address energy and climate change 2008/9

Due to political changeover and a lack of proper policy drivers, the Energy Committee and relevant work streams were only set up in 2008; two years after the City's targets were established. These targets are outlined in Table 3 below, together with provincial and national targets. Because of the late formation of the Committee, the deadline for many of the City's targets has passed. This can be seen in Table 3 below, where many of the targets are due to be reached in 2010. New targets and objectives have been formulated, and actions to be taken are outlined in the Road maps section below.

Sector	City of Cape Town	Western Cape Province	National
Source	City of Cape Town's Energy and Climate Change Strategy, 2006	Sustainable Energy Strategy for the Western Cape, 2007	White Paper on Renewable Energy Policy, November 2003
			Energy Efficiency Strategy, March 2005
			NCCRS – Long Term Mitigation Scenarios, June 2008 (Cabinet)
Overall		15% Overall energy efficiency against business as usual scenario 2014	12% Final energy demand reduction by 2015
Residential	10% of City owned housing stock to have Solar Water Heaters (SWH) by 2010, 50% by 2020	10% Residential energy efficiency by 2014	10% Energy demand reduction by 2015 within the residential sector
	10% of all households to have a solar water heater by 2010		
	All new subsidy housing to have ceilings from 2005;		
	All existing homes to be retrofitted with ceilings by 2020		
	30% of all households to use efficient lighting by 2010, 90% by 2020		
Transport	By 2010 (from 2005 levels)	10% Carbon emissions reduction (off 2000 levels) by 2014 in the transport sector	9% Energy demand reduction by 2015 within the transport sector.
	10% Increase in rail transport share of modal split		
	10% Decrease in private vehicles commuting into city centre		
	Non-motorised transport (NMT) strategy operational by 2015		
Commerce	10% Increased energy efficiency in commercial facilities by 2010	11% Commercial energy efficiency by 2014	15% Energy demand reduction within the commercial and public building sector by 2015
Industry	10% Increased energy efficiency in industrial facilities by 2010	20% Industry energy efficiency by 2014	15% Energy demand reduction within the Industry and mining sector by 2015

Energy Supply	100% of formal households connected to electricity from 2005	15% Renewable energy generation (electricity only) in the Western Cape off the 2006 generation baseline2014	10 000 GWh (0.8 Mtoe) of renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar & small-scale hydro.
	90% of informal households connected to electricity by 2010		
	CO_2 emissions reduced by 10% from 2005 levels by 2010	15% Carbon emissions reduction (off 2000 levels) 2020	CO_2 emissions to peak btw 2020-2025; CO_2 emissions reduced to 34% below expected levels by 2020; 42% by 2025 (NCCRS)
	10% Renewable Energy Supply by 2010	10% renewable energy purchased by Provincial Government 2010	
Government Operations	12% Energy efficiency in all municipal buildings by 2015	50% Government vehicles converted to cleaner fuels by 2008	

Table 3. Energy Targets for the City of Cape Town, Western Cape Province and National

6. ROAD MAPS

The formation of the Energy Committee has helped to initiate the development of an Energy and Climate Action Plan (the Action Plan). The Action Plan compiles both existing and proposed City energy and climate change projects across all Directorates and Departments.

The Action Plan is under constant development, and will be aligned with the outcomes and findings of the LTMS study being conducted for the City. Projects identified in this process will be prioritised according to an overarching goal: energy security, and first and second level criteria (not in hierarchical order), see Figure 18. Business plans will then be developed for projects which are seen as a priority.

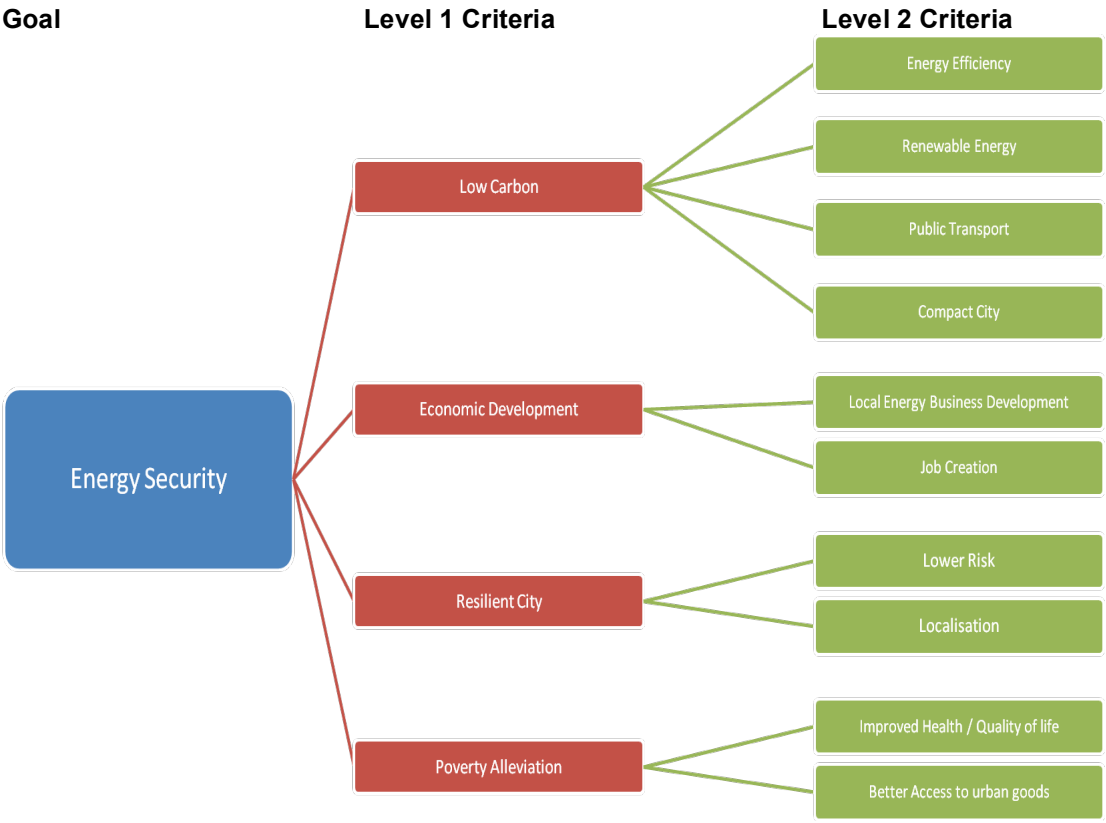


Figure 18. Overall goal, and criteria, used in the prioritisation of programmes in the Action Plan, 2010

Objectives and projects are to be placed onto corporate and directorate scorecards, and the progress will be reviewed on a regular basis through the implementation of a monitoring and evaluation system, across all the scorecards. An overall review of the Action Plan will be conducted annually, to ensure that all targets and projects are up-to-date and relevant.

The Action Plan currently consists of ten key objectives, outlined in Table 4. These have replaced the City's missed deadlines mentioned previously, and found in Table 3 above. 51 Programmes have been developed to achieve the objectives, and 31 of these are listed as priority. There are over 100 projects that fall within these programmes, and these will be prioritised after the LTMS study is complete.

Objective 1: City-Wide 10% Reduction in Electricity Consumption on Unconstrained Growth by 2012 (3.3%/annum 2010-2012) all growth in demand to be met by cleaner / renewable supply	
1.1	Electricity consumption reduction : mandatory
1.2	Solar Water Heating
1.3	Metering
1.4	Limited electricity supply to new developments
Objective 2: 10% Renewable and Cleaner Energy Supply by 2020; all growth in electricity demand to be met by cleaner/renewable supply	
2.1	Renewable Energy large scale supply

2.2	Renewable energy and cleaner energy supply from Council operations
2.3	Renewable energy supply at Eskom rates to City - preparation of a request for proposals
Objective 3: Council Operations: 10% Reduction in Energy Consumption on Unconstrained Growth by 2012 (3.3%/Annum 2010-2012); all growth in demand to be met by cleaner / renewable supply	
3.1	Buildings retrofit
3.2	Upgrade existing CCT rental stock
3.3	Greening the City Procurement Policy
3.4	Energy efficient technologies – Division of Revenue Act funding
Objective 4: Compact resource efficient city development	
4.1	Spatial Development Framework Plan
4.2	Densification around railway stations
Objective 5: Sustainable transport system	
5.1	Integrated Rapid Transit System
5.2	Non-Motorised Transport
5.3	Metropolitan Transport Forum
Objective 6: Adapting to and building resilience to climate change impacts (city wide)	
6.1	Coastal development guidelines
Objective 7: More resilient low income/vulnerable communities	
7.1	Low Income Energy efficient housing + densification
7.2	Greening low income housing units
7.3	Ceilings in low income housing
Objective 8: Development of carbon sales potential of all projects	
Objective 9 Local economic development in energy sector	
9.1	Renewable energy business in Cape Town: Study
9.2	Funding application for establishment of Renewable Energy agency: WC/CCT
Objective 10: Awareness: E&CC communications and education programmes (driven by Objectives 1-9)	
10.1	Electricity Saving Campaign

10.2	Energy Efficiency Forum for Commercial Buildings
10.3	Schools / Youth
10.4	Smart Living campaign
10.5	Staff training CCT
Overall: Energy and Climate Change resources, research, development and monitoring	
11.1	Energy & Climate Change research and development
11.2	Research and Development
11.3	Energy data management, monitoring and evaluation

Table 4. Objectives and programmes prioritised under the Action Plan, 2010

6.1. Objectives and Suggested Action Plans

The Action Plan provides detailed information about what projects are currently underway or to be initiated, which department is responsible for its success, and how the project will be financed. Detailed extracts of the Action Plan can be found in Appendix B.

Objective 1: City-wide 10% reduction in electricity consumption on unconstrained growth by 2012 (3.3%/annum 2010-2012); all growth in demand to be met by cleaner / renewable supply

The Power Conservation Programme rollout, driven by national legislation, is expected to impact the top 500 electricity consumers in South Africa. The City of Cape Town does not have a large energy intensive industrial sector, and as such only a small proportion of the 500 companies affected are expected to reside within the City. If the 40 biggest electricity consumers within the City are required to cut their consumption by 10% the City's electricity consumption would decrease by an estimated 1%.

A Request for Proposals is being developed for the private sector to present business models on how a mass rollout of solar water heaters (SWH) can be achieved. The target market includes mid to high income households. 27% of energy used in residences is to heat water and current plans to rollout solar water heaters could lead to enormous electricity savings. A four year project has been initiated, with a goal of providing 300,000 solar water heaters. This has the potential to save 600GWh per year.

The City is launching an Electricity Saving Campaign, which is expected to lead to a decrease in electricity consumption by 1% per annum. The goal is to instigate consumer behavioural change, through increased consumer awareness.

The City of Cape Town will be limiting the electricity supply to new developments, in an attempt to encourage energy efficiency as part of the design process.

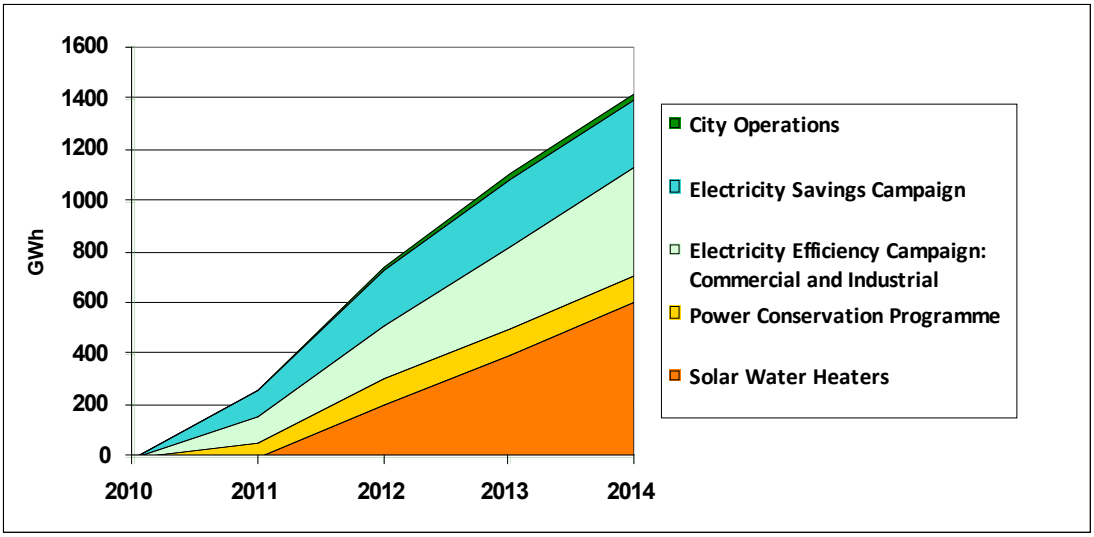


Figure 19. Electricity Saving Campaigns showing expected electricity consumption reductions by 2014

Objective 2: 10% Renewable and cleaner energy supply by 2020; all growth in electricity demand to be met by cleaner/renewable supply

The City of Cape Town purchases the electricity produced by the Darling Wind Farm, north of Cape Town. The City then resells this as 'Green Electricity' with accompanying certificates. Cities across South Africa are currently in discussion with national government regarding Renewable Energy Feed in Tariffs (REFIT). Upon resolution, Independent Power Producers (IPP) are hoping to be able to feed their electricity directly into the national grid.

Various options are being considered by the City to extract energy from waste. These include waste-to-methane gas, waste-to-energy, co-generation, and sewerage gas energy generation. The recovery of landfill and waste-water treatment plant methane is of added significance given that methane is the major contributor to the greenhouse gas emissions from City-owned facilities. Currently, some sites vent the methane, not even flaring it.

Small scale renewable energies are being considered, such as Solar PhotoVoltaic panels and small-micro wind turbines. Methods of making renewable energy accessible and affordable to City residents are being investigated.

Objective 3: Council operations: 10% reduction in energy consumption on unconstrained growth by 2012 (3.3%/Annum 2010-2012); all growth in demand to be met by cleaner / renewable supply

The City controls, or has a direct impact on, a host of functions and activities. It is responsible for providing services to a population of 3.4 million people. It is also the single biggest energy user in Cape Town and the single biggest employer (25 000 staff members). Implementing efficiency measures in municipal activities has a considerable effect on financial savings and carbon savings, see Table 5 below.

Energy Source	Savings Method	Savings/Year (Rand)	Savings/year (tonnes CO_2)
Petrol Fleet	Improved Management	2 642 000	1 943
Diesel Fleet	Improved Management	5 825 000	5 688

Building Electricity Use	Lighting Efficiency	2 792 000 Payback ~ 3 yrs	13 354
Water Supply and Treatment Electricity	Aeration Efficiency and Variable Speed Pumps	1 039 000 Payback ~ 4yrs	4 970
Street/Traffic Light Electricity Use	LED traffic signal retrofit	595 000 Payback ~ 3yrs	2 844
Total		**12 893 000**	**28 799**

Table 5. Summary of total identified energy saving potential with the City of Cape Town operations (CCT, 2006b)

The City has numerous municipality buildings, many of whom are very inefficient in their day to operations. Plans are in place to conduct energy audits on City buildings, and to take necessary steps to increase efficiency. These include replacing light bulbs with compact fluorescent lights, instigating behavioural changes in employees and implementing building management systems.

The City of Cape Town owns 40 000 rental units, and plans to upgrade 7 700 of these to be more energy efficient. These plans include installing ceilings, changing light bulbs, promoting more efficient water heating and water usage habits. There are also health risk reductions that would result from better waste management, and food security improvements resulting from the creation of community gardens.

The Energy Action Plan aims to improve the City's procurement process, by incorporating 'Green' criteria. This will ensure that improvements made to current practices and infrastructure will be maintained.

Objective 4: Compact resource efficient city development

The City of Cape Town aims to pursue a compact form of development, where growth is directed towards areas suitable for development and away from important resource areas and hazards, in order to improve efficiency and sustainability. (CCT, 2009a) This will aid in making better use of the city's resources, and will make public transport more accessible.

Objective 5: Sustainable transport system

The transport sector is responsible for a third of all CO_2 emissions in Cape Town, and it is the main contributor to local air pollution factors, such as NO_2, SO_2, and the 'brown haze' phenomenon. The City of Cape Town has several plans in place to reduce the impact of transport on the environment.

Cape Town has a relatively extensive but poorly integrated public transport system. The City of Cape Town is presently engaged in the detailed planning and the first phases of implementation of an Integrated Rapid Transit (IRT) system. The rail system plays a major role while the bus service provides access across the greater part of the metropolitan area. Service frequencies are very low on many routes and night services are extremely limited. Both rail and bus services are subsidised. Unsubsidised services are provided by minibus taxis, which operate over most of the metropolitan area, especially in low income and high-density residential areas. The IRT system is intended to provide safe, frequent and consistent affordable public transport, which is accessible to many people. (CCT, 2006c)

Cape Town has a significant carless population. This together with the need for learners to get to and from school, and the fact that the City is subject to congestion and vehicle related pollution problems is reason enough to promote non-motorised transport. Bicycle and pedestrian routes are being constructed and extended as part of the 'Non-Motorised Transport (NMT) Strategy.' Bus stops will be linked up with the NMT system, so that journeys can be continued without interruption.

Objective 6: Adapting to and building resilience to climate change impacts

Because Cape Town is surrounded by coastline it is particularly vulnerable to sea level rise and storm surges. Cape Town also has a number of low-lying areas with high water tables. These areas are particularly prone to flooding. A number of settlements exist in these areas and people living in them are at serious risk. Due to the water stress currently experienced in Western Cape Province as a result of a drop in annual rainfall, the demand for water for residential, industrial and agricultural use makes the City particularly vulnerable to the effects of climate change.

The City of Cape Town has developed the Climate Adaptation Plan of Action (CAPA). Coastal protection zones have been designated, and the City is limiting the level of construction along the coastline. Sea walls have been and continue to be upgraded.
Food and water security are also of concern, and form part of the CAPA. Adaptation strategies include water restrictions and tariffs, leak reduction and awareness campaigns. (CCT, 2006d)

Objective 7: More resilient low income/vulnerable communities

Energy poverty is a high priority and one of the key focus areas in Cape Town's Energy and Climate Action Plan. Low-income houses can use up to 25% of their income on energy requirements. Cape Town has led the country in the implementation of a 'LifeLine tariff', where 50kWh of free electricity is given to houses using below 450 kWh per month. However households which have access to electricity may continue to use paraffin, as the cost of electricity and electrical appliances can be prohibitively expensive.

There are significant health related implications to not having access to safe and affordable energy. Paraffin and candles are responsible for devastating fires which spread quickly through informal settlements, leaving hundreds of families homeless. Paraffin can be dangerous as many children have confused it with a drink and have swallowed it, and the smoke from burning fuels inside, without proper ventilation, can result in respiratory diseases.

Ceilings in low-income houses reduce the need for space heating, and can lessen the amount of fuel burned inside. The IMEP agenda specifies a target of 40% of pre 2008 low income houses to be equipped with ceilings. National government has set targets for a mass rollout of solar water heaters to long income households, which aim to have 1 million solar water heaters installed nationally by 2014. Many communities within the City would benefit from a rollout of this size.

The Kuyasa Clean Development Mechanism (CMD) pilot project was initiated in a low income area, Khayelitsha, in 2002. 2300 houses have been retrofitted with solar water heaters, efficient lighting and ceilings. Further plans are underway to increase the energy efficiency in other communities, with full 'Greening' plans being developed

The Integrated Rapid Transit system which is currently being constructed is aimed at helping to reduce congestion, but another benefit will be lower fares for travellers, many of whom will be travelling great distances from informal settlements into the city. This saving will help to alleviate some financial pressure on low-income households.

Objective 8: Development of carbon sales potential of all projects

As a non-Annex I country under the Kyoto Protocol, South Africa is able to access income through the Clean Development Mechanism. Cape Town has the potential to make significant savings on CO_2 emissions, which could be financially beneficial.

Objective 9: Local economic development in the energy sector

The renewable energy industry creates more jobs on average than conventional energy production methods.

Conventional		Renewable	
Coal (now)	0.3	Solar Thermal	10.4
Coal (future)	0.7	Solar Panels (PV)	62
Nuclear Pebble Bed	0.1 0.2	Wind	12.6
Gas	0.1	Biomass	5.6
Liquid Fuel	0.1	Landfill Gas	23
Hydro	1	Ocean Energy	1

Table 6. Number of jobs created per GWh produced [AGAMA 2003]

The City aims to promote and support entrepreneurship in the renewable energies industry, and the City is fostering partnerships with relevant organisations, such as the South African National Energy Development Institute (SANEDI), to achieve this. The development of a labour intensive renewable energy industry could help to promote economic growth and sustainable employment opportunities.

Object 10: Awareness: Energy and Climate Change communications and education programmes (driven by Objectives 1-9)

The City is running a year round programme called the Youth Environmental Schools (YES) Programme. YES serves as a vehicle through which the City's youth can gain knowledge, hands-on skills and respect for their environment. Learners from all backgrounds attend cleanup days, festivals and energy efficiency conferences. YES EduNet is a network which aims to empower and capacitate educators about environmental issues. Selected schools are receiving energy audits and will be retrofitted, with an aim of promoting a concept of 'Green Schools.'

The City of Cape Town is running the Smart Living Campaign. This campaign is to engage with residents of Cape Town through the channel of commercial institutions to disseminate, monitor and evaluate the 'Smart Living Handbook'. The campaign is opening dialogue between business, community and government, creating a platform for partnerships critical to sustainable development.
Another campaign, previously mentioned, is the Electricity Saving Campaign, which will use tools like social marketing, social research and development and tariff increases to reduce the level of electricity consumption.

Overall: Energy and Climate Change resources, research, development and monitoring

The City of Cape Town is researching the Long Term Mitigation Scenarios for the City (LTMS CT), as part of the Climate Change Think Tank on mitigation and adaptation. Together with the World Wide Fund of Nature, South Africa (WWF-SA), the City of Cape Town is conducting a feasibility study of Cape Town being recognised as a Low Carbon Zone.
The accuracy and consistency of data collected is being improved as part of the LTMS CT, and will be an area of focus for the City of Cape Town. Air quality, energy consumption and atmospheric carbon measurements will be monitored and evaluated.

Policies and legislation are being formulated and business plans are being developed to access funds for the proposed projects mentioned above.

6.2. The way forward

Ensuring energy security as well as building a much lower carbon future for the City of Cape Town is a complex and difficult task. The Energy and Climate Action Plan is the first step in accomplishing it. The Action Plan is driven from the City's Integrated Development Strategy across all City departments, and effective implementation of the Action Plan, together with monitoring and evaluation, requires communication and coordination. Critical issues which are being addressed currently are ensuring that the Plan is properly integrated into the City's performance management systems; obtaining additional staff and devising appropriate financing mechanisms and accessing sufficient funding.

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APPENDIX A: INTERNATIONAL AND NATIONAL ENERGY RELATED LAWS AND POLICIES

International energy related laws affecting South Africa	
United Nations Framework Convention on Climate Change (UNFCCC) 1992	This is an intergovernmental treaty developed to address the problem of climate change and which sets out an agreed framework for dealing with the issue.
Kyoto Protocol to the UN FCCC 1997	The Protocol does not commit developing countries like South Africa to any quantified emissions targets in the first commitment period (2008-2012). South Africa ratified in 2002.
Millennium Development Goals 2000	The eight Millennium Development Goals (MDGs) form a blueprint agreed to by all the world's countries and all the world's leading development institutions. One of these goals is to ensure environmental sustainability.
Johannesburg Plan of Implementation World Summit on Sustainable Development 2002	The Plan highlights areas of key importance in terms of meeting sustainable development in terms of economic development, social development and environmental protection. The key focus areas put poverty, sustainable development and Africa high on the global agenda.
South Africa's national energy related laws and policies	
Energy - overarching	
White Paper on Energy Policy for Republic of S.A. (1998)	The White Paper sets out the following: • *Meeting the basic needs of all people*: providing energy for community services such as schools and clinics; increasing electrification of households; improving fuelwood management; making gas and paraffin more affordable; encouraging energy efficient housing design; reducing health and safety problems related to fuel use. • *Promoting economic growth*: promoting the availability of low cost, high quality energy; implementing energy efficiency. • *Promoting a sustainable environment*: monitoring and reducing coal power station emissions; increasing the use of renewable energy; actively promoting energy efficiency.
Integrated Energy Plan (2003)	Published by the DME, this plan is a framework for taking decisions on energy policy and for the development of different energy sources and energy technologies in the country.
National Energy Regulator Act 40 of 2004	To establish a single regulator for electricity, piped-gas and petroleum pipeline industries. The National Energy Regulator of South Africa (NERSA) is funded from a levy on all electricity sales. The role of NERSA includes: licencing generators, transmitters and distributors (and facilitating competition in the industry); approving pricing and tariffs; setting minimum standards for quality of supply and service.
National Energy Regulator's Integrated Resource Plan 2004	The National Integrated Resource Plan (NIRP) provides independent information to support security of energy supply.
National Energy Bill (2004)	This Bill aims to provide for: the establishment of the National Energy Advisory Committee, National Energy Data Base and Information System; integrated energy planning; renewable energy and energy efficiency matters; energy safety, health and environmental matters; energy access by households; and international energy obligations.
Central Energy Fund Act 38 of 1977	Historically focused on management of crude oil and locally produced hydrocarbons. Role is being extended to renewable energy programmes
Energy efficiency	
NERSA's Regulatory Policy for Energy Efficiency and Demand-Side Management 2004	This policy identifies problems of peak generation capacity requirement in the near future and the inefficient end-use of electricity. It also examines the current regulatory mechanisms of implementing energy efficiency and demand side management (EEDSM) programmes through Eskom.
DME Energy Efficiency Strategy	This strategy provides specific targets for reduction in energy demand by 2014

(2005)	within given demand sectors, with an overall target of a 12% national reduction in consumption by 2015. The strategy's 8 goals include: health improvement, job creation, alleviation of energy poverty, reductions in pollution and CO2 emissions, improvement of industrial competitiveness, enhancement of energy security, and the reduction of the need for additional power generation capacity.
South African Energy and Demand Efficiency (SAEDES) Guidelines (DME) 1999	A framework of technical and performance provisions for energy efficiency in new and existing commercial buildings. Conformance is voluntary. They apply to new and existing buildings, portions of buildings and complexes.
Renewable energy	
White Paper on the Promotion of Renewable Energy (2004)	The White Paper addresses four key strategic areas: financial instruments, legal instruments, technology development, and awareness-raising, capacity building and education. It sets a medium (ten-year) target 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. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1667 MW) of the projected electricity demand for 2013 (41539 MW) – equivalent to replacing two (2x 660 MW) units of Eskom's combined coal fired power stations.
Draft Biofuels Industrial Strategy (2006)	Outlines government's approach to policy, regulation and incentives
Electricity	
Electricity Regulation Act (2006)	Establishes a national regulatory framework for the electricity supply industry and makes the National Energy Regulator (NERSA) the custodian and enforcer of the national electricity framework.
Electricity Distribution Industry Restructuring Bill (April 2003)	Provides for the establishment a national framework for the restructuring of the distribution industry, the creation of regional electricity distributors (REDs), and the management of the restructured electricity distribution industry.
Environmentally Sound Low Cost Housing Guidelines (Department of Housing) 1999	The task team focused on the National Housing Programme and no- and very low-cost interventions. Energy efficiency is identified as one of three major aspects to the development of environmentally sound low cost housing. The guidelines are to be incorporated into the Dept of Housing's Norms and Standards.
Nuclear energy	
Nuclear Energy Act 12 of 1999	To provide for the establishment of the South African Nuclear Energy Corporation, a state owned public company.
National Nuclear Regulator Act 47 of 1999	To provide for a National Nuclear Regulator.
Environmental	
National Environmental Management: Air Quality 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.
Disaster Management Act 57 of 2002	• National Disaster management framework must be established by Minister • National Disaster Management Advisory Forum and Management Centre will consist of representatives from local government • Each municipality must establish and implement the policy framework • Each municipality must establish a disaster management centre • This plan must form an integral part of the community's development
National Environmental Management Act 107 of 1998 and Amendment 2003	One of the principles of the Act recognises that sustainable development should consider whether the use of non-renewables is responsible and equitable, and take into account the consequences of the depletion of the resource, and that the use of renewables and their ecosystems of which they are part is not jeopardized.
National Climate Change Response Strategy 2004	This policy document outlines the global and national implications of climate change and clearly indicates the steps or actions to be taken by the government and other players to respond at a national level to the challenges

	posed by climate change.
Draft National Framework for Sustainable Development 2006	Presents a framework for sustainable development in South Africa that includes a national vision, principles, trends, strategic priority areas and implementation measures. It identifies priority areas for strategic intervention including efficient use of natural resources and creating sustainable human settlements. It identifies key energy related risks and trends and lists appropriate energy and climate change related responses.
Draft National Strategy on Cleaner Production and Sustainable Consumption 2005	The strategy is being prepared by DEAT through the implementation of the Johannesburg Plan of Implementation (JPOI), with particular reference to the implementation of recommendations as contained in Chapter 3 on sustainable consumption and production.

(Source: Ward, 2008)