CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

State of Energy Report for Cape Town

2003

Executive Summary

INTRODUCTION

This State of Energy Report provides the 'energy picture' for the Cape Town Metropolitan area. It gives the background and direction for the development of the Cape Town Energy Strategy, which is a component of the City of Cape Town's Integrated Metropolitan Environmental Policy (IMEP). The energy picture is based on sometimes incomplete or old data and information, and as such also identifies these gaps and further areas of investigation.

Energy plays a central role in the functioning of cities. South African cities are, however, very new to the current energy debate and have focused primarily on electricity distribution with little or no coordination across related energy issues.

A local energy strategy will help to institutionalise sustainable energy approaches and practices at the local level, within a framework that has a clear vision and direction. It enables the co-ordination of ad-hoc energy projects and activities, and helps to integrate energy objectives into relevant CCT functions and programmes. It can lead to improved service delivery, save money, assist with employment creation, improve air quality and reduce greenhouse gas emissions.

The development of the Energy Strategy comprises several steps. The first step (this report), gives a picture of the 'state of energy' in Cape Town. It highlights issues that arise from the energy picture and prioritises these issues. As a part of developing this State of Energy Report, a workshop was held with a group of energy experts and the draft document was circulated for comments, the results of which are incorporated herein. The second step is the development of a proposed *Energy Vision and Goals* document for discussion by key stakeholders. The final step is to compile the Energy Strategy based on discussions and inputs received.

ENERGY PICTURE

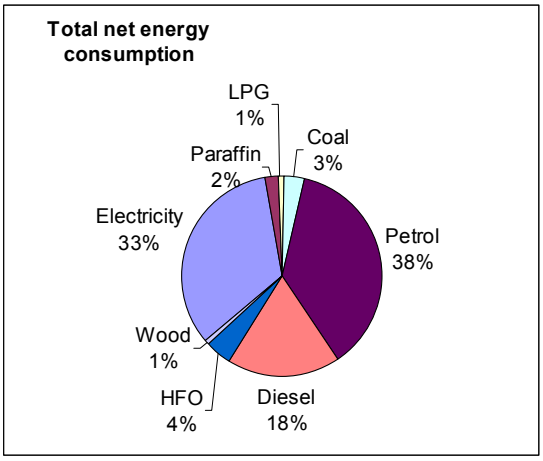
The data segment has been divided into demand and supply sections, with relevant subsections to each as shown in the table.

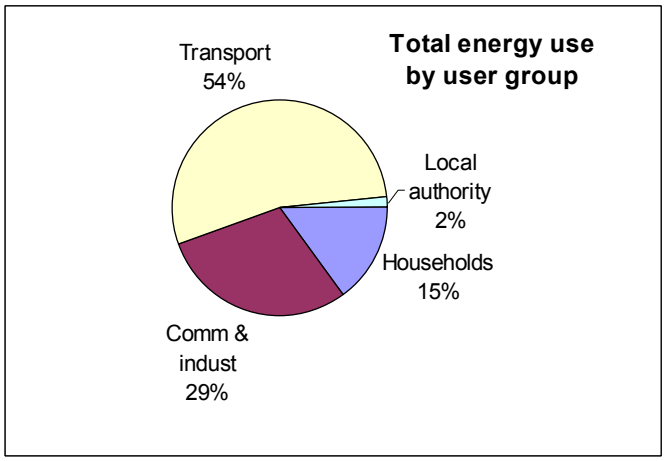
Part 1: Demand sub-sectors	Part 2: Supply sub-sectors
Households	Coal
Commerce and industry	Liquid fuels
Transport	Electricity
Local authority	Nuclear
	Renewable and sustainable energy

Cape Town's energy use profile is dominated by petrol (37% of total energy used), electricity (33%) and diesel (18%). The remaining energy sources – paraffin, LPG, coal, HFO and wood together only comprise 11% of total use. The transport sector is responsible for over half of total energy use (54%), followed by commerce and industry (29%) and households (15%). Local authority energy use is relatively minor (2%).

Total Energy Use by user group and fuel type (annual)

User Group	Electricity GJ	Diesel GJ	Petrol GJ	Paraffin GJ	LPG GJ	Wood GJ	Coal GJ	Heavy Furnace Oil GJ	Total GJ	Total %
Households	14 098 668	-	-	1 723 665	337 500	359 100	43 400	-	**16 562 333**	15%
Industry and Commerce	22 002 386	226 464	-	725 131	347 470	561 317	3 787 952	4 695 842	**32 346 563**	29%
Local Authority	734 230	769 711	280 736	-	-	-	-	-	**1 784 679**	2%
Transport	-	19 131 581	40 406 631	-	-	-	-	-	**59 538 212**	54%
Total	**36 835 284**	**20 127 757**	**40 687 369**	**2 448 796**	**684 970**	**920 417**	**3 831 352**	**4 695 842**	**111 175 325**	**100%**
Total %	33%	18%	37%	2%	1%	1%	3%	4%	**100%**	





While the Local Authority consumes a relatively small proportion of the total energy for Cape Town, as a single large user and large employer (27 000 employees) it can implement programmes which have a significant impact on it's energy use, as well as setting an important example for others to follow.

Commerce and industry

Within the commerce and industry user group, electricity is the dominant energy source (68% of total consumption), followed by HFO (15%) and coal (12%). This sub-sector's share in total consumption (29%) is considerably less than the national figure (47%) indicating that CCT has a much less energy intensive economy on average (Cape Town has no 'large users' as per the definition of the Energy Intensive Users Group).

Due to the fact that electricity is cheap in South Africa, there has been little motivation to pursue energy efficiency, and thus scope for improvement remains substantial. Viable energy saving potential in commerce and industry typically lies between 10% and 30%.

Local authority

The local authority is not only a distributor of electricity but a user of various energy sources as well. In the process of delivering its services to the people of Cape Town it consumes energy in its buildings, streetlights, wastewater treatment, bulk water supply, disposal of general and hazardous waste as well as in its vehicle fleet. Diesel for the fleet and electricity are the major sources of energy for the local authority (43% and 41% of total consumption respectively), with petrol making up the remainder.

In recent years the activity that consumes the bulk of the electricity (50%), street lighting, has become more efficient by using high-pressure sodium lamps. Buildings, which consume 38% of the local authority's electricity, would benefit greatly from energy efficiency interventions such as replacement of current lighting systems. Many energy efficiency interventions in wastewater treatment works, water supply, traffic light operations and vehicle fleet management have been identified already.

Households

The rapid national electrification programme started in 1994 has meant that relatively few urban dwellings are currently not electrified – these are the informal dwellings and backyard shacks. While it is estimated that there are 800 000 households in Cape Town, the housing backlog is said to be about 250 000, increasing at 10 000 per year. A total of 647 679 households are formally connected to electricity, leaving approximately 250 000 'informally' connected (e.g. taking supply from a neighbour) or not connected at all. Low income households, whether electrified or not, are often dependent on paraffin to meet many of their energy needs. Middle to high-income households use electricity almost exclusively. Poor households spend between 10 and 15% of their incomes on energy (excluding transport) while wealthier households spend between 3 and 5%. In total, households are responsible for 15% of CCT's total energy use, roughly equally shared between the approximately 500 000 low income households and 300 000 mid to high-income

households. Electricity accounts for 85% of total household use, and paraffin about 10%. Severe data shortages on household energy use exist, and it is difficult to compile a reasonable picture from existing incomplete and outdated sources.

In terms of greenhouse gases, unelectrified households are responsible for emitting about 146kg of CO2 per household per month; low income electrified households about 193kg/hh/mnth while wealthier households emit 751kg/hh/mnth.

Transport

The transport sub-sector is responsible for more than half of total energy use in Cape Town (54%), with petrol accounting for 68% of this, and diesel the remainder. This sub-sector is thus amongst the most critical from and energy and emissions perspective.

Cape Town's energy use by mode of transport mirrors the rest of the country in that land transport (as opposed to rail), uses the most energy. Cape Town's public/private/other transportation modal split is 49/44/7. 52 % of all Cape Town's public transport commuters use rail each day, while 39 % use minibus taxis and 9 % use buses. Over the last 10 years the minibus taxi has captured 26.5% more public transport commuters leading to a decline in ridership on bus and rail services. Urban sprawl and the location of townships far from employment areas result in long daily commutes. Further, in spite of the fact that rail transport is much more energy efficient and generally economically more cost-effective, there is a high annual growth in motor vehicle numbers leading to congestion on already-stressed city roads.

Due to a lack of intergovernmental coordination and integrated public transportation planning, the transportation system perpetuates road-based transport and fails to provide efficient transport options to all its residents. The combined result of these factors is high consumption of petrol and diesel and, correspondingly, high gaseous emissions that threaten environmental sustainability and the health of Cape Town residents. They also result in a decline in other quality of life indicators such as time spent commuting, levels of stress, and customer choice.

Cape Town's rail network is the most extensive of any city in South Africa and forms the backbone of the public transport system. Fifty-two percent of all public transit users travel by train. Rail system upgrading and maintenance has been inadequate in recent years, resulting in declining service standards and levels of use, the removal of train sets from service, and putting pressure on less efficient transport modes. However a recent announcement indicates that Metrorail and national government will commit over R30 Billion over a 10 year period for the expansion and upgrade of the South African Rail network. In Cape Town, this is likely to include the upgrading and maintenance of existing routes and the extension of the Khayelitsha rail line.

Walking and cycling account for only approximately 7% of the City's trips, as they are not well catered for in the planning, design and operation of streets.

The transportation sector is a major contributor to local gaseous emissions and CO2 emissions.

SUPPLY SIDE SYSTEM

Cape Town's energy supply picture largely mirrors that of the rest of the country. The national electricity grid generation mix is dominated by coal-generation plant located near the coalfields, mainly in Mpumalanga and Gauteng. Around 95% of the national grid electricity is coal generated, about 5% from nuclear, and small amounts from hydro. Other near-term supply options include energy efficiency and natural gas, both of which offer cheap, cleaner alternatives to conventional resources.

Electricity

CCT has a total of 647 679 electricity customers. CCT's peak demand is around 2000MW at present (excluding Eskom distribution areas). The City of Cape Town generates very little of its own electricity -the vast majority is purchased from Eskom. The city's generation plant comprises the Athlone power station (180MW capacity) and two gas turbines (40MW capacity each) situated at Roggebaai and Athlone respectively. CCT also owns a pumped storage plant at Steenbras, which pumps water to the Steenbras Dam in off-peak (cheap electricity) periods, and generates electricity from running the water down again in peak periods (i.e. hydro generation). All of CCT generation plant, including Steenbras pumped storage, is

used for load management or emergency duty rather than being base-load generators. Steenbras alone saves CCT about R2.5 million per month.

Eskom generation plant in the vicinity of Cape Town includes emergency gas turbines at Acacia (171MW capacity), Koeberg nuclear power station (1840MW capacity), and Palmiet pumped storage scheme for national grid load management (400MW capacity).

CCT Electricity Department has implemented five separate domestic geyser ripple-control demand-side management pilot projects, and success has been notable. Geysers are switched off at peak load periods, resulting in an estimated saving of 23MW in total. Potential savings are as high as 40MW if all geysers in the project are switched off. This project is being extended into other areas.

Nuclear

South Africa's only nuclear power plant is Koeberg Power Station, which is located to the north of Cape Town. The electricity generated at Koeberg Nuclear Power Station is fed into the national grid for general distribution. Although in theory Koeberg could meet almost all of Cape Town's electricity demand, in reality it is merely one of a mix of generation plant feeding into the national electricity grid. Koeberg has 22 years of economic life left, and Eskom is looking to construct further nuclear capacity in the form of the Pebble Bed reactors in the vicinity of Koeberg, although final permission to proceed with this is yet to be granted by national government.

Liquid fuels

Of South Africa's 4 crude oil refineries, CalRef is located in Cape Town. This refinery produces all of CCT's liquid fuel needs. The Western Cape accounts for 15% of total national demand for liquid fuels and 25% share of LPG demand.

Renewable energy

Cape Town has a wealth of untapped renewable energy resource potential – primarily in wind, small-scale solar, and possibly wave applications. An independent power producer is developing the first commercial utility-scale windfarm for grid electricity generation in Darling, and Eskom is developing a demonstration windfarm in Klipheuwel.

It is estimated that in 2000 the Western Cape was responsible for 26 percent of the value of South Africa's renewable energy industry, making it a centre of energy expertise. South Africa's renewable energy target for 2013 is 10 000GWh from small-scale hydro, wind, solar and biomass.

EMISSIONS

Local emissions

'Local' emissions are those that affect the air quality in the Cape Town area and have local environmental health and visual impacts. They include nitrogen and sulphur oxides, volatile organic compounds, and particulate matter. Due to the significant role petrol and diesel play in CCT's energy use profile, these energy sources are responsible for much of the local pollutants in the atmosphere. Diesel contributes approximately 40% to the Brown Haze phenomena, and petrol 25%.

Global emissions

'Global' emissions are those that impact on climate change globally rather than having a particular local impact. Carbon dioxide (CO_2) is the principal energy-related global emission. Electricity is responsible for the majority of CO_2 emissions, as shown in the table below. Although much of Cape Town's electricity is generated by coal power stations in areas such as Mpumalanga, the resulting emissions are still part of CCT's energy use 'footprint'.

Total energy-related CO2 emissions for CCT

Fuel	CO2 tons/yr	%
Electricity	11,256,863	68%
Paraffin	175,579	1%
LPG	43,153	0%
Coal	361,680	2%
Petrol	2,815,566	17%
Diesel	1,487,441	9%
HFO	362,519	2%
Wood	0	0%
TOTAL	**16,502,801**	**100%**

ENERGY DATA

This study has highlighted various data inadequacies, none worse than the lack of information on low-income households energy use patterns. Here data is old, incomplete and inconsistent. As a result, paraffin, LPG, wood and coal use figures for households are not considered reliable. There is a need for a consistent local energy data collection and processing system.

ENERGY ISSUES

One of the main outputs of this report is the 'energy issues' – i.e. energy-related problems or opportunities which provide an important starting point for the development of the energy strategy. Because issues are numerous and wide-ranging, they have been prioritised according to CCT's stated priorities (such as poverty alleviation) as well as key national and global imperatives. The overall ranking that emerged is given in the table below, and has been used to guide the prioritisation of issues in this report.

Energy Issue prioritisation

Energy Issue category	Priority
Energy & poverty alleviation Access to energy by poor Affordability of energy	**HIGH**
Health Safety Pollution	**HIGH**
General environmental sustainability	**HIGH**
Renewable energy	**MEDIUM**
Energy efficiency	**MEDIUM**
Cheap energy & economic competitiveness Job creation	**MEDIUM**
Transport system effectiveness & efficiency	NORMAL
Nuclear	NORMAL

The issues identified are listed below.

ENERGY DEMAND ISSUES

Section 3: Demand Overview **Priority**

Issue 3.1: **Energy related data for CCT necessary for planning and strategy development is lacking.** This is particularly the case for demand-side data, although supply-side data is also lacking. **MEDIUM**

Issue 3.2: **There is no one department within CCT currently responsible for energy-related data collection, nor a designated location for storing and accessing such data.** This is related to the fact that energy is a crosscutting issue, and **MEDIUM**

does not fit neatly into the portfolio of any one department.

Section 4: Households		**Priority**
Issue 4.1:	**The cost of meeting a household's energy needs is a significant burden on poor households and a major contributor to poverty**	**HIGH**
Issue 4.2:	**Access to convenient, appropriate, affordable, clean and safe energy sources is limited for many poorer households.** It must be recognised that even electrified households use a range of energy sources for a variety of reasons. This multiple fuel use should be supported and promoted as appropriate. Gas is particularly inaccessible to poor households. The cost of "retooling" is often a barrier to converting to other energy sources. A **'best energy mix'** approach should inform energy supply and management for all households in Cape Town.	**HIGH**
Issue 4.3:	**Energy is a significant contributor to poor health (poor nutrition and respiratory health) in poor households.** This is due to poor indoor air quality or lack of adequate access to energy to cook food or keep warm.	**HIGH**
Issue 4.4:	**Paraffin and candle use is the main cause of the devastating shack fires in poor households in Cape Town.** The extent of the devastation is exacerbated by the density of the settlements and consequent lack of access for emergency vehicles, as well as the difficulty shack dwellers have in alerting emergency services (no telephones etc). Where Johannesburg has poor air quality due to the predominance of coal use amongst poorer households, Cape Town's poor households are the victims of devastating fires due to the predominance of paraffin use combined with windy conditions.	**HIGH**
Issue 4.5:	**Air quality stats are showing very poor air quality in many poorer areas of Cape Town.** This urgently needs to be investigated and understood in order to develop appropriate action.	**HIGH**
Issue 4.6:	**Middle to high-income households are very high energy consumers with large carbon footprints.** Electricity is relatively cheap and extremely convenient for these households so there is little to no incentive to implement energy efficiency measures within the households themselves. The local authority depends heavily on these households for the significant cash flow they provide to the city coffers through electricity consumption so there is no incentive to implement energy efficiency measures from the City's side. Eskom is of course in the business of selling electricity so it sees no reason to promote energy efficiency, except where it coinsides with peak demand.	**HIGH**
Issue 4.7:	**Inadequate damp proofing and poor energy efficiency in low-income households contributes to the high incidence of TB and other illnesses.** Cape Town's wet winters and high water table on the Cape Flats combined with housing, which is not built to be damp proof or energy efficient is contributing to the very high incidence of TB and other respiratory illnesses in Cape Town.	**MEDIUM**
Issue 4.8:	**Middle to high-income households use electricity almost exclusively to meet their energy needs, even where other options are cost-effective and more environmentally sound (such as solar water heaters).** This is due to the fact that electricity is 'too cheap' (it does not include the externality costs) and that households have little access to other energy sources (there is no gas network in Cape Town) or appliances (solar water heaters are not actively promoted and are comparatively expensive due to the small economies of scale).	**MEDIUM**
Issue 4.9:	**Vast quantities of electricity are wasted keeping geyser water hot all day in middle to high income households.** A significant portion of these households energy consumption (up to 60%) is used to heat water in electricity geysers and yet these geysers are designed in such a way that it is extremely difficult for the household to regulate the geyser thermostat. This leads to vastly greater electricity consumption than is necessary.	**MEDIUM**

Issue 4.10:	**Access to information about energy efficiency, best mix etc. is relatively poor for all households.** Even those members of the public service who are directly or indirectly involved in energy issues are poorly informed on these matters or do not see it as part of their job description.	**MEDIUM**
Issue 4.11:	**Available household energy use data is old and does not reflect current usage**. Reliable data on household energy use patterns is very old (1996). This is particularly problematic when one considers that the data is not reflecting the impact of the extensive electrification programme which has taken place largely post -1996.	**MEDIUM**

Section 5: Industry and Commerce		**Priority**
Issue 5.1:	**The international investment market is increasingly discerning and is looking at energy efficiency as an important component of investment decisions.** Greater energy efficiency in industry and commerce will increase Cape Town's competitive advantage internationally.	**MEDIUM**
Issue 5.2:	**There are numerous feasible opportunities for improving energy efficiency in commerce and industry.** The 'cheapness' of Cape Town's electricity means that there has been little incentive to be more energy efficient. However, the increasing cost of electricity (particularly as environmental costs have to be accounted for) means that industry and commerce need to start implementing EE programmes now.	**MEDIUM**
Issue 5.3:	**Industry is one of the more significant contributors to global and local air pollution problems in the Cape Town area.** As this sub-sector is the largest electricity consumer, and electricity is responsible for the vast majority of CO_2 emissions for CCT, efficiency in this sub-sector must be a primary focus for greenhouse gas reductions.	**MEDIUM**
Issue 5.4:	**Energy needs in the informal sector are not well understood, yet supporting this sector is a priority area for attention in Cape Town.** However, energy needs are only one of the needs for small and informal business growth, and a more complete development package needs to be provided in parallel.	Normal

Section 6: Transport		**Priority**
Issue 6.1:	**Planning for rail, bus and road-based transport are undertaken by separate spheres of government.** Since rail services are primarily a national function, local restructuring has focused on road based public transport, resulting in a generally inefficient and energy-intensive transport system. To integrate rail, bus and taxi services into an efficient and sustainable transport system that serves the needs of the population, direct local government involvement will be required in the provision of public transport services, and different modes of public transport controlled by different authorities will need to be integrated.	**HIGH**
Issue 6.2:	**High consumption of petrol and diesel in Cape Town results in significant releases of transport pollutants**, which have significant effects on local air quality, global warming, and human health. In Cape Town, vehicle emissions cause 65 percent of the Brown Haze phenomena, giving rise to undesirable effects including aesthetic spoilage and health impacts such as respiratory illness, lung infections, and eye irritation. Further, transport fuel use emits several direct and indirect greenhouse gases – in total, approximately 25% percent of total GHG emissions for Cape Town	**HIGH**
Issue 6.3:	**Cleaner liquid fuels options for transport are increasingly becoming available and financially feasible.** CCT could consider an active role in promoting fuels such as unleaded petrol, LPG, and biodiesel, amongst others, since transport emissions are a major component of total local emissions.	**HIGH**
Issue 6.4:	**Current Growth in the number of vehicles on City roads is undesirable as the use of motor vehicles for passenger transport is the least efficient per**	**HIGH**

	passenger in terms of congestion, energy consumption and emissions. For example, increased car use causes increased congestion on the exiting road network release 4 times as much pollution as that from free-flowing traffic.	
Issue 6.5:	**As the most energy (and cost) efficient mode of transport, rail use should be expanded.** A targeted approach is needed to address the capacity shortfall experienced on dominant rail lines and to prevent further inadequacies in train services. Further, to make rail relevant to a wider group of customers, rail planning needs to incorporate some of the user-oriented features of metro systems.	**HIGH**
Issue 6.6:	**Urban sprawl causes long commutes, which result in higher transport energy consumption and a corresponding high release of carbon and other emissions**. Long commutes also require longer days away from home, less productive time, and increased vulnerability to transportation-related incidences, which decreases quality of life, primarily for the poor.	**MEDIUM**
Issue 6.7:	**An enormous growth in the minibus taxi industry over recent years corresponds with both a relative and an absolute decline in ridership on bus and rail service.** This trend is undesirable from an energy consumption perspective as rail in particular, but buses as well, are more energy efficient than minibus taxis.	**MEDIUM**
Issue 6.8:	**More compact city design with higher residential densities and the development of multifunctional habitats with reduce the need to travel, and improve quality of life and access to urban goods.**	**MEDIUM**
Issue 6.9:	**Lack of co-ordinated planning has resulted in intense competition between buses and minibus taxis, resulting in duplication on many routes**. In the case of buses, route networks are extensive but underused. This causes an inefficient use of transport energy.	Normal
Issue 6.10:	**Minibus taxis are old and generally in a bad state of repair, suggesting low energy efficiency.** The national government recapitalisation programme offers some help here.	Normal
Issue 6.11:	**Subsidies are not uniformly applied, which impacts the sustainability of transit in the long-term.** Bus services have received steady increases in subsidies over the years, while train subsidies have experienced sharp fluctuations. This is out of context given the fact that 52% of public transit users use rail vs. 9% who use buses.	Normal
Issue 6.12:	**Local planners and developers have not adequately integrated walking and cycling in the planning, design and operation of streets, which has resulted in low uses of these energy efficient modes of transport.** As a result, the benefit of using bicycles and pedestrianism to substitute for automobiles, reduce traffic congestion and lower air pollution and noise, has not been realized. Greater use of these modes has tremendous potential to contribute to achieving an efficient, liveable and sustainable city.	Normal

Section 7: Local Authority		**Priority**
Issue 7.1:	**While there is potential for very substantial energy savings in a number of areas of local authority operations, there is currently no strategy for implementing these.** Identified areas include: ❖ Local authority building efficiency ❖ Vehicle fleet fuel management ❖ LED signals at traffic intersections ❖ Efficient water supply pumping scheduling and technologies ❖ Wastewater aeration changes	**MEDIUM**
Issue 7.2:	**The local authority is in a powerful position as the City's single biggest user, biggest employer and as the service provider to implement far-reaching energy efficiency programmes.**	**MEDIUM**
Issue 7.3:	**There is a lack of policies, regulations and incentives promoting energy**	**MEDIUM**

	efficiency in the local authority activities, or within the City as a whole.	
Issue 7.4:	**The City currently has limited capacity to address energy efficiency in the local authority's operations. There is no designated post responsible for addressing these issues in an integrated way.**	**MEDIUM**
Issue 7.5:	**The housing backlog in 2001 was estimated as 245 000 units increasing at 10 000 units per year - substantial additional street lighting will be required as will appropriate energy supply to the houses.**	Normal

ENERGY SUPPLY ISSUES

Section 10: Coal		**Priority**
Issue 10.1:	**Coal is an unsustainable, polluting energy source, yet the national and local energy picture is dominated by coal.** The range of coal-derived pollutants, largely from its use in electricity generation, are significant contributors to serious local and global consequences, including global warming and poor local air quality.	**MEDIUM**
Issue 10.2:	**Coal and the coal-fired electricity power stations are located far from Cape Town.** This poses issues of security of supply.	Normal

Section 11: Liquid fuels		**Priority**
Issue 11.1:	**Harmful emissions levels from largely petrol and diesel use are high by international standards due to the current non-stringent refining standards.** However, the introduction of low-sulphur diesel and catalytic converters for petrol vehicles together with increased unleaded petrol distribution should reduce emissions and bring South Africa in-line with international standards. These issues are being handled at a national level.	**HIGH**
Issue 11.2:	**Poor households suffer from unacceptably high levels of paraffin poisoning and fires** (this is discussed further in the 'households' section of the report)	**HIGH**
Issue 11.3:	**Potential for introduction of natural gas into CCT's energy supply picture represents an opportunity to move towards a cleaner supply mix.** Should the capacity of fields of the west coast prove adequate, it is likely to be feasible to pipe natural gas to the Western Cape, and Athlone power station is earmarked to be the anchor customer. This will shift CCT's dependence from dirtier coal-based electricity to some extent, and improve supply diversity.	**MEDIUM**
Issue 11.4:	**Potential for environmental damage exists through spills while distributing crude and refined product.**	Normal
Issue 11.5:	**South Africa's relative economic weakness in the global economy results in increasingly expensive liquid fuels.** The cost of oil imports for liquid fuel production is tied to foreign exchange. If the price of crude oil continues to rise, so too will the price of liquid fuels rise for Cape Town residents. This, in turn, will affect the local economy and household disposable income.	Normal

Section 12: Electricity		**Priority**
Issue 12.1:	**CCT may have reduced ability to effectively meet the energy needs of its constituency under the proposed RED.** It is unclear what the rights of the local authority will be towards ensuring adequate and affordable electricity supply for its constituency when incorporation into the RED.	**HIGH**

Issue 12.2:	**Electricity accounts for the majority of CO_2 emissions for CCT (68%), and thus measures to improve efficiency of use and alternative cleaner generation are of added importance in moving to sustainability.**	**HIGH**
Issue 12.3:	**Uncertainties around likely incorporation of CCT Electricity into the RED make planning difficult.** The likely incorporation of CCT electricity functions into the Western Cape RED, including much uncertainty in timeframe, makes it difficult to engage in any sort of medium- or long-term planning for the electricity supply sector. Potential inefficient or uneconomic supply mix may result.	**MEDIUM**
Issue 12.4:	**Data on electricity use and customers in the CCT metro area is extremely inaccessible.** There is an urgent need to have a unified electricity data collection system regarding electricity customers and sales, as currently it is fragmented amongst the different distributors as well in Eskom, and much of it is not kept in useful or quickly accessible format. Planning and analysis without data is difficult.	**MEDIUM**
Issue 12.5:	**The pilot residential demand-side management programme of CCT shows great potential for this type of intervention.** Such programmes are to be encouraged from an environmental and economic point of view – roll-out to all other suitable areas should be encouraged.	**MEDIUM**
Issue 12.6:	**It is unclear whether Cape Town will be able to use its local generating capacity to optimise its load profile under the proposed RED.** Incorporation of CCT electricity functions, excluding generation, into the REDs may reduce CCT's ability to use local generation plant to optimise their load profile, which currently saves them vast amounts of money. There is a huge lack of clarity on this issue at present.	Normal
Issue 12.7:	**Having Eskom as the official distributor in much of CCTs area of jurisdiction has resulted in multiple tariffs and fragmented responsibilities.** This situation also potentially leads to an inability for the local authority to implement policies to address the perceived needs of their constituency (such as the free basic electricity tariff).	Normal
Issue 12.8:	**CCT should ideally undertake an annual IRP to ensure optimum economic supply mix.** Such an IRP should evaluate economic best-mix of supply and demand-side components and guide investment in this regard. It can also assess the potential for local generation in the light of national transmission losses and expected lack of capacity. However this is a demanding function, and currently the capacity may not exist for such a comprehensive exercise – although potential economic benefits are substantial. The uncertainty about incorporation into REDs also discourages the undertaking of such exercises, or developing Departmental capacity in this regard. However, the expected greater capacity in the RED may facilitate the undertaking of IRPs.	Normal

Section 13: Nuclear

Issue 13.1:	**With the existing and intended further nuclear generation plant located within CCT area of jurisdiction, CCT is seriously affected by these issues.** There is widespread contention as to the safety and appropriateness of nuclear generation as an energy source, with strong arguments for and against. Although decisions regarding further nuclear capacity are being dealt with at a national level, residents of Cape Town will be fundamentally affected by these decisions, and thus have a right to input strongly into this process.	Normal

Section 14: Renewable and Sustainable Energy

Issue 14.1:	**Not considering externalities in costing energy supply options has resulted in an economically inefficient supply mix and makes renewable and energy efficiency options uncompetitive.** When environmental, health and safety costs are not included, the country's large coal reserves appear to enable production of some of the cheapest electricity in the world, and distort the comparative costs of other resources. For economic efficiency in supply mix, externalities need to be	**HIGH**

	included.	
Issue 14.2:	**The potential for energy efficiency through passive solar design of buildings, or even retrofitting, is substantial, but passive solar principles are rarely applied.** Standard practice amongst architects and builders includes little or no passive solar consideration in spite of the obvious and immediate benefits to occupants. Offices are typically built with unshaded windows and heavy airconditioning systems to compensate, and low-income houses without ceilings, condemning occupants to higher energy expense and less comfortable and healthy homes for entire life of the house.	**MEDIUM**
Issue 14.3:	**The potential for energy efficiency through widespread use of CFLs is substantial, yet they are not yet widely used.** Although the benefits of CFL use is clear, it is not yet widely known, and businesses and households are generally reliant on less efficient, more expensive forms of lighting.	**MEDIUM**
Issue 14.4:	**CCT has amongst the best wind-generation potential in Southern Africa, and the support of CCT can play a significant role in promoting this option.** Wind-generation is amongst the most cost-effective renewable electricity generation options.	**MEDIUM**
Issue 14.5:	**The potential for energy savings through widespread use of solar water heaters (SWHs) is substantial, yet uptake remains low largely due to lack of suitable financing.** Without suitable financing, for example incorporated in the house bond, SWHs will remain unaffordable in spite of their being a cost-effective option over the medium term. Also, relatively few households are aware of the benefits of SWHs.	**MEDIUM**
Issue 14.6:	**The woodfuel supply situation in and around CCT is largely unknown.** Outdated research indicates that many low-income households still use fuelwood, however the current degree of this dependence and sustainability of supply in this regard is unknown.	Normal
Issue 14.7:	**There is significant potential for CDM funds to implement pilot sustainable energy projects for CCT.** Although the timeframe and mechanisms for the availability of funds is unclear, it appears likely that carbon-saving energy projects will be able to source substantial support through CDM. CCT is well placed to maximise the use of this opportunity, with the support of organisations such as South*South*North.	Normal
Issue 14.8:	**Cape Town has the potential to become known as a 'green energy' city.** Factors in its favour include superior wind-generation potential, important tourist profile and existing energy expertise (corporate and NGO). CCT's taking the lead in projects such as the IMEP and Energy Strategy development also place it well for developing such a profile.	Normal

WAY FORWARD – THE ENERGY STRATEGY

The State of Energy Report comprises the first step in the development of an Energy Strategy for Cape Town. Based on the issues identified in this report, proposed Energy Visions and Goals for Cape Town have been developed and form the basis for discussions with key roleplayers in the development of the final Energy Strategy. The five proposed Visions are:

- **Energy Vision 1**: A city where all people have access to **modern, affordable, safe and healthy** energy services.
- **Energy Vision 2**: A leading African city in **meeting its energy needs in a sustainable way**, and thus fulfilling its constitutional obligations and global responsibilities in this regard.
- **Energy Vision 3**: A city that **uses and manages energy in an efficient way.**
- **Energy Vision 4**: A city with an **efficient and equitable transport system**, based on public transport and compact planning, to enable all residents to enjoy the benefits of urban life.
- **Energy Vision 5**: A city where energy supports **economic competitiveness** and increases **employment**.

2. Introduction & Background

The State of Energy Report provides the basis for the development of the Cape Town Energy Strategy – a component of the Integrated Metropolitan Environmental Policy (IMEP) (see box). As much of the data and information which the report draws on is incomplete or old, this report also identifies gaps and further areas of investigation.

In addition to being an integral part of IMEP, the local energy strategy concept is a step towards coordinating the range of ad-hoc energy related projects being undertaken within CCT such that they promote a common energy goal.

The City of Cape Town (CCT), in partnership with Sustainable Energy Africa (SEA) is developing the energy strategy. In October 2002 an internal Project Management Team (PMT) comprising representatives from the Electricity Department, Transport, Environmental Management and SEA was set up to guide the development of the energy strategy.

What is IMEP?

The City of Cape Town's overarching environmental policy is the Integrated Metropolitan Environmental Policy (IMEP). It aims to be implemented at the highest level of local government, and is "a statement of intent, a commitment to certain principles and ethics and to the development of sectoral strategies which will detail goals, targets, programmes and actions needed to ensure sustainable resource use and management of this unique environment for the benefit of all communities". IMEP was adopted by the City of Cape Town in October 2001 and contains a vision for the environment of Cape Town in 2020, general policy principles, methods of implementation and 15 sectoral approaches (environmental governance, safety and security, environmental education, environmental health, economy, waste, energy, transportation, infrastructure, urbanisation and housing, cultural heritage, fauna and flora, landform and soils, water resources and air). Eight detailed sectoral strategies including energy have further been identified for development in the short-term.

2.1 WHY A STATE OF ENERGY REPORT AND HOW DOES IT FIT INTO LAES?

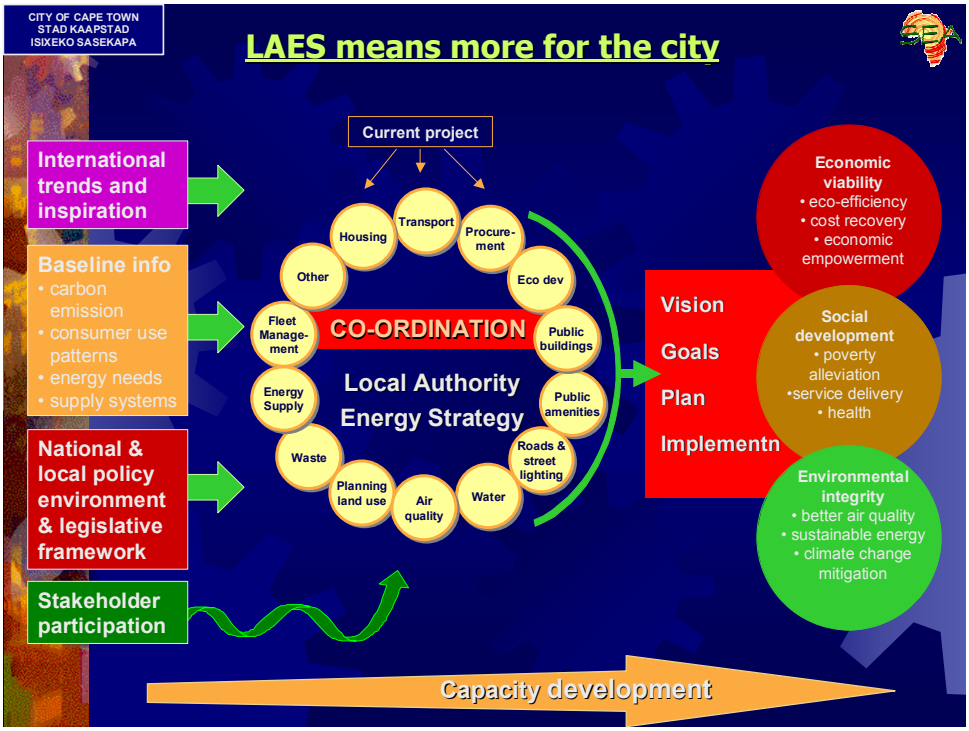
Energy and local authorities

A local energy strategy is a plan that helps institutionalise sustainable energy approaches and practices at the local level, within a framework that provides a clear vision and direction. It facilitates the co-ordination of currently ad-hoc energy projects and activities, and the integration of energy objectives into all the local authority functions and programmes. It enables improved service delivery, improved air quality, reduced greenhouse gas emissions and better financial sustainability in local authority operations.

In northern countries over the past 20 years and southern countries within the last 5 years, energy efficiency and sustainable energy interventions have been gaining momentum. In the past few years northern countries have started to develop overarching sustainable energy policies and strategies to provide vision and direction, help prioritise projects, and to measure the impact of interventions.

The overall objective of an energy strategy is sustainable development, which includes economic viability (economic efficiency, cost recovery and economic empowerment), social development (poverty alleviation, job creation, service delivery, health), and environmental integrity (air quality, mitigation of climate change, cleaner energy supply). This is illustrated in the following diagram:

Figure 2.1: Overview of the Local Authority Energy Strategy process



Why a Local Energy Strategy?

Energy plays a central role in the functioning of cities. South African cities are, however, new to the current energy debate and have focused primarily on electricity distribution with little coordination across energy-related functions and very little attention to sustainability or awareness of the substantial savings that can be made through energy efficiency. In CCT, for example, 64 different energy-related activities have been identified across the local authority's different departments, with little coordination between them.

Local authorities take energy decisions every day, often without recognising the energy content of these decisions. Many of the decisions in the following areas have direct energy implications:

- Urban planning (land use regulations)
- Housing (low cost housing and other residential buildings)
- Public transport and transportation development
- Waste management
- City owned facilities and public buildings
- Community amenities
- Electricity supply
- Economic development
- Internal procurement
- Water and waste water management
- Vehicle fleet management

The direction provided by a city-wide energy strategy will assist a municipality in making strategic longer-term decisions on issues such as buying green energy, investing in public transport and waste management efficiency, addressing local air pollution and so on. It will help with prioritisation of projects.

A major component of urban poverty is energy poverty. Between 15% and 25% of a poor household's income is spent on acquiring the necessary energy to survive. These households are also often dependant on energy sources which are unsafe, unhealthy, expensive and inconvenient. While it is vital that all households are electrified, electricity in fact does not meet the most important energy needs of poor households as it is expensive for cooking, heating water and heating the home. These households continue to use a range of different energy sources and in fact use very little electricity. A more integrated approach to energy provision is required – one which is driven by an understanding of demand (needs) instead of being driven by top-down supply issues. For example, people need hot water and they need warm houses in winter– the response to this could be solar water heaters and energy efficient housing interventions (eg.

ceilings) as part of a job creation programme rather than an often inappropriate, more costly, and unsustainable energy supply driven response (electricity as a cure-all).

Local Authorities, as distributors of electricity, are in the process of being handed the responsibility for energy efficiency programmes by the National Electricity Regulator (NER). This requires a good understanding of energy consumption patterns in the city, as well as the ability to prioritise projects appropriately. Local authorities can achieve significant cost savings by implementing energy efficiency programmes in their own operations: an energy audit of a council building in Cape Town showed that *at no additional cost* the city could save 13% of its electricity bill for this building, and, with minimal intervention cost savings of 26% could be realised. It is estimated that South Africa will run out of peak electricity capacity by 2005/06. Energy efficiency focus in cities such as Cape Town can delay costly generation expansion, reduce longer-term energy costs, and improve sustainability.

The municipal sector produces a significant amount of the world's GHG emissions through their operation and management of the following:

- Landfills and waste treatment centres
- Public vehicle fleets
- Transportation infrastructure
- Water treatment and pumping
- Municipal buildings, sport and other facilities

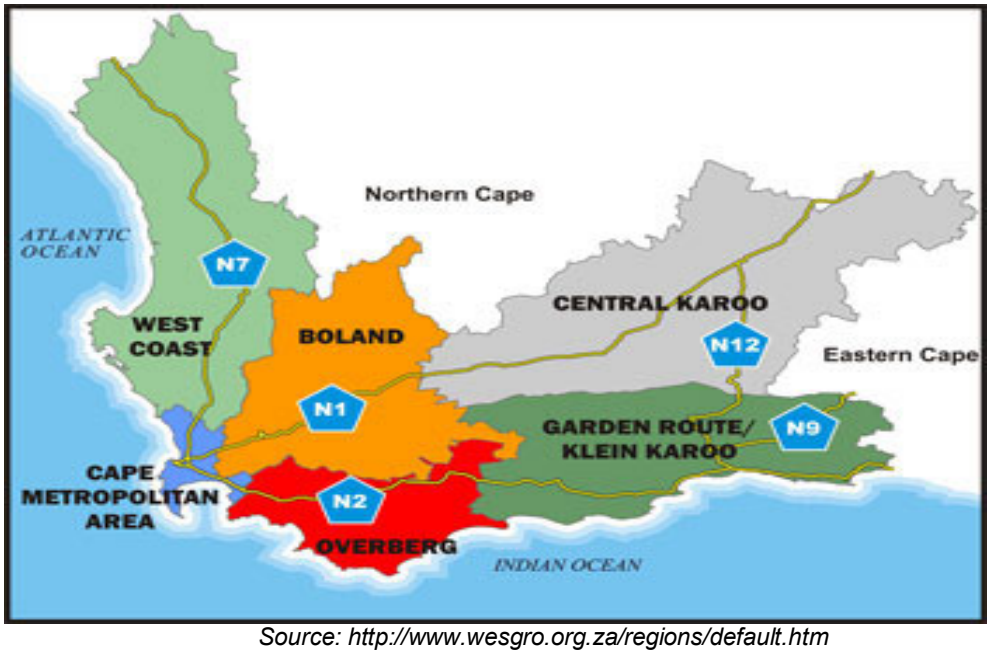
They also influence daily energy, transport and land use practices. This gives municipalities a key role in reducing GHG emissions.

South Africa has ratified the Kyoto Protocol and is one of the developing world's heaviest carbon emitters: this means that, while we are not yet obligated, South African Cities are well placed to lead the way in reducing carbon emissions. Driven by issues of climate change and inspired by cost savings and better service delivery, other cities around the world are making pioneering and cutting edge interventions to address their energy activities in an integrated way. Some examples include Portland, Barcelona, Curitiba, Leicester; and others, which have made commendable interventions, include Delhi, Bangalhore and Mexico City. Their programmes are having far reaching implications for these cities in terms of social development, environmental sustainability, service delivery improvement, citizen involvement and resource efficiency. These cities can provide real inspiration for South African city programmes.

2.2 DEFINING THE STUDY AREA

The City of Cape Town and five rural district councils namely: West Coast, Boland, Central Karoo, Garden Route / Klein Karoo and Overberg form the local government in the Western Cape Province. The map below indicates the new boundaries of the province as of December 2000. The City of Cape Town is indicated by the Cape Metropolitan Area.

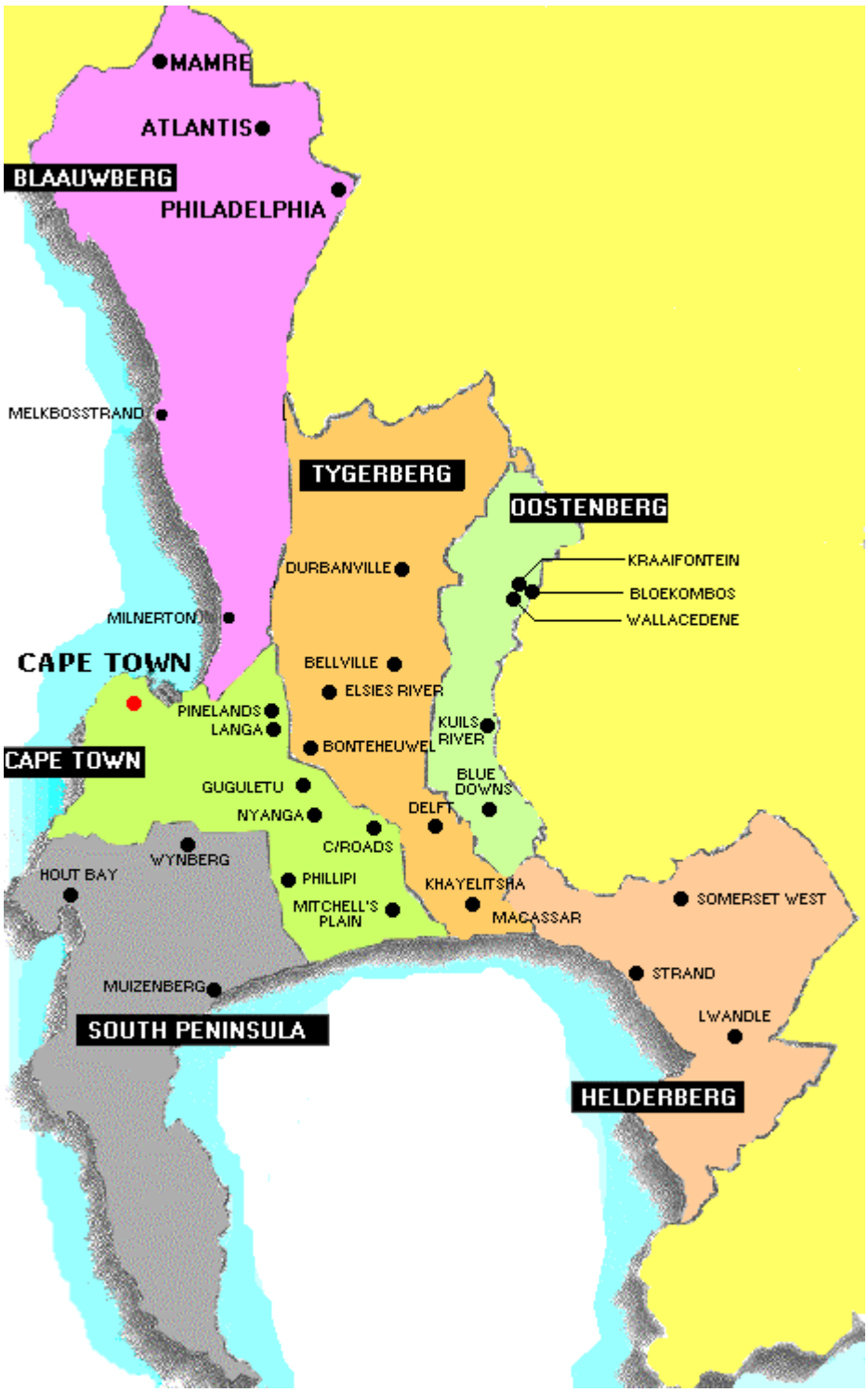
Figure 2.2: The City of Cape Town within the Western Cape



Source: http://www.wesgro.org.za/regions/default.htm

On the 6th of December 2000 the City of Cape Town (CCT) was formed with the amalgamation of the 6 metropolitan local councils (MLCs) and Cape Metropolitan Council that previously made up the Cape Metropolitan Area (CMA). The MLCs continue to function as administrative areas within the CCT. They are Tygerberg, Oostenberg, Blaauberg, Helderberg, South Peninsula and Cape Town. The 6 administrative areas are indicated in the map.

Figure 2.3: Cape Town metropolitan area, showing the 6 different administrations.



2.3 DATA SOURCES AND PROBLEMS

The data was sourced via interviews with various stakeholders (CCT officials and key organisations), secondary data sources (reports), and estimates from various other sources.

The City of Cape Town is one of eight participating cities in the ICLEI (International Council for Local Environmental Initiatives) Cities for Climate Protection Campaign (CCP) Project. Data collected from the greenhouse gas inventory [1] has been the main source for the Local Authority energy use section.

The current municipal boundaries for the City of Cape Town were instated only recently - in December 2000. This, coupled with the amalgamation of the different MLC's into one metro, has resulted in data collection systems have often not yet adapted to the new geographical data requirements of the CCT. In addition, in many areas energy data has never been systematically collected for the CCT, and this report has often had to rely on ad-hoc studies, old data, or make assumptions based on national or provincial data. Data is more readily available at a provincial level for the Western Cape, and since CCT makes up approximately 70% of the total population of the province, this data has sometimes been used as a guide for CCT.

Opportunities for improving the energy information base

There are a number of initiatives underway which could fill gaps in data and provide more disaggregated data for CCT:

- The initial results of the **Census 2001** will be available from April 2003[2] and the detailed report in October 2003. The census data has included increasingly detailed energy information, and is likely to constitute one of the most important future information sources.

- The Energy Research Institute at the University of Cape Town has a database on energy data demand and supply data on a national and provincial level and are in a process of disaggregating this further to cover the City of Cape Town.

- The City of Cape Town is installing a city-wide Systems Application Product (SAP) aimed at administering the key business processes of the City electronically. The SAP system is part of the Smart City Strategy and will be implemented in two stages. Stage one will be launched in December 2002, and deals with human resources, finances, materials management, project systems and the maintenance side of the business. Stage two deals with billing and rates amongst other which will 'go live' in the first half of 2003. The latter stage would enable access to city-wide electricity and fuel use data, amongst others.

Statistics South Africa compiles a survey of Quarterly Financial Statistics of Local Government Institutions covering all district and metropolitan municipalities as well as a sample of local municipalities in South Africa. Data is collected on income generated for electricity and gas, purchases of electricity, gas and water, intergovernmental transfers and subsidies and sale of electricity, gas and water. Statistics South Africa in Cape Town will be hosting a workshop to discuss survey needs on non-financial information for local municipalities as well as information for business and industry in February 2003. The survey should be completed by the end of 2003, and could contribute substantially to the comprehensiveness of CCT energy data.

While it is important that more detailed, disaggregated data becomes available to inform the City's energy decisions, it is also important that different institutions involved in data collection coordinate so that efforts are not duplicated, and information shared freely. It is anticipated that the data collected for this report will be housed at a central location in the City of Cape Town. Development Information Services, who currently host all GIS-related data, could be considered in this regard.

2.4 DATA CONVERSION FACTORS AND PARAMETERS

In order to compare energy sources, units were converted to joules, the standard energy unit-either mega-joules (MJ) or giga-joules (GJ). The conversion factors used are given in the table below.

[1] Greenhouse Gas Inventory 2002 compiled by Sustainable Energy Africa in partnership with City of Cape Town
[2] Personal Communication, Stats South Africa, December 2002

Table 2.1: GJ conversion factors

Energy source	Available Units	GJ Conversion	
Electricity	KWh	**0.0036**	GJ/kWh
Coal (Bituminous)	Kg	**0.031**	GJ / kg
Anthracite	Kg	**0.029**	GJ / kg
Coke	Kg	**0.034**	GJ / kg
Heavy Furnace oil	Litres	**0.040**	GJ / Litre
Diesel	Litres	**0.037**	GJ / Litre
Paraffin	Litres	**0.036**	GJ / Litre
Wood	Kg	**0.019**	GJ / kg
Wood waste	Kg	**0.019**	GJ / kg
Gas (Natural)	m^3	**0.039**	GJ / m^3
LPG	m^3	**0.025**	GJ / m^3
Waste	m^3	**0.011**	GJ / kg
Petrol	Litres	**0.034**	GJ / Litre

Source: Energy Information Administration, USA, 2001

Local Air Pollutants and Greenhouse Gas Emissions were calculated by multiplying fuel and electricity consumption data by emission factors. The emission factors used for local air pollutants are the EPA[3] factors, South African electricity coefficients and IPCC[4] coefficients for other fuels.

Emissions coefficients used

Table 2.2: Local air pollution coefficients

TYPE FUEL	Units	SO2	Particulates	NOx
Anthracite	kg/ton	19	170	9
Waste	kg/ton	1.25	15	1.5
HFO	kg/1000L	62.7	2.75	5.72
Coal	kg/1000L	8.5	1.2	1.5
Diesel	kg/1000L	8.8	13.2	8.47
Woodwaste	kg/ton	0.2	15	5
LPG	kg/m3	0.006	0.22	1.45
Wood	kg/ton	0.2	15	5

Source: Coefficients used by Cape Town Air Pollution Control
Note: Much of the emissions data used in the report was also sourced from the Energy Research Institute report 'Cape Town Brown Haze Study' (1997), which uses slightly different coefficients to the above.

Table 2.3: CO_2 coefficients (tons/GJ)

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

Source: IPCC

[3] US Environmental Protection Agency
[4] IPCC Guidelines for National Greenhouse Gas Inventories, 1996

2.5 ENERGY 'ISSUES' AND THEIR PRIORITISATION

A key output of the 'State of Energy' report is the identification of **Energy Issues** – these are generally significant problems or opportunities regarding use, supply or broad impacts of the energy sector. The issues are listed at the end of each chapter.

Because issues are numerous and wide-ranging, they have been prioritised according to CCT's stated priorities (such as poverty alleviation) as well as key national imperatives (such as paraffin safety) and global imperatives (such as global warming). The local priorities and other imperatives are described in Appendix 2, and the prioritisation framework is given in Appendix 5. The prioritisation is intended to give a sense of which issues should be dealt with sooner rather than later, but should not be considered definitive. The overall ranking that emerged is given in the table below, and has been used to guide the prioritisation of issues in this report.

Table 2.4: Energy Issue general prioritisation

Energy Issue category	Priority
Energy & poverty alleviation Access to energy by poor Affordability of energy	**HIGH**
Health Safety Pollution	**HIGH**
General environmental sustainability	**HIGH**
Renewable energy	**MEDIUM**
Energy efficiency	**MEDIUM**
Cheap energy & economic competitiveness Job creation	**MEDIUM**
Transport system effectiveness & efficiency	NORMAL
Nuclear	NORMAL

ENERGY DEMAND

3. Demand Overview

3.1 THE IMPORTANCE OF A DEMAND-LED APPROACH

Historically, energy sector assessment or planning has often been driven by supply-side industries – for example the electricity utility. Also, supply-side information is often relatively easily collected (i.e. from the supply companies/utilities), whereas demand-side information gathering usually takes considerably more effort. However, in recent years the economic and social benefits that can arise from first considering the demand-side picture has become increasingly acknowledged. This avoids various deficiencies, which arise from a predominantly supply-side approach:

- Disproportionate focus is on the needs of the supply industry – while this industry clearly has legitimate needs, this focus can lead to inadequate consideration of the needs of the customers or consumers (i.e. the demand-side), who are in fact the reason for existence of the supply industry. Safety and health concerns, for example, are better identified by a demand-side focus. Economically efficient fuel-switching alternatives are also best identified by first looking at the demand-side.
- Limited perception of suppressed demand – an example is households that could afford a particular energy service, such as a solar water heater, if proper financing was available. A supply-side focus would tend to miss such opportunities.
- Reduced attention to efficiency and demand-side management options, including behavior change – both of these require an understanding of the demand-side.
- Potential for (and history of) misjudging future demand – Eskom's huge electricity generation surplus is an example of this.

Analysis of the energy demand is therefore the starting point for the discussion on the state of energy in the City of Cape Town. One of the implications of the above is that a good demand-side database is necessary to develop energy strategies and evaluate implementation thereof.

3.2 OVERALL DEMAND

Cape Town's energy use profile is dominated by petrol (37% of total energy used), electricity (33%) and diesel (18%). The remaining energy sources – paraffin, LPG, coal, HFO and wood together only comprise 11% of total use. The transport sector is responsible for over half of total energy use (54%), followed by commerce and industry (29%) and households (15%). Local authority energy use is relatively minor (2%), however, its significance lies in the fact that it is a *single* user.

Figure 3.1: Total energy use by user group

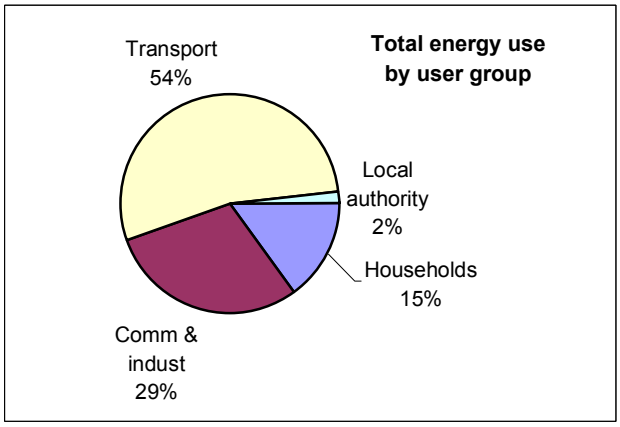


Table 3.1: Total Energy Use by user group and fuel type (annual) in GJ

User Group	Electricity GJ	Diesel GJ	Petrol GJ	Paraffin GJ	LPG GJ	Wood GJ	Coal GJ	Heavy Furnace Oil GJ	Total GJ	Total %
Households	14 098 668	-	-	1 723 665	337 500	359 100	43 400	-	**16 562 333**	15%
Industry and Commerce	22 002 386	226 464	-	725 131	347 470	561 317	3 787 952	4 695 842	**32 346 563**	29%
Local Authorities	734 230	769 711	280 736	-	-	-	-	-	**1 784 679**	2%
Transport	-	19 131 581	40 406 631	-	-	-	-	-	**59 538 212**	54%
Total	**36 835 284**	**20 127 757**	**40 687 369**	**2 448 796**	**684 970**	**920 417**	**3 831 352**	**4 695 842**	**111 175 325**	**100%**
Total %	33%	18%	37%	2%	1%	1%	3%	4%	**100%**	

Notes: *- some of the data is not reliable – particularly data on domestic coal, paraffin, LPG and wood use.*
- other fuels are used in addition to the above (e.g. anthracite), but are not included where amounts are not significant
- petrol for industry, commerce and households is included under Transport

Table 3.2: Total Energy Use by user group and fuel type (annual) in units

User Group	Electricity	Diesel	Petrol	Paraffin	LPG	Wood	Coal	Heavy Furnace Oil
	GWh	'000 litres	'000 litres	'000 litres	'000 m^3	tons	tons	'000 litres
Households	3 916	-	-	47 879	13 500	18 900	1 400	-
Industry and Commerce	6 112	6 120	-	20 142	13 898	29 543	122 192	117 396
Local Authorities	204	20 803	8 257	-	-	-	-	-
Transport	-	517 069	1 188 430	-	-	-	-	-
Total	**10 232**	**543 993**	**1 196 687**	**68 022**	**27 399**	**48 443**	**123 592**	**117 396**

Notes:
- some of the data is not reliable – particularly data on domestic coal, paraffin, LPG and wood use.

3.3 EQUITY – THE NEW FOCUS

Before 1994, energy supply to industry, commerce and wealthier households was relatively well developed, but convenient, cheap and safe energy sources were not made readily available to the poor in many places. This created a legacy of relative energy poverty among millions of South Africans.

Since the changeover to democracy, national government has attempted to address historical shortcomings in energy supply to these consumers. The South African Department of Minerals and Energy (DME) developed an energy policy - the Energy White Paper of 1998 – with new objectives: to meet the basic needs of all people, promote economic growth, and address environmental issues. It aims to restructure energy markets away from a centrally planned system towards market-based competition. Another key development complementing DME's work was the introduction of the Municipal Systems Act, which directs municipalities to provide sustainable services to their communities.

3.4 OVERALL EMISSIONS

Emissions from the different supply and demand sub-sectors are covered in the appropriate sections of the report. Local pollution is largely from transport fuels, and global greenhouse gas emissions mainly from electricity use.

Global pollutants

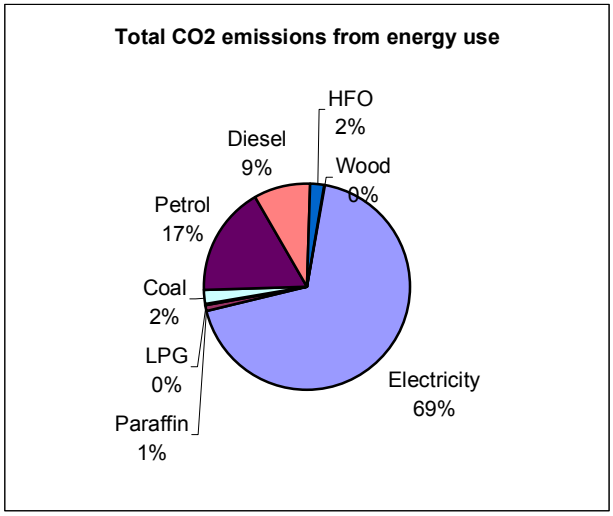
'Global' emissions are those that impact on climate change globally rather than having a particular local impact. Carbon dioxide (CO2) is the principal energy-related global emission, although methane release from landfills is also an important source of such emissions. Electricity is responsible for the majority of CO2 emissions, as shown in Table 3.3. Although much of Cape Town's electricity is generated by coal power stations in areas such as Mpumalanga, the resulting emissions are still part of CCT's energy use 'footprint'.

Table 3.3: Carbon emissions by fuel type

Fuel	CO2 tons/yr	%
Electricity	11,256,863	68%
Paraffin	175,579	1%
LPG	43,153	0%
Coal	361,680	2%
Petrol	2,815,566	17%
Diesel	1,487,441	9%
Heavy Furnace Oil	362,519	2%
Wood*	0	0%
TOTAL	**16,502,801**	100%

**Wood is considered to be carbon neutral*

Figure 3.2: Total CO2 emissions from energy use



Local Air Pollutants

'Local' emissions are those that affect the air quality in the Cape Town area and have local environmental impacts. They include nitrogen and sulphur oxides (NOx and SOx), volatile organic compounds (VOCs), and particulate matter (PM). Due to the significant role petrol and diesel play in CCT's energy use profile, these energy sources are responsible for much of the local pollutants in the atmosphere. Diesel contributes approximately 40% to the Brown Haze phenomena, and petrol 25%.

Table 3.4: Summary of primary local atmospheric emissions for Cape Town (tons/year)

	SO2		NOx		VOCs		PM10		PM2.5	
	tons/yr	%	tons/yr	%	tons/yr	%	tons/yr	%	tons/yr	%
RESIDENTIAL										
Coal	185	1%	15	0%	49	0%	40	0%	16	0%
Paraffin	344	1%	61	0%	4	0%	8	0%	8	0%
LPG	0	0%	31	0%	11	0%	2	0%	2	0%
Wood	1	0%	542	2%	2,387	4%	1,877	16%	1,314	21%
TRANSPORT										
Petrol vehicles	1,591	5%	16,848	59%	33,696	61%	562	5%	472	8%
Diesel vehicles	2,716	8%	1,781	6%	460	1%	1,927	17%	1,773	29%
Brake and tyre wear							86	1%	0	0%
Paved roads							2,129	18%	213	3%
Unpaved roads							1,391	12%	139	2%
Aviation fuel	46	0%	576	2%	470	1%	33	0%	30	0%
Ship diesel	69	0%	739	3%	31	0%	52	0%	47	1%
Ship bunker oil	1,145	4%	582	2%	109	0%	67	1%	60	1%
INDUSTRY & COMMERCE										
Coal	4,750	15%	1,875	7%	6	0%	975	8%	390	6%
HFO	7,686	24%	695	2%	4	0%	451	4%	406	7%
FFS fuels	146	0%	154	1%	1	0%	100	1%	90	1%
Diesel vehicles	84	0%	900	3%	38	0%	64	1%	59	1%
Power paraffin	39	0%	7	0%	0	0%	1	0%	1	0%
Caltex refinery	10,880	34%	1,643	6%	1,700	3%	432	4%	302	5%
Kynoch			888	3%			135	1%	122	2%
Athlone power station	2,261	7%	893	3%	3	0%	464	4%	186	3%
OTHER										
Tyre burning	241	1%	13	0%	107	0%	335	3%	168	3%
Medical incineration	1	0%	2	0%	0	0%	3	0%	3	0%
Wildfires	40	0%	107	0%	647	1%	460	4%	322	5%
Other VOCs					15,618	28%				
TOTAL	**32,225**	**100%**	**28,352**	**100%**	**55,341**	**100%**	**11,594**	**100%**	**6,123**	**100%**

Source: Cape Town Brown Haze Study, Energy Research Institute, UCT, 1997.

The local air pollutants covered in this report include nitrogen oxides, sulphur dioxide and particulates. These local air pollutants have an impact on our health. Some of the adverse effects include:

Local Air Pollutant	Adverse health impacts
Nitrogen oxide	Asthmatics adversely affected
Sulphur dioxide	Asthmatics are at risk Chemical bronchitis at high concentrations SO2 oxidises to form particulates
Particulate matter	Increased hospital admissions for respiratory problems Increased deaths Associated with cancer

Source: WESSA Transport Plan, 1999

Emissions legislative and policy environment

The powers and functions of the local authority are guided by certain policies and legislation:

- The management and control of air pollution is a function of the City of Cape Town and falls under:
  - Air Pollution Control Section: Municipal Health Department (Health and Trading Services)
  - Air Quality Monitoring Section: Scientific Services Department (Water & Waste)
  - Environmental Management Department (Planning, Environment & Housing)
- Section 156(1) of the Constitution states that a municipality has the executive authority in respect of, and has the right to administer the local government matters listed, in Part B of Schedule 4 of the constitution which deals with air pollution.
- Section 156(2) allows for a municipality to make and administer by-laws for the effective administration of the matters which it has the right to administer as long as such by-laws do not conflict with national or provincial legislation.

Emissions trends and developments

- An Air Quality Situation Assessment[1] was completed in March 2002 with specific recommendations for an organisational framework to guide the Air Quality Management in the City and provide an assessment of the local air quality situation.

Recommendations from Air Quality Assessment:

- *Development & maintenance of an emissions inventory*
  The existing local emissions inventory can be extended to include sources other than fuel combustion appliances. This function could take expertise from Air Quality Assessment & Planning, GIS department and Cities for Climate Protection project.
- *Establish impact of local air pollutants*
  The impact of local air pollutants on human health, the built environment and vegetation needs to be considered.

- The Air Pollution Control by-law and Smoke Control Zone Policy was approved by the City Council Health Portfolio Committee and will go to the City Council for a decision on implementation[2]. This by-law aims to address shortcomings in the current air pollution legislation in a two-phase approach.

3.5 DATA

As has been mentioned earlier in this report, suitable energy data is often lacking for the CCT area, and particularly so with demand-side data. While this report has collated the available data, gaps and uncertainties remain a problem. With the expected introduction of the SAP system to administer electricity and other information, this situation is likely to improve somewhat, although many data areas will not be covered by this system. The data should be disaggregated as far as possible within each sector (ie. low, middle, high income households; clothing, glass, food etc industries) – the greater the level of disaggregation the better. There is also no one location within the local authority where such data is kept, nor a department responsible for data collection. The Development Information Services may be an appropriate location for such data in future.

3.6 ISSUES

		Priority
Issue 3.1:	**Energy related data for CCT necessary for planning and strategy development is lacking.** This is particularly the case for demand-side data, although supply-side data is also lacking.	**MEDIUM**
Issue 3.2:	**There is no one department within CCT currently responsible for energy-related data collection, nor a designated location for storing and accessing such data.** This is related to the fact that energy is a crosscutting issue, and does not fit neatly into the portfolio of any one department.	**MEDIUM**

(Note: Issues linked to **air quality** are dealt with under the relevant supply and demand sections.)

[1] Air Quality Situation Assessment and Framework Plan for Air Quality Management Plan Development by the City of Cape Town, Report No.: MTX/01/CCT-01b, March 200

[2] Bulletin of the City of Cape Town, Issue No. 6 -October 2002

4. Households

4.1 HOUSEHOLD PROFILE

The population City of Cape Town is approximately 3 154 000, or about 800 000 households. The unemployment rate is 19,4% with 26% of people living below the poverty line (R12 000/year[1]). Of the employed households, 19% earn less than R 1000 per month, 55% earn between R1000/month and R8000/month and 13% earn more than this.

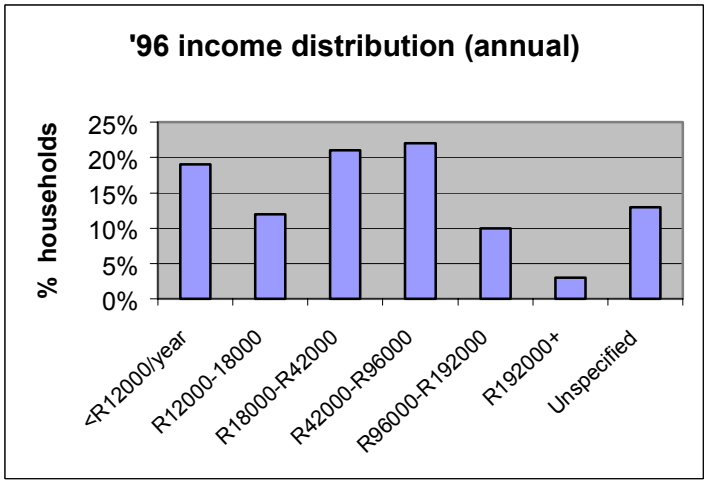
Table 4.1: Number of Households and Population

	Population	Comparative data
Number of households	800000 (IDP Needs Analysis 2002)	653000 (1996 Census)
Number of people	3154000 (CCT stats 2001)	2560600 (1996 Census)
% pop under 'breadline'	26% (IDP 2002)	
Unemployment	19.4% (CCT stats 2001)	

Table 4.2 and Figure 4.1: Household income profile (per annum) 1996

Income	No. of households	%
<R12000/year	126362	19%
R12000-18000	78037	12%
R18000-R42000	137718	21%
R42000-R96000	140388	22%
R96000-R192000	62573	10%
R192000+	20525	3%
Unspecified	86421	13%
TOTAL	**652025**	**100%**

Source: 1996 CCT socio-econ profile



As indicated in Table 4.3 below, the employed population of about 900 000 people are primarily employed in manufacturing (20%) Retail and catering (15%) and in government/community/social activities (19%). 25% of Cape Town's Gross Geographic Product (GGP) comes from manufacturing, 23% from trade and 17% from services. It is estimated that formal employment has declined from 77% in 1991 to 64% in 2000 and that the informal sector employs 18% of the economically active population and contributes 12% of the GGP[2].

[1] Integrated Development Plan (IDP) Needs Analysis 2002. In informal areas 60% of households were estimated to be below HSL and 31% in public housing areas.
[2] IDP Needs Analysis 2002

Table 4.3: Employment profile 1996

Employment type	Population	%
Agriculture, forestry, fishing	15533	2%
Mining	1775	0%
Manufacturing	177525	20%
Elec, gas, water	8149	1%
Construction	66524	7%
Wholesale, retail, catering, accommodation	137932	15%
Transport, communicatns	52898	6%
Finance, property, insure, buss	106028	12%
Govt, community, social	175254	19%
Unclear	162293	18%
TOTAL	**903911**	**100%**

Source: CCT socio-economic profile 1996

In terms of housing, 60% of people live in formal houses (29% live in individual houses) while 19% live in informal dwellings, but 21% are homeless or their dwelling type is not known. The current housing backlog stands at 240 000 houses and it is estimated that this increases by 10 000 houses per year.

Table 4.4: Dwelling profile

Dwelling types		No. of houses	%	Source
formal	house	189370	29%	1996 CCT socio-econ profile*
	flats	78360	12%	
	backyard house/shack/room	19590	3%	
	cluster/semi	84890	13%	
	room/flat on shared property	13060	2%	
	retirement village	6530	1%	
informal	shack/informal	104480	16%	
	backyard shack/informal	16560	3%	
	homeless/unclear	137130	21%	
	TOTAL	**649970**	**100%**	
42,000 rental flats and approx. 20,000 hostel beds under the control of the CCT.				
Housing backlog	shacks in informal areas	84000		IDP 2002
	shacks on serviced sites	23000		
	overcrowded	60000		
	backyard shacks	61000		
	other	12000		
	total	**240000**		
Housing backlog incr/yr		10000		CCT Dept of Housing

** more recent data is not currently available*

4.2 HOUSEHOLD ENERGY USE PROFILE

Most of the data on household energy use is old (1996) or unreliable (census data does not provide an accurate picture of energy use). This means that we do not have an accurate picture of the impact of the huge increase in electricity connections on household energy use – we have fairly reliable information on the number of connections, but we do not know what effect this is having on the energy use in those households. We do know that newly electrified poor households have in the past been slow to increase their electricity use, but this may change markedly as more and more households have electricity and so bringing

more second hand electrical goods onto the market for example. The steep price increase of paraffin may also be having an impact on energy use profiles.

Households consume about 15% of total energy used in Cape Town and 38% of total electricity. The rapid electrification programme since 1994 has meant that only 5% of dwellings are currently not electrified – these are all informal dwellings and backyard shacks. Low income households, whether electrified or not, are very dependent on paraffin to meet their energy needs (paraffin is the poor person's fuel in Cape Town with its oil refinery, compared to coal in Joburg with its proximity to the coal mines). Middle to high income households use electricity almost exclusively. Other fuels, such as wood and dung, are popular amongst all households for specific activities such as braaiing, brewing beer and so on. Coal is used very little (it is expensive due to the transport costs associated with it) and gas is used very little amongst poor households due to poor access and perceptions that it is unsafe, however, it is becoming fashionable amongst high income households for cooking. Poor households spend between 10% and 25% of their incomes on energy while wealthier households spend between 3% and 5%. In terms of greenhouse gases, unelectrified households are responsible for emitting on average 146kg of CO2 per household per month; low income electrified households emit 193 kg/hh/mnth while wealthier households emit an immense 737kg/hh/mnth (1MJ elect = 0.3kg/CO2; 1MJ paraffin = 0.07kg/CO2).

Table 4.5: Indicative total carbon emissions for all households – CCT[3]

Income/annum	No. households	Average CO2/hh/mnth	TotalCO2 emissions/month
< R 42 000	470 000 hhs	300kg	141 000 000kg
> R 42 000	330 000 hhs	800kg	264 000 000kg
	800 000	**Total**	**405 000 000kg**

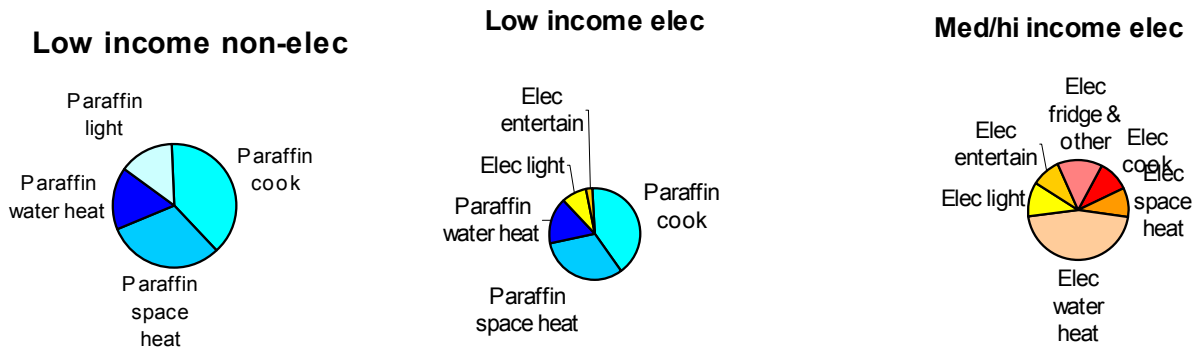
Table 4.6: Indicative typical monthly household energy consumption - CCT

Energy service	low-inc non-elec					low inc elec					med/hi inc				
	Source	MJ	qty	unit	CO2 kg	Source	MJ	qty	unit	CO2 kg	Source	MJ	qty	unit	CO2 kg
cooking	Paraffin	777	21	litres	56	Paraffin	777	21	litres	56	Elec	265	74	kWh	80
space heating	Paraffin	603	16	litres	43	Paraffin	603	16	litres	43	Elec	227	63	kWh	68
water heating	Paraffin	344	9	litres	25	Paraffin	344	9	litres	25	Elec	1066	296	kWh	319
lighting	Paraffin	311	8	litres	22	Elec	174	48	kWh	53	Elec	302	84	kWh	91
media	no data					Elec	52	14	kWh	16	Elec	238	66	kWh	71
											Elec fridge,other	361	100	kWh	108
		2035			**146**		**1950**			**193**		**2458**	**683**	kWh	**737**
Energy expenditure	10-25% of hh income					10-15% of hh income					3-5% of hh income				
Energy related problems	indoor air quality paraffin poisoning fires inconvenience					indoor air quality paraffin poisoning fires inconvenience					Low cost, high convenience but large carbon footprint				
Greenhouse gas emissions	146kg/hh/mth					193kg/hh/mth					737kg/hh/mth				

Source for fuel quantities: Energy services in low-income urban South Africa: A quantitative assessment. EDRC 1996

[3] This is a very rough estimate, and should be recalculated once more accurate figures for domestic consumption of all fuels are available. CO_2 emission figures for CCT domestic electricity consumption figures alone account for 350 000kg per month.

Figure 4.2 Indicative typical monthly household energy consumption -CCT



4.3 LOW-INCOME HOUSEHOLD ENERGY USE

Low income households, whether electrified or not, use a range of different energy sources to meet their energy service needs. This is known as multiple fuel use. Electrified low income households use electricity for lighting, media and refrigeration (if they have a fridge), but continue to depend on paraffin for their heavier energy service needs. The reasons for this are complex: electricity can be an expensive energy source for cooking, space heating and water heating, especially if "retooling" (replacing of existing appliances) is required; paraffin is a much more flexible or "social" fuel – it can be borrowed and it can be bought in small amounts from a local spaza, perhaps on credit, paraffin appliances are also more portable than many electrical appliances and can be used to fulfil different functions: paraffin stoves and heaters can double as heaters and stoves. Gas is little used, due to a combination of barriers such as poor access, high initial cost and a perception that it is less safe than other energy sources. Paraffin and candles cause bad fires in shack areas and paraffin contributes to poor indoor air quality.

Table 4.7: Monthly paraffin use in low income hhs by access to electricity and dwelling type (litres)

	Electrification		Dwelling type			
	electrified	Not electrified	formal	planned informal	unplanned informal	backyard shacks
Cape Town	29	53	36	39	37	27.5

Source "Energy services in low-income urban South-Africa: A quantitative assessment" EDRC, 1996

Table 4.8: Monthly paraffin use in low-income hhs by end use*

End uses Cape Town	Quantity litres		Monthly cost Rands		Delivered energy (MJ)		Efficiency		Useful energy (MJ)	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Best*	*Worst*
Cooking	13.5	21	17.55	27.3	499.5	777	30%	55%	274.7	233.1
Space heating	10.5	16.3	13.65	21.19	388.5	603	45%	100%	388.5	271.4
Water heating	6	9.3	7.8	12.09	222	344	30%	55%	122.1	103.2
Lighting	5	8.4	6.5	8.45	185	311	no data			

**The report estimates that low-income households use between 35 - 55 litres of paraffin per month.*
Source "Energy services in low-income urban South-Africa: A quantitative assessment" EDRC, 1996

Table 4.9: Monthly gas use in low income hhs by access to electricity and dwelling type (kgs)[4]

	Electrification		Dwellng type			
	electrified	Not electrified	formal	planned informal	unplanned informal	backyard shacks
Cape Town	15	21-29	25	29	16.3	11.8

Source "Energy services in low-income urban South-Africa: A quantitative assessment" EDRC, 1996

[4] Gas use figures do not match supply side estimates – this data is unreliable

Table 4.10: Monthly gas use in low-income households by end use[5]

End uses Cape Town	Quantity kgs		Monthly cost Rands		Delivered energy (MJ)		Efficiency		Useful energy (MJ)	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Best*	*Worst*
Cooking	12	24	30	60	588	1176	40%	60%	470.4	352.8
Water heating*	3	6	7.5	15	147	294	40%	60%	117.6	88.2

**Efficiency values are for water heating with gas ring appliances, not gas geysers as few hhs own these*
Source "Energy services in low-income urban South-Africa: A quantitative assessment" EDRC, 1996

Table 4.11: Monthly candle use in low income hhs by access to electricity and dwelling type (nos. of candles)

	Electrification		Dwellng type			
	electrified	Not electrified	formal	planned informal	unplanned informal	backyard shacks
Cape Town	19	28-35	*	15	*	*

** no data available*
Source "Energy services in low-income urban South-Africa: A quantitative assessment" EDRC, 1996

4.4 ELECTRICITY CONNECTIONS

The electrification programme for Cape Town has proceeded apace and currently it is roughly estimated that 5% of households do not have access to electricity, while approximately 15% of households have indirect access to electricity (this would include backyard shack dwellers, people in overcrowded conditions etc.)[6]. The total domestic electricity connections for Cape Town are outlined in Table 4.12 below (information on connections and usage in each administrative area can be found in the appendix).

Table 4.12: Electricity connections for Cape Town Unicity

Connection type	Number of customers	Total energy usage/ annum kWh/yr	Average/mnth/hh kWh/mnth
Conventional meters (credit meter)	215877	2005004690	774
Energy Dispensers (prepaid meter)	431802	1911291967	369
	647679	**3916296657**	

Source: CCT Administrations 2001/2

4.5 ENERGY COSTS

Electricity

Following are the tariffs for Eskom and City of Cape Town electricity supply.

Table 4.13: Electricity tariffs

		basic charge (incl VAT)	tariff (incl VAT)
Eskom[7]	Homepower(credit meter):	R41.53	22,58 c/kWh
	Homelight (prepaid) 20 amps		33,12 c/kWh
	60 amps		37,25 c/kWh
CCT[8]	Domestic 1 (> 500kWh/m)	R34.20	31,69c/kWh
	Domestic 2 (<500kWh/m)		38,82c/kWh

[5] Gas use figures do not match supply side estimates – this data is unreliable
[6] Pers. com Roger Macfarlane of CCT Electricity Dept, Jan 2003: It is extremely difficult to estimate how many houses are unelectrified. MacFarlane submits that all estimates are a thumbsuck. Informal settlements change frequently due to people moving in/out, fires, formalization, etc. Informal housing settlements on private land are not eligible for electrification (although some houses on private land do get some form of electrification in cases where they boarder informal electrified areas), and not all housing settlements on municipal land are eligible for electrification - such as those on road reserves. A number of households are illegally electrified, a 'small business venture' for the electrified house. MacFarlane estimates the percentage of unelectrified households as follows: 99% of the formal sector is electrified. 80-85% of the informal sector on municipal land which is available to be electrified (ie not located on encumbered municipal land) is electrified. Roughly 60% of total shacks in informal areas (both on private and on municipal land) are electrified.
[7] Source: CCT State of the Environment Report Year 4 (2001) Draft, pg. 131
[8] CCT Schedule of tariffs Aug 2002

Paraffin

Paraffin costs vary greatly from R 5.00 per litre (from Pick 'n Pay, includes container) to about R3.40 per litre (from a spaza shop in Gugulethu, no container) (Jan 2003 data)

LPG

Gas costs R 7.00 (incl. VAT) per kilogram, a deposit on a gas bottle is R 85.50. (Feb 2003 data)

Comparative energy use costs for different services

Cooking with paraffin costs around R2.8/MJ while LPG and electricity cost between R1.0/MJ and R1.7/MJ. Paraffin heaters are also more expensive in economic terms – around R2.2/MJ as opposed to between R1.7/MJ and R2.0/MJ for LPG and electricity (all 1996 costs).

Solar water heaters are a cost effective choice for water heating. The economic cost (ie. including externalities) is around R0.6/MJ, while gas, electricity and paraffin generally cost at least double this.
Solar PV electricity is very expensive, and is therefore not yet cost effective in areas with access to the electricity grid[9].

4.6 MAJOR FACTORS AFFECTING HOUSEHOLD ENERGY USE

There are a number of factors which affect a household's choice regarding the energy source used for a particular energy service. These can be summarized as follows:

- access to particular energy sources; electricity and gas in particular
- household income and, to some extent, dwelling type and location
- cost of the energy source, including upfront costs such as connection fees or gas bottle deposits; cost of an energy source for a particular energy services – this may be determined by perception rather than fact as people have limited access to information about the best energy source for a particular service
- cost of appliances - particularly for poorer households if retooling is required in order to make use of a 'new' energy source
- 'flexibility' of the energy source and appliances: can an appliance be used for a range of purposes, can the energy source be borrowed, bought on credit etc
- convenience
- behavioural issues: for example timing of use, requiring hot water on demand and so on
- perceptions of an energy source, eg. is it 'safe'
- cultural issues also play a role: wood and charcoal are used for braaiing, wood and cow dung are better than other fuels for brewing beer and so on.

4.7 BEST MIX[10]

Following is an economic assessment (with a financially cheapest option comparison) of the best energy mix for households. An economic costing includes externalities (see note below Table 4.14) whereas a financial costing excludes externalities. Note that the economically sound choice is often congruent with the financially cheapest option.

[9] Source: Shell Foundation: Market analysis of the SME energy sector: Energy paper. SEA, August 2002, pg. 28f (based on a study by Mark Borchers EDG 1997 'Strategies to promote economically sound energy use in low-income households").
[10] CCT's Local Agenda 21 Households Project aims at promoting a sustainable lifestyle at the household level. Twenty-one households from Manenberg, Khayelitsha and Wynberg are exploring themes of water conservation, waste management and more efficient use of energy. This information will contribute to the development of city-wide strategies for households.

Table 4.14: Economic life-cycle cost comparison of appliances for different end uses for households
Underlined = Financially cheapest options

	Cooking	Water heating	Space heating	Lighting	Refrigeration
Economically sound choice	Gas ring/stove Electric hotplate/stove	Solar water heater	Wood fire Gas heater	Electric CFL/fluorescent	Electricity
Economically OK choice	Electric microwave Paraffin primus	Gas geyser/in-line Electric in-line	Electric bar heater Paraffin heater	Electric incandescent	Paraffin
Economically poor choice	Wood Paraffin wick	Electric geyser Paraffin wick/primus Wood	Elec oil-filled heater Wood stove	Paraffin Gas Candles	Gas

Externalities considered in economic life-cycle costing: respiratory health, paraffin poisoning, fires, distribution costs not included in price, environmental effects of woodfuel use, greenhouse gasses, water consumption in electricity generation, health risks in coal mining.
Source: Mark Borchers, Energy & Development Group 1997: Strategies to promote economically sound energy use in low-income households, Cape Town.

Amongst high income households very significant energy savings and therefore carbon emission reductions can be achieved through using economically sound energy and appliance choices, particularly with regard to water heating and lighting. Good insulation in dwellings also reduces the need for heating in winter. Time-of-use tariffs, incentives and regulations may be effective methods for encouraging energy efficiency in these households.

Energy efficiency measures in poorer households (in dwelling construction and energy use) can improve health, reduce cost and improve convenience for these households.

4.8 HEALTH AND SAFETY

Fires

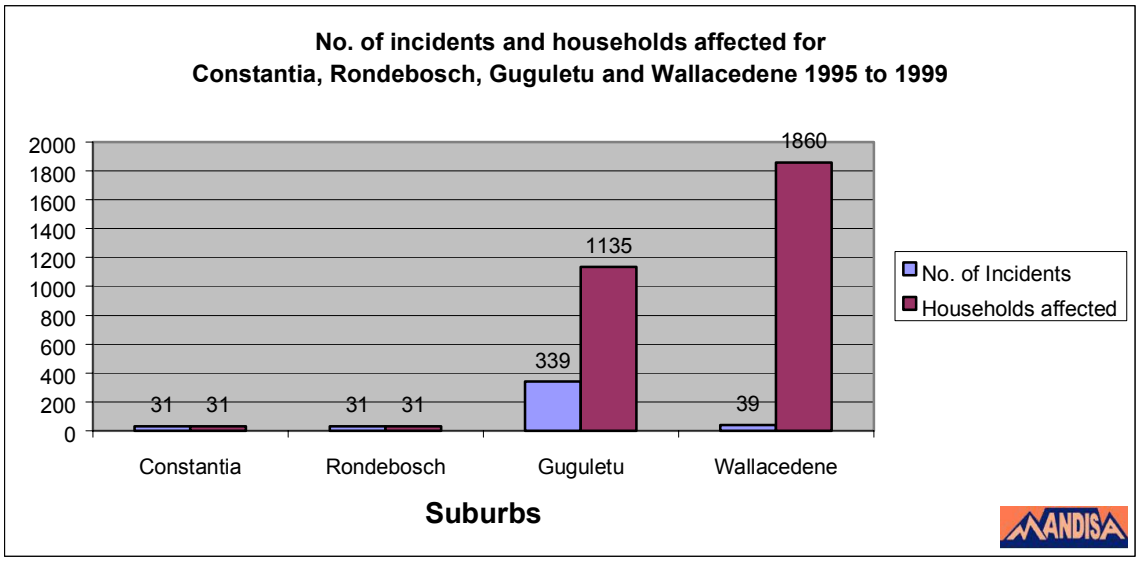
People living in informal settlements in Cape Town are particularly vulnerable to fires – the combination of high paraffin use, unsafe appliances, overcrowding, flammable construction materials and high wind speeds are a recipe of devastating fires. While the incidence of fire varies greatly from year to year, the following statistics give some indication of the impact on people living in households with the least resources to cope with this devastation.

In the year 2000, 1200[11] shacks were destroyed by fire. These fires were mainly caused by paraffin appliances or by candles. Windy conditions and problems of access for emergency vehicles into shack areas makes these fires difficult to control. Nationally, burns are the fourth highest cause of death amongst children under 14 years of age (statistically very high compared to other countries). The devastation caused by fires should also be understood in terms of their longer term impact – people loose all their belongings, for which they have no insurance; they may also loose their survival networks and systems; and those who are suspected of causing the fire are often chased out of the area.

Following is an analysis giving some indication of the frequency and impact of fires in different areas of Cape Town. Note that even though the frequency of fires is highest in Gugulethu, the actual severity is lower than in Wallacedene. This can probably be attributed to the fact that the latter area is informal, overcrowded and houses are built of flammable materials. The greater number of incidents in Gugulethu compared to Wallacedene probably reflects the greater number of houses in the Gugulethu.

[11] Source: Ukuvuka

Figure 4.3: Number of incidents and households affected by fires in specific areas in CCT[12]



Paraffin poisoning

Paraffin poisoning is also a very serious problem. Most poor households in Cape Town, whether electrified or not, uses paraffin and this is stored in cooldrink or milk bottles and these are usually within reach of small children, due to lack of space. According to PASASA's (Paraffin Safety Association of South Africa) 2001 national data, there are 80 000 ingestions of paraffin by children every year, about half of these result in chemical pneumonia and between 1 and 10% of these result in death[13]. Most of these statistics will reflect incidences in coastal areas where paraffin use is much higher than in inland areas.

Air quality

Indoor air quality

All paraffin stoves tested in a 2001 PASASA study failed miserably: for example, carbon monoxide emitted by all flame stoves tested was twice the level specified by the SABS standard. Flame stoves were 41% efficient while primus stoves were 56% efficient.

Outdoor air quality

No data has to date been generated that specifies / differentiates among domestic fuels and their relative impacts on ambient air quality. However, informal areas have been found to have a PM10 twice that of formal areas, and high air pollution measured in Khayelitsha[14] has prompted the CCT Health Department to target a focused study on the area to determine what the various energy sources contribute towards air quality. This study will be undertaken within the next 6 months[15].

[12] Source: Disaster Risk Centre UCT, Helen Macgregor. Detailed analysis of Joe Slovo is available for '90-'00 including costs – this is "highly illustrative of the complexities of undertaking disaster mitigation outside of a clearly defined risk profile". Detailed information for the whole City may be obtained from the DR Centre database on presentation of a substantiated research agenda and a budget.
[13] PASASA's Tanner Methvin states that this data is "conservatively accurate" but makes it clear that it is very difficult to arrive at accurate data, particularly of deaths. Many cases of ingestion will not be reported or will only be captured once the child comes to a clinic with pneumonia and then the case may not be recorded as caused by paraffin. There is little data from doctors as they know how to treat paraffin poisoning and so do not contact the poison centres. Data is also generally by region as hospitals service regions.
[14] PM10 levels in Khayelitsha are very high compared to the rest of the city. In 2002 PM10 levels exceeded the guidelines on **84 days**. Compare this to the London, UK: 35 days, Goodwood: 22 days and the CCT city center: only 6 days.
[15] Pers com: Grant Ravenscroft – Air Quality Control CCT Feb 2003

4.9 POLICY AND REGULATORY CONTEXT

Quality and Standards[16]

Stoves

According to tests commissioned by PASASA, all stoves failed on SABS guideline standards, especially with regard to safety. Standards are not mandatory, however there is a current process to develop SABS standards and make these mandatory. Wick stoves were assessed to be between 41% and 49% efficient while primus stoves were 56% efficient. Carbon monoxide emissions from wick stoves were twice that indicated in the SABS standards[17]. The Energy White Paper of 1998 acknowledges governments responsibilities in the managing of potentially hazardous fuels and appliances. Government has stated that it will require the petroleum industry to introduce child resistant containers.

Appliance labeling

For some years investigations have been made and task teams set up by the DME into comprehensive appliance labeling in South Africa which will provide consumers with accessible information on the efficiency of appliances. There is also an international appliance labeling and standards initiative called CLASP in which South Africa is participating. There has to date been no concrete progress in this area.

Paraffin

In 1979 a temporary "CFK" standard was set for the quality of paraffin (in anticipation of a more time consuming SABS standard being established). This has never been amended. However, PASASA have now commissioned a toxicology research project with University of Natal Durban which will specify the health and environmental impacts of chemicals in paraffin and propose a standard[18].

Safe storage in residential areas

The Fire Safety Community Bylaw 28/2/2002 limits the storage of paraffin and gas on private residential plots to 200 litres and 38 kgs respectively. Storage must be outside of the building. SABS 0400/1987 updated 1990 in the National Building Regulations and Standards Act regulates the storage of larger quantities for merchants in an area.

Smokeless zones

While there are smokeless zones in effect throughout the city, these are only acted on if a complaint is received or a problem is observed by the authorities.

Energy efficient housing

The national Department of Housing has developed a guideline document to promote the building of more environmentally sound housing – the energy section covers orientation, ventilation, construction, the need for ceilings, proper damp proofing and so on. This is not regulation yet, but the Department has recently put out a tender for the development of energy efficiency *standards* for all types of housing (this will lead to a review of the National Building Regulations). This was preceded by a cost benefit study of energy efficient measures for low cost housing (EDRC 2000) and a green financing study (Environmental Evaluation Unit 2000). The department has also initiated a residential eco-rating system for South Africa. This all falls under the Department's Environmental Implementation Plan (first edition 2001?).

The housing subsidy for certain areas of the Western and Southern Cape (areas which experience damp winters) is receiving a R1004 top-up to improve damp proofing in order to reduce the incidence of TB, an illness exacerbated by damp conditions.

4.10 TRENDS AND DEVELOPMENTS

The primary trend is towards increased electricity use, particularly by poor households as they are electrified and slowly access electrical goods. It is becoming more fashionable for high income households to use gas for cooking and, to a small extent, solar for water heating. A few projects are demonstrating solar water heating in low income houses as well as other energy efficiency measures such as ceilings, proper damp proofing and orientation. A new top up by national government to the housing subsidy for improved damp

[16] The relevant standards for paraffin packaging, handling and appliances are SABS 1913, SABS 1906, SABS 1243, SABS 0265 – these are currently not mandatory.
[17] Pers. com with Tanner Methvin of PASASA Feb 2003
[18] Pers. com with Tanner Methvin of PASASA Feb 2003

proofing in areas with damp winters indicates a recognition by national government that certain environmental conditions merit different subsidization of the top structure.

4.11 ISSUES

		Priority
Issue 4.1:	**The cost of meeting a household's energy needs is a significant burden on poor households and a major contributor to poverty**	HIGH
Issue 4.2:	**Access to convenient, appropriate, affordable, clean and safe energy sources is limited for many poorer households.** It must be recognised that even electrified households use a range of energy sources for a variety of reasons. This multiple fuel use should be supported and promoted as appropriate. Gas is particularly inaccessible to poor households. The cost of "retooling" is often a barrier to converting to other energy sources. A **'best energy mix'** approach should inform energy supply and management for all households in Cape Town.	HIGH
Issue 4.3:	**Energy is a significant contributor to poor health (poor nutrition and respiratory health) in poor households.** This is due to poor indoor air quality or lack of adequate access to energy to cook food or keep warm.	HIGH
Issue 4.4:	**Paraffin and candle use is the main cause of the devastating shack fires in poor households in Cape Town.** The extent of the devastation is exacerbated by the density of the settlements and consequent lack of access for emergency vehicles, as well as the difficulty shack dwellers have in alerting emergency services (no telephones etc). Where Johannesburg has poor air quality due to the predominance of coal use amongst poorer households, Cape Town's poor households are the victims of devastating fires due to the predominance of paraffin use combined with windy conditions.	HIGH
Issue 4.5:	**Air quality stats are showing very poor air quality in many poorer areas of Cape Town.** This urgently needs to be investigated and understood in order to develop appropriate action.	HIGH
Issue 4.6:	**Middle to high-income households are very high energy consumers with large carbon footprints.** Electricity is relatively cheap and extremely convenient for these households so there is little to no incentive to implement energy efficiency measures within the households themselves. The local authority depends heavily on these households for the significant cash flow they provide to the city coffers through electricity consumption so there is no incentive to implement energy efficiency measures from the City's side. Eskom is of course in the business of selling electricity so it sees no reason to promote energy efficiency, except where it coinsides with peak demand.	HIGH
Issue 4.7:	**Inadequate damp proofing and poor energy efficiency in low-income households contributes to the high incidence of TB and other illnesses.** Cape Town's wet winters and high water table on the Cape Flats combined with housing, which is not built to be damp proof or energy efficient is contributing to the very high incidence of TB and other respiratory illnesses in Cape Town.	MEDIUM
Issue 4.8:	**Middle to high-income households use electricity almost exclusively to meet their energy needs, even where other options are cost-effective and more environmentally sound (such as solar water heaters).** This is due to the fact that electricity is 'too cheap' (it does not include the externality costs) and that households have little access to other energy sources (there is no gas network in Cape Town) or appliances (solar water heaters are not actively promoted and are comparatively expensive due to the small economies of scale).	MEDIUM
Issue 4.9:	**Vast quantities of electricity are wasted keeping geyser water hot all day in middle to high income households.** A significant portion of these households energy consumption (up to 60%) is used to heat water in electricity geysers and yet these geysers are designed in such a way that it is extremely difficult for the household to regulate the geyser thermostat. This leads to vastly greater electricity consumption than is necessary.	MEDIUM

Issue 4.10:	**Access to information about energy efficiency, best mix etc is relatively poor for all households.** Even those members of the public service who are directly or indirectly involved in energy issues are poorly informed on these matters or do not see it as part of their job description.	**MEDIUM**
Issue 4.11:	**Available household energy use data is old and does not reflect current usage**. Reliable data on household energy use patterns is very old (1996). This is particularly problematic when one considers that the data is not reflecting the impact of the extensive electrification programme which has taken place largely post -1996.	**MEDIUM**

5. Industry and Commerce

5.1 OVERVIEW OF ECONOMY OF CITY OF CAPE TOWN

The economy of Cape Town contributes 75%[1] to the provincial economy (or Gross Geographical Product GGP) of the Western Cape and 11% to the national economy[2]. Western Cape exports comprised 7.6% of South Africa's total exports, with the UK being the Western Cape's biggest export market. The share that each sector contributed to CCT's GGP and to employment in 2001 is given below:

Table 5.1: Gross Geographic Product and Employment for 2001, Cape Town

Real GGP (1995 prices) and factor cost	2001		2001	
Sector	**Output (R'000)**	**%**	**Employment**	**%**
Agriculture, Forestry and Fishing	559 266	0.89	7 258	0.71
Mining and Quarrying	104 853	0.17	1 530	0.15
Manufacturing	16 455 329	26.17	282 513	27.53
Electricity and Water	1 147 080	1.82	4 677	0.46
Construction	2 247 932	3.57	73 378	7.15
Trade and Catering	14 696 204	23.37	248 358	24.21
Transport, Communication	5 715 421	9.09	75 364	7.35
Finance, Real Estate	11 821 775	18.80	109 385	10.66
Services	10 140 917	16.13	223 580	21.79
TOTAL	**62 888 777**	100.00	**1026043**	100.00

Source: Economic Development and Tourism Department, City of Cape Town

While the manufacturing sector's contribution to Cape Town's economy is highest at 26.17%, it is the combined trade and services or tertiary sector (which includes the finance, real estate, trade and catering and services sectors) which generates 58% of the GGP. This sector also provides employment to 55% of the 1 026 043 economically active population. Manufacturing and other secondary activities (electricity, water; construction, transport and communication) are also significant contributors to employment (43%). Primary sector activities play a fairly minor role.

The economy of the Western Cape shows similar characteristics to those of the City of Cape Town. The only marked difference is the higher contribution (6.3%) by the primary sector (in the form of agriculture, forestry and fishing) to the Western Cape's economy.

Table 5.2: Sector contributions to Value Added – 1999

Sectors	City of Cape Town %	Western Cape %	South Africa %
Primary	0.9	6.3	10.9
Secondary	27.6	26.7	26.5
Tertiary	71.5	67.0	62.6
Total	100	100	100

Source: Western Cape Economic Monitor, September 2000

[1] Personal Communication Feb 2003, Ray Wolpe, Department of Economic Affairs and Social Development
[2] Integrated Development Plan, 2002/03, City of Cape Town

There are several factors which, according to WESGRO[3], make Cape Town an attractive investment location for many businesses:

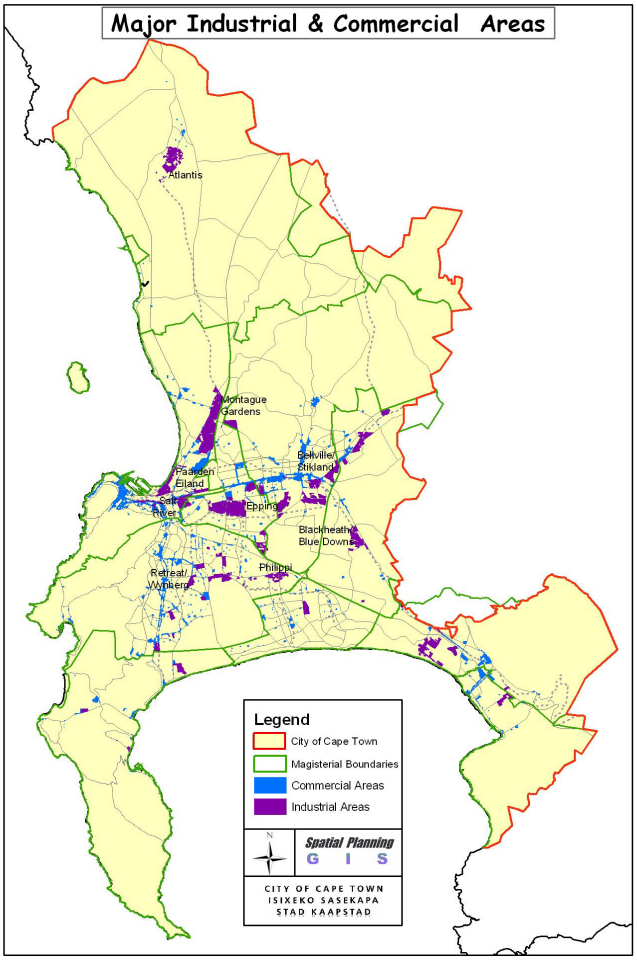
- South Africa has cheap electricity - at a cost of R0.20 to R0.25 per kWh to commerce/industry
- Cape Town has a relatively large skilled and semi-skilled labour force, more so than the rest of South Africa (in the Western Cape 13.1% of people have a tertiary education compared to South Africa as a whole at 11%)
- Cape Town has relatively well developed transport infrastructure.

Cape Town's beauty, combined with these factors, has meant that Cape Town has developed a competitive advantage in the following areas in certain areas such as high quality niche products (crafts, textiles) and services (financial, trade and the film industry)

Informal Sector

The informal sector produces 12% of economic output and employs 18% of the economically active population. This constitutes a significant component of the economy, and substantial job creation in particular, and thus the energy needs of this sector will have to be adequately met. The informal sector has been identified in the Integrated Development Plan[4] as a key development focus and recipient of future support.

Map 5.1: Geographic Location of Industries and Commerce



Source: GIS Department, City of Cape Town

[3] Personal communication, Anders Aero, WESGRO Cape Town, 2002.
[4] Integrated Development Plan, 2002-2005

From the map above, the largest number of industries and commercial areas are situated in the Cape Town municipal local council. This has implications for local air pollutant concentrations. The major industrial areas where the heavy energy consumers are located are as follows:

- Epping
- Atlantis
- Montagu Gardens
- Salt River
- Retreat / Wynberg
- Phillipi East
- Blackheath / Blue Downes
- Bellville / Stikland
- Paarden Eiland

Growth Trends

The GGP for the City of Cape Town has grown by 3% from 2000 to 2001. The key growth sectors for the City of Cape Town in the future are manufacturing, tourism, and financial and business services[5]. More details of the growth sectors for the greater Western Cape are given below, most of which are relevant to Cape Town (these are not in order of importance):

- Food processing
- Metal processing
- IT software
- Film–making
- Education and training
- Quality clothing
- Health and medical related services and equipment
- Environmental industry
- Publishing
- High-value crafts
- Tourism
- Regional and Corporate Offices

The Metropolitan Spatial Development Framework (MSDF) adopted in October 2001 has to a large extent given direction to the expenditure of public sector funds and spatial development planning in CCT. Growth in the South East Metro is the priority, with the Inner City CBD, Northern and Southern Suburbs having a lower priority. The townships in the South East Metro house approximately 1 million people (approximately 30% of CCT's population) and are where the growth challenges currently are:

Key Growth Challenges in South East Metro

Townships	**Population***	**Development Initiatives**
Khayelitsha	400 000	Launched a CBD initiative
Mitchell's Plain	250 000	Restructuring efforts to attract industry
Phillipi Brown's Farm	80 000	Phillipi East Development Initiative focussing on Fedsure Project along NewEisleben/ Lansdowne Road Fresh Produce Market
Blue Downs /Mfuleni	60 000	CBD location for mixed business development
Langa	70 000	
Gugulethu / Nyanga / Crossroads	180 000	
Total	**1 040 000**	

* *Population estimates from Wesgro*

[5] Western Cape Economic Monitor, September 2000

Other initiatives include:

- Gugulethu / Manenberg Spatial Development Framework - a study which identified projects to support the integration and growth of the Wetton / Lansdown Corridor
- Nigeria Way Development Framework - a study commissioned by the City of Tygerberg aimed at identifying economic and housing opportunities south of Epping Industria II for the surrounding community.

5.2 LEGISLATIVE AND POLICY ENVIRONMENT

The main regulatory issues relevant to energy use and associated environmental impact in commerce and industry are:

- All fuel-burning appliances have to be registered under the Cape Town Municipal Regulation No. 1997 relating to smoke control. Therefore all industries which operate fuel-burning appliances have to submit information to the City of Cape Town Air Quality Department.
- The Draft National Electricity Regulator Energy Efficiency and Demand Side Management Policy outlines the procedures, responsibilities and obligations of various stakeholders with regard to energy efficiency, as outlined in the Energy White Paper of 1998.[6]

The South African Institute of Chartered Accountants has recently issued its practice statement SAAS 2051 which requires auditors to include environmental matters for consideration when they audit financial statements of a company. This has implications for energy use and efficiency.

5.3 OVERVIEW OF ENERGY DEMAND FOR INDUSTRY AND COMMERCE

In Cape Town industry and commerce consume 29% of total net energy use. This is low compared with the figure for the whole country of 47%[7], indicating that Cape Town's economy is relatively less energy intensive (Cape Town has no 'large users' as per the definition of the Energy Intensive Users Group). Energy intensity measures the amount of energy used per unit of GDP.

Electricity accounts for 68% of commerce and industry's total energy consumption. Heavy furnace oil accounts for 15%, followed by coal at 12%. The remaining fuels – paraffin, LPG, diesel and wood – play minor roles.

Table 5.3: Annual fuel consumption for commerce and industry

Fuel	GJ/yr	%
Electricity	22,002,386	68%
Paraffin	725,131	2%
LPG	347,470	1%
Coal	3,787,952	12%
Petrol*	0	0%
Diesel	226,464	1%
HFO	4,695,842	15%
Wood	561,317	2%
TOTAL	**32,346,563**	100%

** Note: transport fuels are accounted for under the 'transport' category*
Source: project database (see Appendix 4)

Table 5.4: Electricity consumption by commerce and industry

Customer category	Number of customers	Total kWh/year used
Commercial – Small 1 & 2	34,337	1,612,201,904
Large & Very Large	3,359	4,377,786,230

Electricity consumption from commerce and industry in the different administrations is shown in the table below.

[6] National Electricity Regulator Energy Efficiency and Demand Side Management Policy within South African Electricity Industry, Draft, 2002
[7] Energy Outlook for South Africa, 2001. ERI, Cape Town. Figure excludes non-energy use of energy sources such as coal and oil.

Table 5.5: Electricity consumption by commerce and industry

Administration	Commercial		Large & very Large	
	No.of customers	MWh/yr	No. of customers	MWh/yr
Cape Town & South Peninsula	17,681	739,118	568	1,728,409
Tygerberg	6,967	151,091	719	1,000,499
Blaauwberg	520	20,458	198	232,247
Helderberg	3,695	174,435	0	0
Oostenberg	1,974	47,100	174	116,632
Eskom Areas within Unicity	3,500	480,000	1,700	1,300,000
Total For Unicity (incl Eskom Areas)	34,337	1,612,202	3,359	4,377,786

Source: Project database (see Appendix 4) – compiled from figures supplied by different MLCs

Industry energy intensity

At a national level the most energy intensive sectors are the secondary sector followed by primary and then tertiary sectors[8]. Although detailed information on energy intensity is not available for CCT, the local economy relies largely on the tertiary sector, and thus on the whole Cape Town's economy is not heavily reliant on energy.

Nevertheless there are several specific examples of large secondary industries in manufacturing sector where energy is an important input cost. Some of the heavy energy users are:

- Oil Refinery – Heavy Furnace Oil (Caltex)
- Foundries – Coal
- Kraft, Brick and Clay plants – Coal
- Fish processing – Heavy Furnace Oil (SA Sea Products)
- Some textiles/nylon spinning operations – Heavy Furnace Oil and Coal (SA Nylon Spinners, Cotten Mills)
- Glass – Heavy Furnace Oil (Consol Glass)

Commerce

The commercial sector (also known as the service sector) includes government, office buildings, financial institutions, educational facilities and places of entertainment and recreation. Here electricity is the main energy source as opposed to the industrial sector that relies on other fuels for much of their energy. Office blocks are the main consumers of electricity in this sector as shown in the text box.

CCT Electricity consumption by commercial sector

Office Blocks	60%
Hotels	4%
Hospitals	18%
Shopping malls	18%

Source: Preliminary Energy Outlook for South Africa, 2001

Informal Sector

A detailed analysis of the CCT informal sector in relation to energy has not been undertaken to date, although various studies cover this issue on a project or area basis, both in CCT and nationally. While total energy consumption by this sector is not a significant component of overall energy use for CCT, access to appropriate energy sources is vital to the development of this sector. Given the significant role of this sector in both economic output (12% of GGP) and employment (18% of total), and that it has been flagged for development, this is an area requiring attention.

A great range of business opportunities are exploited by the informal sector. Research shows that many of these benefit from the use of electricity[9], for example through enabling:

- Refrigeration and freezing at shops, spazas and bars (with improved nutritional value of food, and cool liquid refreshments)
- Indoor lighting (enabling businesses to be open at night more easily)
- Machines for sewing and knitting for home industries

[8] Energy Futures 2000/2001, JJ Doppegieter, J du Toit, E Theron, Institute for Futures Research
[9] National Electrification Programme Evaluation, Interim Outcomes Report: WCape (Khayelitsha) programme evaluation, May 2001, EDRC, UCT

- Small scale manufacture machinery (shoe making, metalwork)
- Machinery/tools for small workshops, panelbeaters etc
- Cooling (fans)
- Office equipment (computers)
- Entertainment and TV (particularly important for income generation at bars etc)

However, other informal businesses use wood or gas, or even coal, such as roadside food vendors and bakeries.

Eskom has an SMME support department aimed at increasing the financial viability of its electrification programme (the Community Development Fund) through stimulating local economic development, so improving incomes and increasing electricity consumption in an area. The annual national budget for this venture is R 4 million. The initiatives include facilitating support for existing businesses and as well as initiating and supporting the development of new businesses.

5.4 ENERGY EFFICIENCY

Electricity prices in South Africa are very low by world standards. While this has the effect of increasing the competitiveness of businesses, it does not promote efficiency. Potential for, and benefits from improved efficiency are vast, judging by the following:

- Energy savings potential in commerce and industry lie between 10% and 30%, with savings equal to 12% of final energy consumption and 19% of total installed generation capacity realizable[10].
- The Department of Minerals and Energy have indicated that end-use energy efficiency measures can save between 15 to 30% of current energy use and increase GDP by 3%[11].

The behaviour of the industrial and commercial sectors are largely determined by price. With the low price of electricity there is no incentive to adopt cleaner technologies, or more energy efficient practices. Generally therefore, South African industry and commerce pays little attention to efficiency except where particularly energy intensive. The same applies in Cape Town. However, activity in this area is increasing, as indicated by the below programmes:

- Eskom's energy efficiency demand side management (EE-DSM) programme for 2002 was aimed at the commercial and industrial sectors and households. The National Energy Regulator approved a 6.2% increase in budget for 2002 for the Eskom DSM projects.
- Three South African industries - South African Breweries, Anglogold and Sappi Kraft, volunteered for the 3E (Energy Efficiency Earnings) Strategy. This programme aimed to show how improving industrial efficiency could increase profits. A summary of the results is as follows:

Table 5.6: 3E Strategy results

Businesses	Costs of 3E Strat impl	Return	Payback period
South African Breweries	R 1 180 000	R 1 370 000	10 months
Anglogold	R 1 290 000	R1 990 000	8 months
Sappi Kraft's	R 32 220 000	R5 550 000	7 months

Source: Energy Efficiency Earnings – 3E Strategy, http:www.eri.uct.ac.za

The limited numbers of energy audits that have been done in Cape Town on commercial and industrial facilities show that substantial savings can be realised with minimal capital expenditure.

Opportunities for energy efficiency in industry and commerce exist in:

- End-use efficiency: improve end-user energy efficiency e.g. retrofit incandescent light bulbs with compact fluorescent light bulbs.
- Management: better monitoring systems can improve efficiency of systems by early detection and repair of leaks, conducting energy audits and monitoring energy use over time by setting targets.
- Individual behaviour change: awareness and training campaigns with staff can lead to huge savings.
- New technologies: in commercial buildings fibre optic lighting can reduce lighting costs by 50%, space heating requirements can be reduced by responsive computerised control systems and by passive solar design of buildings.

[10] Energy efficiency potential in the South African economy, 1996. EDRC, University of Cape Town.
[11] DME website.

5.5 EMISSIONS RELATED TO ENERGY USE

The combustion of fuels release local air pollutants and greenhouse gasses, which impact on the natural environment, human health and safety. The CCT energy-related emissions have been calculated by fuel type and by magisterial district, as shown in the following tables.

Table 5.7: Total energy consumption and emissions by fuel type

Annual Consumption		Local Air Pollutants %				Global GHG emissions %
Fuel	**GJ**	**Sulphur Dioxide**	**Nitrous Oxide**	**Carbon Monoxide**	**Particulates**	**CO_2**
Coal*	3 789 614	**23.21**	4.19	n.a	**79.67**	**44**
Anthracite	1 366	0.01	0	n.a	0.04	0
Coke	918	0.01	0	n.a	0.02	0
HFO	4 695 842	**73.58**	3.07	n.a	1.62	**45**
Diesel	232 014	0.55	0.14	n.a	0.41	2
Paraffin	725 131	1.74	0.46	n.a	0.73	6
Wood	61 275	0.01	0.06	n.a	0.19	0
Wood waste	500 042	0.05	0.6	n.a	1.98	0
Gas/LPG	347 470	0.82	**91.48**	n.a	**15.33**	3
Waste	1 056	0	0	n.a	0.01	0
Diesel / paraffin	6 920	0.02	0	n.a	0.01	0
Total	**10 361 650**	**100**	**100**	n.a	**100**	**100**

Source: Air Quality Dept, CCT, 2002.
**Coal used at Athlone Power Station has been included*
Notes:
- Diesel used by all vehicles is included in transport section, not in the above table
- Electricity has not been included

The largest percentage of sulphur dioxide emissions are as a result of the combustion of heavy furnace oil (74%) and coal (23.21%). Gas (91%) is responsible for the highest concentrations of nitrous oxide emissions and coal (80%) for the majority of the particulate matter. Coal (44%) and heavy furnace oil (45%) are responsible for the carbon dioxide emissions.

The total electricity consumption for commerce and industry results in 6 700 tons CO2 emissions per year. Because this sub-sector is the largest electricity consumer, and electricity is responsible for the vast majority of CO2 emissions, efficiency in this sub-sector must be a primary focus for GHG reductions.

Pollution inventories

The National Air Pollution Source Inventory Database of 1994 includes total annual emissions for Cape Town. The National Inventory has 20 industries operating a total of 88 scheduled processes in the City of Cape Town. CCT's emission inventory contains data for some of the fuel burning appliances for 6 industries operating scheduled processes. This data has been used to compute the local air pollutants from industry and commerce and, while useful, is of uncertain comprehensiveness.

Geographical spread of emissions

The highest concentration of local air pollutants and greenhouse gas emissions is in the Cape Town magisterial district, where the largest number of industries are located.

Table 5.8: Emissions by Magisterial District

Magisterial District	Local Air Pollutants Tons per year				Global GHG emissions Tons per year
	Sulphur Dioxide	Nitrous Oxide	Carbon Monoxide	Particulates	CO_2
Bellville	4 273	732	2 191	1 039	1 796 820
Cape Town	14 830	20 816	8 728	6 962	3 409 781
Goodwood	1 363	222	214	2154	1 314 725
Kuils River	1 035	86	1 305	212	44 456
Malmesbury	229	38	6	235	256 345
Mitchells Plain	67	668	415	786	609 031
Simons Town	22	4 161	1 849	643	103 248
Somerset West	1 65	58	19	973	275 351
Strand	18	12	6	30	85 153
Wynberg	2 898	1 509	577	8 803	3 241 766
Total	**24 903**	**28 300**	**15 313**	**21 838**	**11 136 675**

Source: Air Quality Dept, CCT, 2002.

According to the Air Quality Assessment and Framework Plan for Air Quality Management Plan Development by the City of Cape Town (March 2002) Cape Town, Goodwood, Wynberg and Bellville magisterial districts have the largest concentrations of local air pollutants. The main sources of pollutants are discussed below:

- Cape Town Magisterial District - Cape Town has the highest levels of sulphur dioxide and nitrous oxide levels. The Caltex oil refinery contributes more than 80% of the sulphur dioxide and more than 90% of the nitrous oxide emissions from heavy furnace oil combustion and other processes. Sappi Cape Kraft and Brick and Clay Plants' coal combustion is the other significant source of sulphur dioxide and nitrous oxide.
- Wynberg - Athlone Power Station, during power consumption peaks, is responsible for approximately 40% of the sulphur dioxide emissions within Wynberg. BMD Knitting Mills and Puma Jersey's use of coal and heavy furnace oil contribute 29% and 5 % respectively to sulphur dioxide emissions, with heavy furnace oil use at South African Sea Products contributing 7%.
- Bellville - Consol Glass and South African Nylon Spinners represent the major sources of SO_x and NO_x emissions in this magisterial district.
- Goodwood - Heavy furnace oil combustion by Migra Textiles and Colas South and coal use by Cotton Mills is the main sourced of sulphur dioxide emissions. The coal used by SBH Cotton Mills, Mondi Pak and Nampak are responsible for 60% of the industrial particulate emissions.

5.6 TRENDS AND DEVELOPMENTS

- The City of Cape Town, in partnership with South South North capacity building programme on Clean Development Mechanisms, is investigating the possibility of capturing methane from existing landfill site and selling it to Consol Glass.
- The Draft National Electricity Regulator Energy Efficiency and Demand Side Management Policy is likely to have implications for energy efficiency obligations of local authorities, including programmes involving commerce and industry.
- The South African Institute of Chartered Accountants has recently issued its practice statement SAAS 2051 which requires auditors to include environmental matters into consideration when they audit financial statements of a company. This has implications for energy use and efficiency.
- 45% of 2.2 million tons of waste generated in City of Cape Town is generated by commercial activities and industries. BECO Institute for Sustainable Business has a number of initiatives with industry aimed at waste minimisation which reduce not only waste, but energy and water consumption.
- Other initiatives to reduce waste, and thus energy use, are a free waste information exchange where businesses can list their waste free of charge (www.capetown.gov.sa/iwex) and the Fairest Cape Association offers services to encourage waste minimisation, re-use and recycling.
- The Department of Trade and Industry launched a National Cleaner Production Centre in collaboration with UNIDO in September 2002. The centre is situated at the CSIR's Process

Technology Centre in Pretoria, and is part of the CSIR Manufacturing and Materials Business Unit. The Business Unit supports the manufacturing and materials industry in achieving global competitiveness. Industries can use this Centre to access information and resources to use cleaner technologies.

- The Metropolitan Spatial Development Framework (discussed in more detail earlier) has prioritized growth in the South East Metro, with the Inner City CBD, Northern and Southern Suburbs having a lower priority. Other economic development initiatives or studies include (both discussed earlier):
  - Gugulethu / Manenberg Spatial Development Framework
  - Nigeria Way Development Framework (Epping)
- Oilkol Pty Ltd is the first used-oil collector in Africa to have ISO 14001 listing. It operates a road tanker fleet on behalf of ROS and collects used oil around the country and has a depot in Brackenfell, Cape Town.

5.7 ISSUES

		Priority
Issue 5.1:	**The international investment market is increasingly discerning and is looking at energy efficiency as an important component of investment decisions.** Greater energy efficiency in industry and commerce will increase Cape Town's competitive advantage internationally.	**MEDIUM**
Issue 5.2:	**There are numerous feasible opportunities for improving energy efficiency in commerce and industry.** The 'cheapness' of Cape Town's electricity means that there has been little incentive to be more energy efficient. However, the increasing cost of electricity (particularly as environmental costs have to be accounted for) means that industry and commerce need to start implementing EE programmes now.	**MEDIUM**
Issue 5.3:	**Industry is one of the more significant contributors to global and local air pollution problems in the Cape Town area.** As this sub-sector is the largest electricity consumer, and electricity is responsible for the vast majority of CO_2 emissions for CCT, efficiency in this sub-sector must be a primary focus for greenhouse gas reductions.	**MEDIUM**
Issue 5.4:	**Energy needs in the informal sector are not well understood, yet supporting this sector is a priority area for attention in Cape Town.** However, energy needs are only one of the needs for small and informal business growth, and a more complete development package needs to be provided in parallel.	Normal

6. Transport Sector

Cape Town's transport energy demand is shaped by a number of factors. The urban spatial structure, which is characterized by urban sprawl and the location of townships far from employment areas, results in long daily commutes. Transportation is dominated by road vehicle demand which results in annual growth in motor vehicles and congestion on already-stressed city roads. Due to a lack of intergovernmental coordination and integrated public transportation planning, the public transportation system perpetuates road-based transport rather than rail, and fails to provide efficient transport options to all residents. The combined result of these factors is high consumption of petrol and diesel because of the lower efficiency of road-transport compared with public rail transport, and correspondingly, high emissions that threaten environmental sustainability and the health of Cape Town residents. The result is a decline in other quality of life indicators such as time spent commuting, levels of stress, and customer choice.

Data Gaps

Within the scope of this study, air and sea travel were not investigated due to the difficulty of obtaining information on the quantity of fuel consumed. Since transport energy demand is dominated by road vehicle consumption, and key energy issues for the City revolve primarily around rail and road transportation, the authors opted to narrow the focus accordingly.

However, information on air and sea travel should be included in future reports. During 2001 the Port exceeded its theoretical maximum capacity of number of containers moved per annum, and plans are in place to expand the container terminal.[1] This indicator of economic activity suggests that sea transport demand is increasing and should be captured. The same applies to air travel. The World Energy Council reported that in recent years, South Africa has experienced large growth in demand for aircraft fuel, primarily due to increased tourism.[2] In the case of Cape Town, international tourist numbers have increased and are influencing air travel patterns.[3] Since sea and air transport generates carbon emissions, fuel-related data from these sectors should inform future analyses.

6.1 OVERVIEW OF THE TRANSPORT SECTOR

Urban Spatial Structure

In Cape Town, as in other major South African cities, settlement patterns are characterised by urban sprawl and apartheid planning, both of which affect passenger transport. Urban sprawl - resulting from the development of low-density suburbs and mono-use residential Group Areas on the periphery of the city – have increased travel distances to work and reduced the efficiency for public transit, which in turn causes increased private car use. Residents from lower income areas travel on average 15.5 km on a home to work trip, compared to those from higher income areas that travel on average 12.6km.[4]

The transportation patterns resulting from both urban sprawl and apartheid planning have damaging environmental and social impacts. High rates of fuel consumption result in high carbon emissions, which impact on the environment. Long commutes also require longer days away from home, less productive time, and increased vulnerability to transportation-related incidences, which decreases the quality of life, primarily for the poor.

Road-based private transport

Private transport is the dominant form of transport used in Cape Town. In absolute numbers, vehicle ownership increased by 45% in the 10-year period from 1990 to 2000, with the number of registered vehicles in all classes in 2000 reaching 825 000.[5]

There is a strong link between vehicle population and energy demand, particularly where average trip lengths and efficiencies do not change significantly over time. A crude indicator of passenger fuel demand

[1] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 125.
[2] ERI, Preliminary Energy Outlook for South Africa, 10 October, 2001, pg.47, which obtained this fact from World Energy Council, Global Transport Sector Energy Demand Towards 2020, 1996.
[3] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 126.
[4] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 117 sourcing CMD, 1997/8.
[5] City of Cape, City of Cape Town State of Environment Report Year 4, 2001, pg. 117.

per person is the number of private vehicles per 1000 of the population.[6] In 2000, there were on average 178 vehicles per 1 000 people.[7]

This growth in the number of vehicles on the existing road network causes increased congestion. During peak periods the capacity of road networks in certain areas of Cape Town is exceeded, and in other areas it is reaching full capacity. As Table 6.1 shows, the number of private motor vehicles entering and leaving the Cape Town CBD has been growing steadily over the last several years.

Table 6.1: Light motor vehicles entering and leaving Cape Town CBD over 12 hr period (7:00 to 19:00)

Year	Inbound	Outbound
1994	123 985	125 181
1995	135 723	129 231
1996	144 586	137 003
1997	148 078	142 634
1998	NA.	NA.
1999	NA.	NA.
2000	NA.	NA.
2001	157 452	163 639

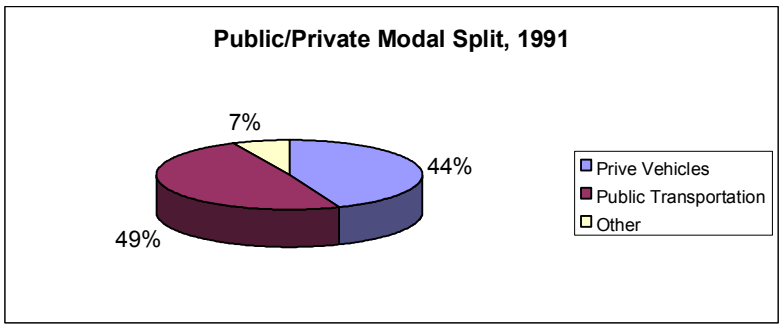
Source: Annual Vehicle Screenline Survey – Cape Town CBD 2001. City of Cape Town, Directorate: Transport, Roads and Stormwater (Vol. 1 & 2). NA – not available

This overall shortage of capacity is a result of the lack of investment in both road and transportation infrastructure.[8]

Public/Private Modal Split

Household interview surveys conducted in 1991 assessed Cape Town's public/private/other model split at 49/44/7. While there have been no recent surveys to establish the current modal split in Cape Town as a whole, the Transport Roads and Stormwater Directorate of the City stated that in 2000/2001 the proportion of trips made by public and private transport is unlikely to have changed much.[9] Within the City of Cape Town, the private/public modal split is commonly regarded to be approximately 50%.[10]

Figure 6.1: Public/Private Modal Split, 1991



Data Source: Moving Ahead, Cape Metropolitan Transportation Plan, Part 1: Contextual Plan, September 1998

Significantly, the public/private modal split for the Central Business District (CBD) differs from that of the wider metropole with the percentage of private vehicle use varying between 50% and 55%. This is unique when compared to international cities where CBDs usually attract the highest proportion of public transport users. One reason for this discrepancy is the fact that the metropolitan modal split is greatly influenced by the high number of captive public transport users compared to the CBD work-force which consists primarily of higher income white collar workers who use private transportation.[11] As discussed elsewhere, local government has set targets to increase overall reliance on public transport over private vehicles, as the use of motor vehicles for passenger transport is the least efficient per passenger in terms of congestion, energy consumption and emissions.

[6] ERI, Preliminary Energy Outlook for South Africa, 10 October, 2001, pg. 45.
[7] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 117.
[8] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 116.
[9] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 8.
[10] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 117.
[11] City of Cape Town, Moving Ahead, City of Cape Town Transport Plan, Part 1: Contextual Framework, Sept. 1998.

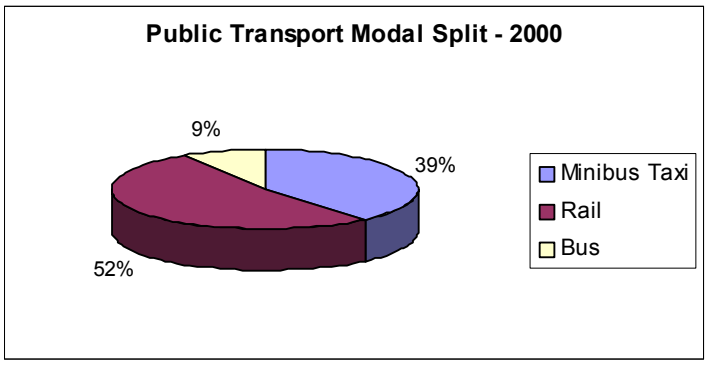
Public Transportation

Approximately 50 percent of all trips made by people in the metropolitan area are made on public transportation. In 2000, during a typical weekday morning peak period of two and a half hours, a total of 442 000 passengers used rail, bus and minibus taxi services in the metropolitan area.[12]

Public Transport Modal Split

Public Transport Modal Split shows the percentage of commuters using each of the three public transportation nodes. As figure 6.2 illustrates, 52 percent of all CCT public transport commuters use rail each day, while 39 percent use minibus taxis and 9 percent use buses.

Figure 6.2: Public Transport Modal Split – 2000



Data Source: Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, 2002

Figure 6.2 shows an enormous growth in the minibus taxi industry over recent years with the minibus taxi market share more than doubling in the past ten years. It also shows how the bus industry has suffered as passengers have transferred to one or both of the other modes of transport.

The total number of passengers carried on all public modes in the morning peak period has only increased by 4 percent since 1998. [13] As table 6.2 below illustrates, all of this growth has gone to minibus taxis and has resulted in both a relative and an absolute decline in ridership on bus and rail service.

Table 6.2: Passengers Carried by Mode of Public Transport

Passengers Carried by Mode of Public Transport						
Mode	**1991**	**1998 AM**	**2000**			
			AM	**Interpeak**	**Evening**	**Total**
Minibus Taxi		100 000	152 000	172 000	130 000	454 000
	12.20%	24%	34.40%	47.30%	35.30%	38.70%
Rail		265 000	249 000	160 000	205 000	614 000
	55.10%	62.40%	56.30%	44.00%	55.70%	52.30%
Bus		60 000	41 000	32 000	33 000	106 000
	32.70%	14.10%	9.30%	8.70%	9.00%	9.00%
Total		**425 000**	**442 000**	**364 000**	**368 000**	**1 174 000**

Note: Includes all recorded boardings, including transfers between vehicles and modes, but excludes taxi boardings not made at ranks.
Source: Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, 2002

Public Transportation Services

Local government has always participated in the planning for public transport, but operators for each mode have implemented services independently. This section provides an overview of each of Cape Town's transportation modes.

Rail Service

All commuter rail services in Cape Town are currently provided by Cape Metrorial, which is a business unit of the parastatal company Transnet (Pty) Ltd. In 2000/2001 at peak travel times, Metrorail operated 90 trains sets on 16 service lines, made 183 train trips and accommodated 249 000 passengers.[14] This network serves mainly the southern and the eastern areas, with no commuter rail routes to the northern area of Cape Town.

[12] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 8.
[13] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 4.
[14] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 14.

Cape Town's rail network is the most extensive of any city in South Africa and forms the backbone of the public transport system.[15] Fifty-two percent of all public transit users travel by train, which has several benefits. As Table 6.6 later in this chapter demonstrates, unlike other vehicular modes, rail does not emit any PM2.5 and N0x and is therefore preferable from an urban emissions point of view. Further, for passengers rail is the cheapest form of transport (and requires lower government subsidization) and is therefore essential in ensuring that the poor have affordable access to work and other activities.[16]

However, rail faces several challenges. It currently has rail routes with infrequent stops and transfers, long train sets operating at low frequencies, a multi-class system, timetable operations and limited access control at stations.[17] This differs substantially from typical metro systems found in many large cities in the world. Clearly, rail planning needs to incorporate some of the user-oriented features of metro systems to continue to make rail relevant to a wide group of customers.

Of more immediate concern is the finding of the 2000/2001 transportation survey[18] that some of the dominant rail lines are experiencing a capacity shortfall in the peak directions in the peak periods. Of particular significance, the Khayelitsha service line carries more passengers than any other individual service line (i.e. 20 percent of the total morning peak period rail passengers), but on the busiest section of the line it carries 37 percent more than the carriages are designed for. Capacity shortfall on this service line has grown from 20 percent in 1998. The Mitchell's Plain line (which carries 14 percent of all rail passengers in the morning peak) experiences up to 13 percent capacity shortfall. Since measuring capacity shortfalls on these two lines in 1998, additional capacity shortfalls have also since been measured on the Wellington and Muldersvlei lines.

Rail system upgrading and maintenance funding has been inadequate for a number of years, which has resulted in the declining service standards, reduced levels of use, and removal of train sets from service. However a recent announcement indicates that Metrorail and national government will commit over R30 Billion over a 10 year period for the expansion and upgrade of the South African Rail network. In Cape Town, this is likely to include the upgrading and maintenance of existing routes and the extension of the Khayelitsha rail line.

Bus Service

The dominant operator of passenger bus services in Cape Town is Golden Arrow Bus Services (Pty) Ltd. In 2000/2001 at peak travel times 687 (of a total 770) buses operated and accommodated 38250 passengers[19].

The bus service was designed as a hub-and-spoke system of primarily feeder services to the rail network. However, due to competition from minibus taxis and a lack of co-ordinated planning, the bus network has experienced a reduction in feeder services and an increase in more direct line haul routes. Route networks are extensive but underused: in the morning peak, 58 percent of all operational routes have only one bus trip, while only 7 percent have more than 5 trips in the same period.[20]

Some key issues that need to be addressed to ensure the provision of an efficient and safe bus service are[21]: high bus subsidies; duplication of routes by competing modes of transport; lack of coordination between fare structures, timetables and routes; and inadequate facilities at stops and interchanges.

Minibus-Taxi Services

The minibus-taxi services are provided by about 3500 private owners of over 10 000 taxis, operating as individuals or small businesses who are required to operate in terms of permits issued by the Local Road Transportation Board (LRTB). [22] In 2000/2001 during peak operating times, 6 128 vehicles operated on some 271 mini-bus taxi routes and accommodated 152 372 passengers.[23] They operate from about 80 formalised taxi ranks and about 100 other locations. The capacity of a minibus-taxi varies from 11 to 15 passengers.[24]

[15] City of Cape Town, Moving Ahead, City of Cape Town Transport Plan, Part 2: Public Transportation Operational Component, October 2001.
[16] City of Cape Town, Moving Ahead, City of Cape Town Transport Plan, Part 2: Public Transportation Operational Component, , October 2001.
[17] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 4.
[18] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 4.
[19] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 18.
[20] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 4.
[21] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 4.
[22] City of Cape Town, Public Transport Business Plan, 7 June 2002.
[23] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 22.
[24] City of Cape, City of Cape Town State of Environment Report Year 4, 2001.

The number and type of taxi services operating in Cape Town vary. There are feeder services to rail stations, long-haul routes providing direct services from origin to destination, and corridor services that 'trawl' for passengers along busy streets. Routes are generally defined by their origin and destination, and many are negotiated between taxi associations and the traffic authority. According to the 2000 transportation survey,[25] during the morning peak period the number of operational routes has increased from 217 in 1998 to 271 in 2000. The survey concluded that in many cases, routes mirror those of buses, leading to intense competition. The findings of the survey also confirmed that taxi usage is concentrated on routes between the metropolitan southeast and the three largest employment centres. The busiest five ranks (based on passenger boardings) serve 42 percent of all taxi passengers carried over the day. Three of the five – Cape Town, Wynberg, and Bellville – are work destinations while the remaining two – Mitchell's Plain and Khayelitsha – are residential areas.

Minibus taxis are old and generally in a bad state of repair, unregulated and unsafe. As discussed earlier, the associations have been brought into a national consultative process with the National Taxi Task Team to address problems within the industry.

Subsidies for Public Transport Modes

Subsidies are not uniformly applied, which impacts the sustainability of transit in the long-term. Bus subsidies are designed to benefit specific communities, and are not necessarily related to operating costs. Rail subsidies are determined as the difference between total costs and revenue from ticket sales, rather than on a per-trip basis.[26] As Table 6.3 below shows, bus services have received steady increases in subsidies over the years, while train subsidies have experienced sharp fluctuations. This is out of context given the fact that 52 percent of public transit users use rail vs. 9 percent who use buses.

Table 6.3: Bus and Rail Subsidies 1990 – 2001 (in million Rands)

Mode	Year											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Bus	45	51	44	54	59	70	86	120	160	240	200	275
Rail	110	132	154	176	198	220	229	248	255	150	230	240

Source: City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001.

Metered Taxi and Tourist Services

Metered taxi services and tourist services are provided by private owners grouped into associations or tour operators, who are required to operate in terms of permits issued by the Local Road Transportation Board (LRTB). There are 500 metered taxis operating in the City.[27] They provide a personalized service to individuals or small groups travelling together. Most official ranks are in the CBD, at the airport and other tourist attractions, and a large number of passengers arrange transportation through centralized dispatch operators. The 2000 transportation survey found that the variation in service and methods used by passengers to arrange a fare make it difficult to properly document the true demand for these services.[28]

Non-Motorised Transport

Walking and cycling account for only approximately 7 percent of the City's trips due to neglect in the planning, design and operation of streets. Local planners and developers are, however, beginning to recognise the need for greater use of these modes and their potential contribution to achieving an efficient, liveable and sustainable city.

Bicycling

The bicycle is an affordable, space-efficient, low-maintenance method of personal transportation that promises future growth. In urban areas, bicycles can substitute for automobiles, reducing traffic congestion and lowering air pollution and noise. Bicycles take up one thirtieth the road space used by cars traveling at a moderate pace.[29]

A number of cities, particularly in industrial countries, are promoting the bicycle as a sustainable form of

[25] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 4.
[26] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002, pg. 28.
[27] Transport, Roads and Stormwater, City of Cape Town, Public Transport Business Plan, 2002/2003-2004/2005 Financial Year, June 2002.
[28] Arup (PTY) Ltd for the City of Cape Town, Public Transport in Cape Town, June 2002.
[29] Earth Policy Institute website: http://www.earth-policy.org/Indicators/indicator11.htm, 2002.

transportation by developing cycleways and offering incentives for using bicycles for commuting. In Copenhagen, one third of the population commutes to work by bicycle; in all of Sweden's urban areas, 1 out of every 10 trips is taken by bicycle; and in the Netherlands, bicycles are used for 27 percent of all trips.[30]

Bicycling in Cape Town

Bicycle lanes totalling 81km have been implemented in Cape Town, and the City manages a Bicycle Locker Demonstration Project at railway stations.[31] However, certain factors discourage increased bicycle usage in the City area, the main one being the perception that it is unsafe in terms of road safety, personal safety and the security of personal belongings of cyclists. Further, cultural perceptions among South Africans result in higher aspirations for driving a private motor vehicle than cycling to work and a gender perspective that discourages women from travelling by bicycle.

Pedestrians

City planners and engineers have begun to realise the contribution of pedestrian activity to achieving an efficient, liveable city. European cities are renowned for their public spaces and pedestrian walkways, which contribute to making them international attractions. The merits of these planning approaches are causing them to be adopted throughout the rest of the world.

Pedestrians in Cape Town

Cape Town has an absence of a pedestrian culture due to a number of factors. For one, the lack of an integrated approach between spatial and transportation planning and between the various spheres of government often results in the creation of hazardous pedestrian areas. The City's housing crisis and continuing densification of the urban population in low-income township areas result in informal settlements along vacant strips of land. The sites that residents choose for informal settlements are often on vacant land along road reserve areas that are earmarked for high speed mobility routes or even inside rail reserves with active train services, as is the case presently in Khayelitsha. As a result, pedestrian safety becomes a burning issue.[32] Furthermore, due to a bias towards car-orientated engineering and planning, pedestrian facilities do not always receive the attention that they deserve.

Governance

Public Transport planning, infrastructure and service provision is legislated in terms of the National Land Transportation Act, Act 29 of 2000 (NLTTA). The NLTTA defines the roles of the various government institutions by distributing functions and devolving responsibilities to the lowest competent level.

The responsibility for rail funding and concessions currently rests with the National Department of Transport. The Provincial Administration of the Western Cape exercises control of bus subsidy funds, service contracts and the regulation of minibus taxis. With the establishment of the Transport Authority for the CCT, the range of functions assigned to the transport authority is determined through a formal agreement between the Province and the CCT. At this time, local government provides public transport planning and service integration, the provision and management of facilities, the provision and regulation of municipal public transport services and the surveying of and dissemination of information.

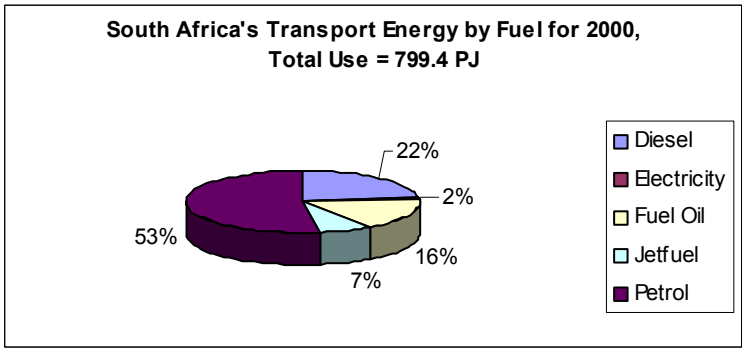
The CCT and the Provincial Administration of the Western Cape are in the process of restructuring public transport, but these fractured institutional arrangements have complicated it. Since the local and provincial authorities have less control over rail services, restructuring has focused on road based public transport,[33] which threatens the development of an efficient and sustainable transport system.

6.2 ENERGY USE WITHIN THE TRANSPORT SECTOR

Like the rest of the world, South Africa's transport sector is predominantly dependent on oil. In 1995, 97 percent of the national energy consumption for transport was met with liquid fuels, 0.3 percent with coal and 2.7 percent with electricity. In terms of primary fuel supply, 22 percent of the liquid fuel was produced from locally-mined coal at the Sasol synfuels plants, and the remaining 78 percent from imported crude oil refined locally.[34]

[30] Earth Policy Institute website: http://www.earth-policy.org/Indicators/indicator11.htm, 2002.
[31] City of Cape Town, City of Cape Town Policy for Non-Motorised Transport, Draft, 22 January 2003.
[32] City of Cape Town, City of Cape Town Policy for Non-Motorised Transport, Draft, 22 January 2003.
[33] Transport, Roads and Stormwater, Public Transport in Cape Town, Summary of CPTR 2000/2001, June 2002, pg. 5.
[34] Energy Research Institute, University of Cape Town, Preliminary Energy Outlook for South Africa, 10 October 2001.

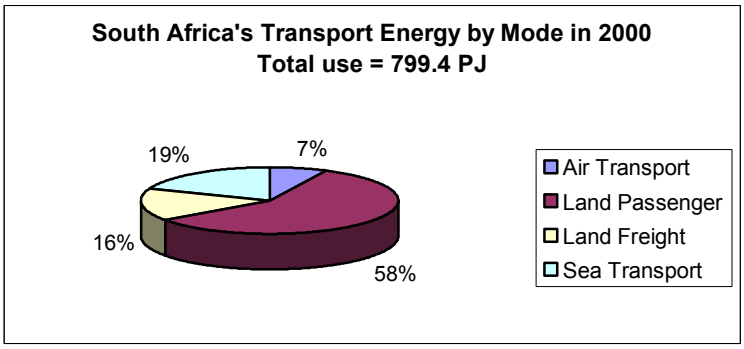
Figure 6.3: South Africa's transport energy by Fuel for 2000



Data Source: Energy Research Institute, University of Cape Town, Preliminary Energy Outlook for South Africa, 2001.

Air transport uses jet fuel (which is almost identical to paraffin) for gas turbine engines; marine engines use almost entirely diesel; and land transport uses predominantly petrol and diesel with some electricity use for trains. Figure 6.4 below shows South Africa's proportion of energy use by mode.

Figure 6.4: South Africa's transport energy by Mode for 2000



Data Source: Energy Research Institute, University of Cape Town, Preliminary Energy Outlook for South Africa, 2001.

This diagram shows that land transport, and specifically passenger transport, uses the most energy on a national basis. Because land transport is largely petrol-based, this fuel is the chief source of transport energy.

While corresponding data specific to Cape Town was not found during research for this study, the City's transportation modal uses suggest that energy use by type and mode will likely be very similar to that of the rest of the country. Since Cape Town has higher rail and sea transport compared to the rest of the country overall, the proportion of electricity and diesel consumption may be slightly higher.

Transport Energy within Cape Town

Transport accounts for 54% of the CCT's total energy consumption. Using fuel sales in the CCT as a proxy for the CCT's vehicular fuel consumption, the CCT consumed about 1 700 million litres of petrol and diesel in 2001 (see table 6.4). Petrol accounts for 68% of total transport energy used, while diesel accounts for 32%.

Table 6.4: Petrol and diesel sales in the CMA 1997-2001

Year	Petrol	Diesel
	Litres	litres
1997	1,155,337,268	389,774,227
1998	1,175,408,164	425,256,164
1999	1,206,150,970	441,601,428
2000	1,183,225,512	503,028,925
2001	1,188,430,310	517,069,766

Data Source: Deon Mannefeld, Caltex, 2003.

As Table 6.4 above indicates that petrol and diesel sales in the CMA have been increasing over the past years. It has been estimated that petrol and diesel sales in the CCT will grow at an average of about 3-5 percent per annum over the next five years.[35]

Emissions

As the Table 6.5 below shows, transport pollutants have significant effects on local air quality, global warming (measured below in terms of global warming potential – GWP), and human health.

Table 6.5: Transport Pollutant Effects

Pollutant	GWP	Other Effects
CO	(I)	Slows reflexes, drowsiness
NOx	(I)	Reduces resistance and lung infection
HCx	(I)	Drowsiness, eye irritation and coughing
O3	(I)	Reduced lung function
Pb		Affects circulatory system and nervous system
Particulates		Carcinogenic
SO2	(I)	Acid rain; lung disease
CO2	1	Greenhouse gas
CH4	64	Greenhouse gas
N2O	270	Greenhouse gas

(I) – Refers to indirect greenhouse gas.
Source: ERI, Preliminary Energy Outlook for South Africa, 2001.

M.C. Wicking-Baird *et al*. of the Energy Research Institute (ERI) produced an emissions inventory in their study of the Brown Haze phenomenon in Cape Town.[36] Table 6.6 shows the transportation emissions.

Table 6.6: Summary of primary atmospheric emissions from the transport sector in CCT (tons/year)

	Emissions (in tons/year and%)									
Transport	**SO2**		**N0x**		**VOCs**		**PM10**		**PM2.5**	
	Amt.	**%**	**Amt.**	**%**	**Amt.**	**%**	**Amt.**	**%**	**Amt.**	**%**
Petrol vehicles	1591	4.9	16848	59.4	33696	60.9	562	4.9	472	7.7
Diesel vehicles	2716	8.4	1781	6.3	460	8.3	1927	16.6	1773	29
Brake and tyre wear	0	0	0	0	0	0	86	0.7	0	0
Paved roads	0	0	0	0	0	0	2129	18.4	213	3.5
Unpaved roads	0	0	0	0	0	0	1391	12	139	2.3
Aviation fuel	46	0.1	576	2	470	0.8	33	0.3	30	0.5
Ship diesel	69	0.2	739	2.6	31	0.1	52	0.4	47	0.8
Ship bunker oil	1145	3.6	582	2.1	109	0.2	67	0.6	60	1
Total	5567	17.2	20526	72.4	34766	70.3	6247	53.9	2734	44.8

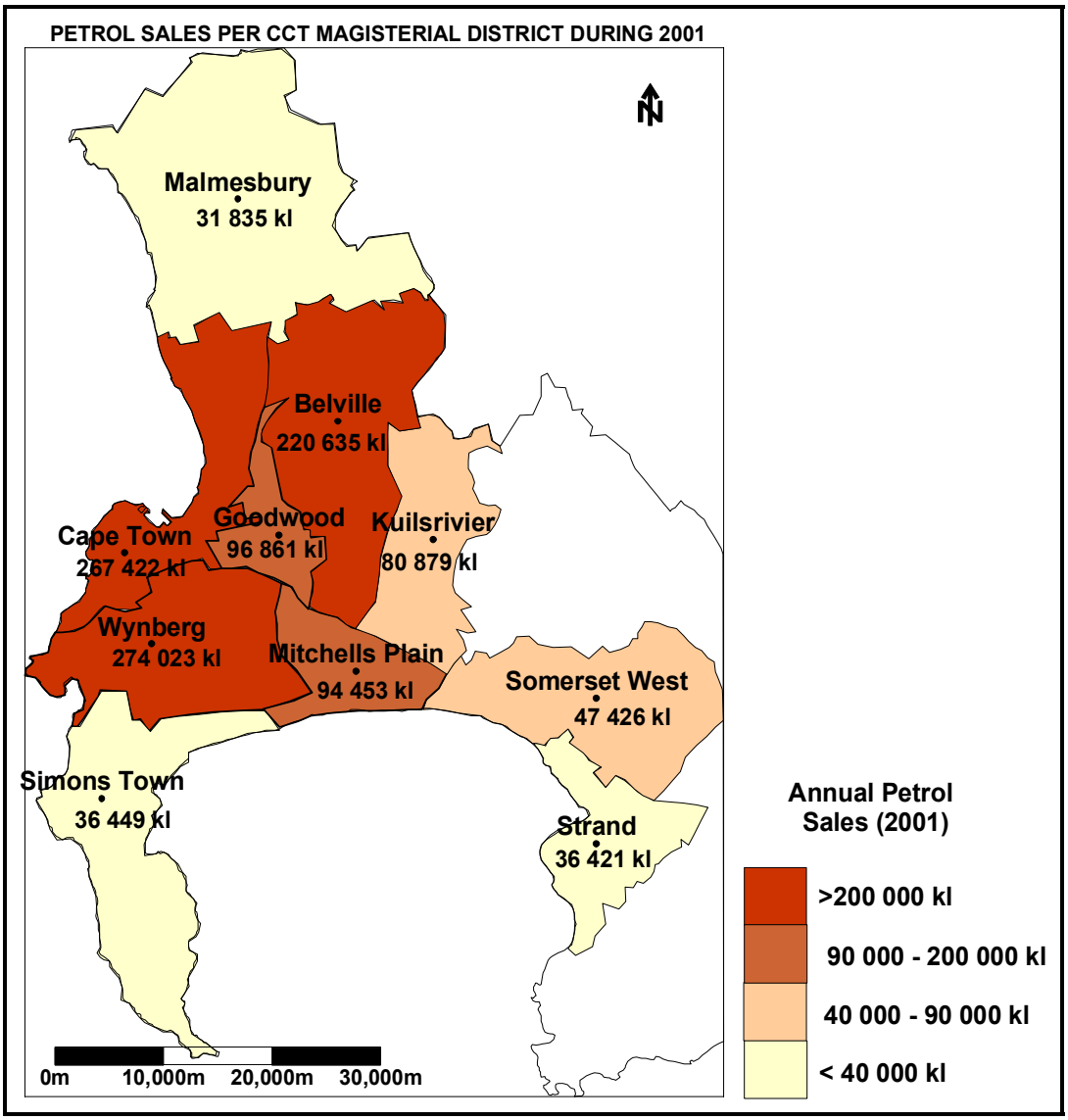
Data Source: Cape Town Brown Haze Study, Wicking-Baird et al., 1997

According to this study, the transportation sector is a significant contributor to all emissions. It contributes 17.2 percent to total sulphur dioxide emissions, 72.4 percent to total nitrogen oxide emissions, 70.3 percent to total VOCs, 53.9 percent to total PM10 and 44.8 percent to total PM2.5. The transport sector is also the most prevalent contributor to NOx, VOC and PM10. The authors calculated that emissions from vehicles are responsible for 65 percent of the Brown Haze phenomena over Cape Town, with petrol contributing 25 percent and diesels input approximately 40 percent.

The study mapped petrol sales by magisterial district to indicate the likely spatial distribution of vehicular activity and hence vehicle-related emissions.[37] The data is illustrated in Map 6.1 below:

[35] Wicking-Baird *et al*., Cape Town Brown Haze Study, 1997, pg. 60.
[36] Wicking-Baird *et al*., Cape Town Brown Haze Study, 1997, pg. 30.
[37] Yvonne Scrogie *et al*. for the City of Cape Town, Air Quality Assessment and Framework for Air Quality Management Plan Development by the City of Cape Town, March 2002.

Map 6.1: Petrol sales per CCT Magisterial district during 2001



In a business-as-usual scenario, the brown haze phenomena will likely be further exacerbated by the fact that (i) fuel consumption is growing and (ii) that the average age of vehicles is increasing. An increasing and ageing vehicle population will result in:[38]

- Greater quantity of emissions per vehicle
- Increased total emissions from vehicles
- More tyres available for burning
- Greater road dust emissions
- Greater fuel consumption and therefore greater VOC emissions from the entire fuel chain including refining and tanking filling.

Emissions by Transport Mode

As table 6.7 below indicates, different modes of transport vary considerably in terms of the quantity of fuel they consume and correspondingly, how much they emit. Showing the highest energy consumption per seat-km and total emission per passenger-km (other than for motocycles), motorvehicles stand out as the most environmentally inefficient form of travel. Conversely, other than walking and cycling, rail shows potential to be the most efficient mode.

[38] Wicking-Baird *et al.*, Cape Town Brown Haze Study, 1997, pg. 60.

Table 6.7: Characteristics of Different Transport Modes

Mode of Transport	Persons per hour per lane	Energy consumption per seat-km	Total cost per person-km (US cents)	Total emission per passenger-km (grams)
Walking	1800	0.04	Negligible	None
Bicycling	1500	0.06	0.2	None
Motorcycle	1100	N/A	N/A	27.497
Motorcar	440-800	0.29	8.6	18.965
Bus: Mixed Traffic	10000	0.12	1.4	1.02
Bus: Busway	1900	0.09	0.9	0.89
Light Rail Transit	1800	N/A	N/A	Coal: 4.35 Gas: 0.19 Fuel oil: 0.62
Rapid Rail Transit	54000	0.15	2.4	Coal: 4.97 Gas: 0.23 Fuel oil: 0.71

Source: ERI, Preliminary Energy Outlook for South Africa, 2001

For Cape Town, the Brown Haze study found that rail is most efficient in terms of the amount of PM2.5 and N0x it emits (See Table 6.8 below)

Table 6.8: Grams of Urban Emissions per Passenger km for Different Modes of Transport

Mode of Transport	PM2.5	N0x
car (petrol)	0.04	1.44
mini-bus (petrol)	0.016	0.58
bus (diesel)	0.15	0.15
rail	0	0

Source: Cape Town Brown Haze Study, Wicking-Baird et al., 1997.

Greenhouse Gas Emissions

Important quantifiable emissions from the transport sector that either directly or indirectly contribute to the greenhouse effect include: CO2, CH4, N2O, NOx, CO and SO2.[39] South Africa is a relatively large producer of GHGs, especially compared to other developing countries. Currently, transport emissions on a cradle-to-grave basis account for over 20 percent of CO2 emissions from South Africa's energy use, due to the high percentage of gasoline and diesel produced from coal.[40] In Cape Town in 2001, the amount of emissions of CO_2 resulting from petrol consumption was 2 815 566 kg[41] and from diesel consumption 1 487 441 kg[42].

6.3 CURRENT DEVELOPMENTS AND PLANS

The aim of the Transport Plan[43] for the Cape Town region is to provide "An effective, efficient, equitable and affordable metropolitan transport system that promotes sustainable social and economic development in an environmentally responsible manner". To this effect, numerous initiatives are being undertaken, some key ones of which are discussed in this section.

Urban Sprawl

The City of Cape Town has taken steps to address urban sprawl through its planning processes. Some initiatives relevant to transportation include:[44]

- In 2001 it adopted the *Metropolitan Spatial Development Framework (MSDF) Redraft*, to direct and contain patterns of urban growth and development to reduce the distances between places of residence and employment. The *Moving Ahead Metropolitan Transport Plan* was developed in support of the MSDF objectives to promote, among other things, high density public transport corridors and peak

[39] ERI, Preliminary Energy Outlook for South Africa, October, 2001, pg, 49.
[40] Jolanda Pretorius *et. al,* Transportation in Developing Countries – Greenhouse Gas Emissions for South Africa, February 2002.
[41] Calculated using 2001 petrol sales and a CO2 coefficient of 0.034.
[42] Calculated using 2001 diesel sales and a CO2 coefficient of 0.037.
[43] Cape Metropolitan Council, Moving Ahead, Cape Metropolitan Transport Plan, Part 1: Contextual Framework Discussion Document, September 1998, Cape Town.
[44] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001, pg. 104-107.

period counter flow movements to maximise the use of existing road infrastructure and reduce average trip lengths and travel times.
- In 2001 it adopted three urban edge studies, which form part of a growth management study to counter urban sprawl and direct the form and pattern of metropolitan growth.
- In 2001 it finalised a *Rural Management Study*, which formulates guidelines and policy recommendations for rural land use and management in the CCT.
- A Metropolitan Transport Authority (MTA) was established in 1998/99 to implement new legislation for land based transportation to ensure integration of transport planning with spatial and environmental planning processes.

Road-based Transport – Cleaner Fuels

Cleaner Fuel

The Department of Environmental Affairs and Tourism is developing a national vehicle emissions strategy in parallel with the development of national ambient air quality standards. The draft strategy would mandate tailpipe standards for both petrol and diesel vehicles, and recommends that European vehicle emission standards be adopted. European vehicle emissions controls represent international best practice.

The strategy is reliant firstly on the cleaning up of fuel. The changes envisaged for petrol content are: banning lead by 2006, reducing sulphur to 500 parts per million by 2004 and 50ppm by 2010, reducing benzine to 1% by 2010, and banning MMT, an octane booster in unleaded petrol, after 2006. Secondly, Government has proposed that catalytic converters be fitted to all new models of petrol vehicles by 2006 and to all new petrol vehicles by 2008 (for both imported and locally manufactured vehicles). Catalytic converters would reduce toxic vehicle emissions by approximately 90 percent.[45] The control of tailpipe emissions from diesel vehicles would lead to a significant reduction of sulphur content.

However, as the following overview of the introduction of leaded petrol shows, market uptake is not proving as promising as hoped.

Unleaded Petrol

South African petrols all contained lead as an additive until February 1996, when unleaded petrol was introduced. Government set a target for all vehicles to switch to unleaded petrol (ULP) by 2006. In 2002, it was reported[46] that a Shell SA survey revealed that eight in 10 SA motorists are still using leaded petrol six years after the introduction of the more environmentally friendly unleaded alternative. This is despite the fact that all but a fraction of the vehicles on SA roads could switch to unleaded fuel immediately without any adverse effect on their engines. Matlhetlhe Mosetlhi, manager of Shell's V-Power brand, said the survey revealed widespread ignorance about which cars could use unleaded fuel, and general confusion over the implications of government's 2006 target date for the complete conversion to leadfree products.

The survey findings prompted Shell to launch a consumer education campaign that will include interacting with customers on service station forecourts and disseminating information aimed at eradicating common misconceptions. A fuel compatibility table has been devised for publication on the internet and elsewhere so that motorists can check whether their cars are designed to use unleaded petrol.

Diesel Emissions Monitoring

Diesel emission monitoring teams have been deployed within the City for vehicle emissions testing. There number of vehicles failing the test has decreased from 11 percent to 6 percent, and there has been a 100 percent increase in the number of vehicles tested. Smoking diesel vehicles and air pollution can be reported to the City of Cape Town Air Pollution Control Centre.

Alternate Transport Fuels

Alternative transport fuels being considered globally include[47]: compressed natural gas (CNG), electricity, liquid petroleum gas (LPG), methanol, ethanol, rape-seed oil methyl ester (RME) (biodiesel) and hydrogen. The following clean fuel initiatives have been considered for Cape Town.

[45] Melanie Gosling, Plan for Cleaner Fuel Hailed as Boost for Health, Environment, Cape Times, November 14, 2002.
[46] David Marrs for Business Day, posted on the All Africa website, http://allafrica.com/stories/200207080136.html on July 8, 2002
[47] ERI, Preliminary Energy Outlook for South Africa, 10 October, 2001, pg. 54.

Liquified Petroleum Gas

Thousands of motorists abroad and in Johannesburg use LPG, a cheaper, more environmentally friendly product of crude oil, to fill their vehicle fuel tanks. In 2002, a black empowerment group, Kulani Africa Gas, opened its first gas filling station in Cape Town, offering not only a cleaner, but a potentially cheaper alternative. A gas conversion kit – which costs between R5000 and R7000 with fitting - enables motorists to switch between gas and petrol. Proponents explain that companies and private motorists who travel long distances can recoup the costs of a conversion kit in short periods of time.[48] LPG is a more desirable fuel from an environmental perspective as it does not contain benzene, lead, or sulphur and has low levels of nitrogen oxides. It also does not require a choke-up start, which results in less harmful, unburnt petrol emissions.

Electricity

ESKOM maintains that there is potential in South Africa for significant use of electric road vehicles. It believes that the cost of travelling by electric vehicle with inexpensive South African tarrifs is significantly cheaper than using gasoline or diesel.[49] Complete adoption of electric vehicles is hindered by inadequate battery design.

Biodiesel

Biodiesel is a diesel fuel derived from plant oils or animal fats. It can be used either neat or blended with petroleum fuel. To encourage production and use of biodiesel, government has introduced a 30 percent reduction on the liquid fuel levy tax applied against other liquid fuels used for transportation. Uptake of biodiesel is currently very minimal: it is only produced in small quantities in the Free State and KZN; production has not begun in Cape Town.

Inter-modal Competition

National, Provincial and Local Governments all have a public transport first policy, which require public transport to receive priority over private transport.[50] A long-term target has been set to reduce the public/private modal split for the CCT to 20:80 percent.[51] In the shorter term, the Overall Key Performance Indicator for the local Transport, Roads and Stormwater Branch is to increase this modal share of public transport from 50 percent to 54 percent by 2005.[52]

Public Transportation

Various initiatives have been undertaken to improve public transportation. Key initiatives include:

Public Transport Restructuring:

- The City of Cape Town and the Provincial Administration of the Western Cape are in the process of restructuring public transport. Since national government is responsible for rail services, the restructuring is focused on road-based improvements, despite the fact that rail service are an important part that needs to be integrated with road-based services.
- A taxi recapitalisation programme was initiated by the National Government so that qualifying operators can purchase new mini-buses. The intent is to help reduce overloading and the number of vehicles on the road.
- Selective routes are being tendered to increase network efficiency and end duplication of services.

Improving Service Delivery

- The Inner City Public Transport service, a new high frequency public transport service operating between the CBD, the Waterfront and Kloof Street is being initiated. It is intended to improve access within central Cape Town and to transport people within the City Bowl area to and from the CBD. Service is intended to commence in February 2003.

[48] Green Clippings, Issue No 14, December 2002.
[49] ERI, Preliminary Energy Outlook for South Africa, 10 October, 2001, pg, 57 which sources International Energy Agency, Cars and Climate Change, OECD, Paris, 1993.
[50] Transport, Roads and Stormwater, City of Cape Town, Public Transport Business Plan, 2002/2003-2004/2005 Financial Year, June 2002, pg. 3.
[51] Arup (PTY) Ltd, Public Transport in Cape Town, June 2002, pg. 4.
[52] Transport, Roads and Stormwater, City of Cape Town, Public Transport Business Plan, 2002/2003-2004/2005 Financial Year, June 2002, pg. 13.

Introducing Energy Efficiency

- The City of Cape Town plans to introduce 10 energy efficient buses to replace buses currently in use. These new buses will reduce fuel consumption from 43 litres/100 km to 36 lites/100 km.

Non-motorized Transportation

The City's goal regarding non-motorised transport is to "increase the use of bicycles and encourage walking by creating a safe and pleasant bicycle and pedestrian network of paths to serve all the citizens in the Cape Town Area."[53]

Bicyles

A number of bicycle planning projects and bicycle-related initiatives have recently been undertaken or are currently underway. These initiatives are listed below. [54]

- The Bellville - Cape Town class I bicycle path adjacent to the Bellville-Cape Town railway line
- The class I cycle path running from Guguletu to Zeekoeivlei along the Big Lotus River canal
- The Blaauwberg Administration cycle path network and identified demonstration projects
- The City of Cape Town Masterplan. The metropolitan cycle path network complements existing bicycle planning in local areas and will form an important consideration and guide in the development of local area bicycle planning where it does not exist.
- Khayelitsha Bicycle Study and identified demonstration projects. This study resulted from the interest created by the establishment of a NDoT-driven Shova Kalula bicycle shop in Khayelitsha.
- The NDoT's Shova Kalula Bicycle Transport Demonstration Program was launched in Khayelitsha to promote the use of non-motorised transport. It is especially targeted at primary and secondary school students in the most disadvantaged rural and urban settings.
- The NDoT has made funds available for bicycle planning and infrastructure provision projects in Mitchells Plain and Khayelitsha as part of a national government driven program called the Allocation for Poverty Alleviation, Infrastructure and Job Summit Projects.
- The City has initiated the Vukuhamba project, which focuses on job creation opportunities in poor areas. A possibility exists that bicycle projects can be implemented as part of this project.
- The City won the bid to host the Velo Mondial 2006 international bicycle conference. Velo Mondial focuses on how to promote and integrate the bicycle mode of transport in urban and rural areas.
- The City actively engages with lobby groups and interested and affected parties for bicycles in Cape Town, namely the Pedal Power Association, Afribike and the Bicycle Empowerment Network (BEN). Afribike and BEN promotes the distribution of second-hand bicycles to low-income individuals in township environments in Cape Town and also promotes the use of the bicycle in all of its forms in order to address low-cost mobility, health and access to opportunity, employment and education. BEN presently has bicycle workshops located in Masiphumulele township near Fish Hoek, Westlake, and Atlantis, all low-income areas in Cape Town. BEN is also presently managing the Afribike bicycle workshop in Khayelitsha.

Pedestrianism

Some initiative has been taken to address the need for pedestrian-oriented planning in the City:[55]

- The Western Cape Pedestrian Plan-Phase I: Audit Report[56] was compiled as a first phase of a Pedestrian Plan for the Western Cape Province. The audit report identified 50 pedestrian accident hazardous locations of which 84 percent are located in the City area.
- The City developed a Draft Traffic Calming Policy,[57] which provides one strategy for making residential streets safer for pedestrians and cyclists.
- Construction work on a project to upgrade the Heerengracht and Hertzog Boulevard centre islands will commence in early 2003 to create a more user-friendly environment for pedestrians. The Convention Centre, which will open for business in July 2003, will extend the very popular tourism hub of the Waterfront into the city centre. The intention is to upgrade the landscaping and general quality of the streets and pedestrian routes around the Convention Centre. This will involve re-paving the sidewalks and centre islands on the Heerengracht, Hertzog Boulevard, Coen Steytler, Hans Strijdom as well as adjacent side streets. Of specific concern are also pedestrian links such as the link between St George's

[53] City of Cape Town, City of Cape Town Policy for Non-Motorised Transport, Draft, 22 January 2003.
[54] City of Cape Town, City of Cape Town Policy for Non-Motorised Transport, Draft, 22 January 2003.
[55] City of Cape Town, City of Cape Town Policy for Non-Motorised Transport, Draft, 22 January 2003.
[56] CSIR, Transportek, Western Cape Pedestrian Plan-Phase 1: Audit Report, CR-2---/44, March 2000.
[57] City of Cape Town, Draft Traffic Calming Policy, approved on 27 September 2001.

Mall, Anton Anreith Place, Pier Place and the Convention Centre as the major pedestrian link. This project will be completed by the end of June 2003.

Governance

- As mentioned earlier, a Metropolitan Transport Authority (MTA) was initiated in the 1998/99 financial year, which aims to implement new legislation for land based transportation to ensure integration of transport planning with spatial and environmental planning processes.

6.4 ISSUES

		Priority
Issue 6.1:	**Planning for rail, bus and road-based transport are undertaken by separate spheres of government.** Since rail services are primarily a national function, local restructuring has focused on road based public transport, resulting in a generally inefficient and energy-intensive transport system. To integrate rail, bus and taxi services into an efficient and sustainable transport system that serves the needs of the population, direct local government involvement will be required in the provision of public transport services, and different modes of public transport controlled by different authorities will need to be integrated.	HIGH
Issue 6.2:	**High consumption of petrol and diesel in Cape Town results in significant releases of transport pollutants**, which have significant effects on local air quality, global warming, and human health. In Cape Town, vehicle emissions cause 65 percent of the Brown Haze phenomena, giving rise to undesirable effects including aesthetic spoilage and health impacts such as respiratory illness, lung infections, and eye irritation. Further, transport fuel use emits several direct and indirect greenhouse gases – in total, approximately 25% percent of total GHG emissions for Cape Town	HIGH
Issue 6.3:	**Cleaner liquid fuels options for transport are increasingly becoming available and financially feasible.** CCT could consider an active role in promoting fuels such as unleaded petrol, LPG, and biodiesel, amongst others, since transport emissions are a major component of total local emissions.	HIGH
Issue 6.4:	**Growth in the number of vehicles on City roads is undesirable as the use of motor vehicles for passenger transport is the least efficient per passenger in terms of congestion, energy consumption and emissions.** For example, increased car use causes increased congestion on the exiting road network – traffic jams release 4 times as much pollution as that from free-flowing traffic.	HIGH
Issue 6.5:	**As the most energy (and cost) efficient mode of transport, rail use should be expanded.** A targeted approach is needed to address the capacity shortfall experienced on dominant rail lines and to prevent further inadequacies in train services. Further, to make rail relevant to a wider group of customers, rail planning needs to incorporate some of the user-oriented features of metro systems.	HIGH
Issue 6.6:	**Urban sprawl causes long commutes, which result in higher transport energy consumption and a corresponding high release of carbon and other emissions**. Long commutes also require longer days away from home, less productive time, and increased vulnerability to transportation-related incidences, which decreases quality of life, primarily for the poor.	MEDIUM
Issue 6.7:	**An enormous growth in the minibus taxi industry over recent years corresponds with both a relative and an absolute decline in ridership on bus and rail service.** This trend is undesirable from an energy consumption perspective as rail in particular, but buses as well, are more energy efficient than minibus taxis.	MEDIUM
Issue 6.8:	**More compact city design with higher residential densities and the development of multifunctional habitats with reduce the need to travel, and improve quality of life and access to urban goods.**	MEDIUM

Issue 6.9:	**Lack of co-ordinated planning has resulted in intense competition between buses and minibus taxis, resulting in duplication on many routes**. In the case of buses, route networks are extensive but underused. This causes an inefficient use of transport energy.	Normal
Issue 6.10:	**Minibus taxis are old and generally in a bad state of repair, suggesting low energy efficiency.** The national government recapitalisation programme offers some help here.	Normal
Issue 6.11:	**Subsidies are not uniformly applied, which impacts the sustainability of transit in the long-term.** Bus services have received steady increases in subsidies over the years, while train subsidies have experienced sharp fluctuations. This is out of context given the fact that 52% of public transit users use rail vs. 9% who use buses.	Normal
Issue 6.12:	**Local planners and developers have not adequately integrated walking and cycling in the planning, design and operation of streets, which has resulted in low uses of these energy efficient modes of transport.** As a result, the benefit of using bicycles and pedestrianism to substitute for automobiles, reduce traffic congestion and lower air pollution and noise, has not been realized. Greater use of these modes has tremendous potential to contribute to achieving an efficient, liveable and sustainable city.	Normal

7. Local Authority

7.1 OVERVIEW OF LOCAL AUTHORITY

The local authority controls, or has a direct impact on, a host of functions and activities in the City. It is responsible for providing services to the population of 3.1 million people. It is the single biggest user in Cape Town and the single biggest employer (27 000 staff). Every day it makes numerous energy related decisions, and according to a recent survey, is involved in about 40 energy related activities or projects (listed in Appendix 3), many of which would benefit from strategic coordination and planning. The local authority's functions which involve energy use, include the following:

- Bulk water supply
- Storm water drainage
- Management of bulk wastewater
- Disposal of general and hazardous waste
- Facilitation of primary health services
- Libraries and museums
- Cemeteries and crematoria
- Regulation of fresh produce wholesale markets
- Regulation of abattoirs
- Facilitation and delivery of housing
- Provision of services such as water and electricity

The main activities, which use energy within these functions of the local authority, are:

- Vehicle fleet operation (petrol and diesel)
- Electricity for local authority buildings
- Electricity for streetlights
- Electricity for waste water treatment and bulk water supply

While the City's waste management activity is not an energy activity in itself, methane recovery from the landfill sites can provide the city with a substantial alternative energy source.

7.2 REGULATORY AND POLICY ENVIRONMENT

Although various regulations and policies relate to the supply and use of energy by various sub-sectors, there is little of relevance to energy use by the local authority itself. While national-level policies often exist regarding energy efficiency, for example, they do not explicitly obligate or involve local authorities. Given that the local authorities should be amongst the main implementing agents in many cases, this policy 'gap' is likely to impede implementation.

The National Electricity Regulator has released a draft energy efficiency policy for the country, and includes specific obligations for local authorities around developing electricity efficiency strategies and plans. There are a number of uncertainties regarding how this will apply to local authorities – firstly, it may apply largely to the new Regional Electricity Distributors (REDs) rather than the local authority; secondly, no content of the strategy is included and thus overall impact of the strategy remains uncertain; third, the policy may not require any changes in local authority energy use but rather focus on external users; and finally, the document is a draft and may change substantially.

7.3 OVERVIEW OF ENERGY DEMAND

The local authority activities use approximately 2% of the total energy consumed in Cape Town, as shown in the figure below.

Figure 7.1: Proportional Energy Consumption of Local Authority

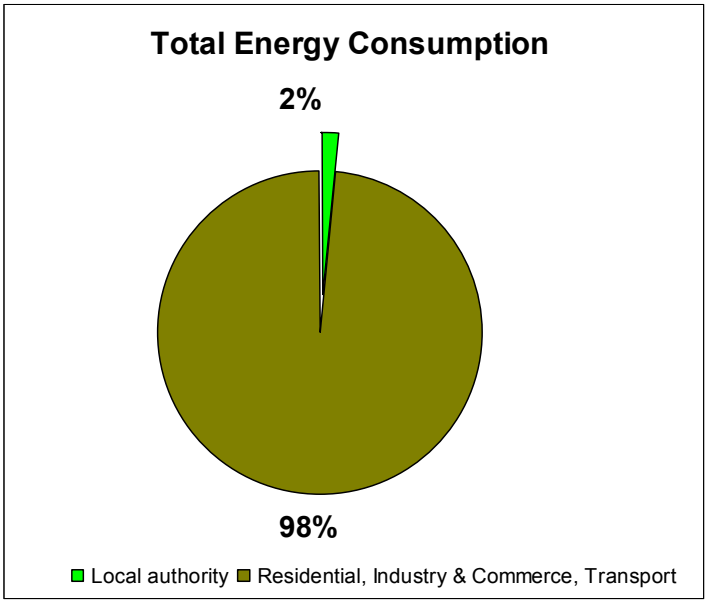


Table 7.1: Fuel and Electricity Consumption for Local Authority (annual)

Fuel	Local Authority	Total CCT	*Local authority %*
Petrol litres	8 257 373	1 196 687 310	0.7%
Diesel litres	20 803 313	543 993 426	3.8%
Electricity GWh	204	10 232	2.0%
Total energy	**1 784 679 GJ**	**110 231 787 GJ**	**2 %**

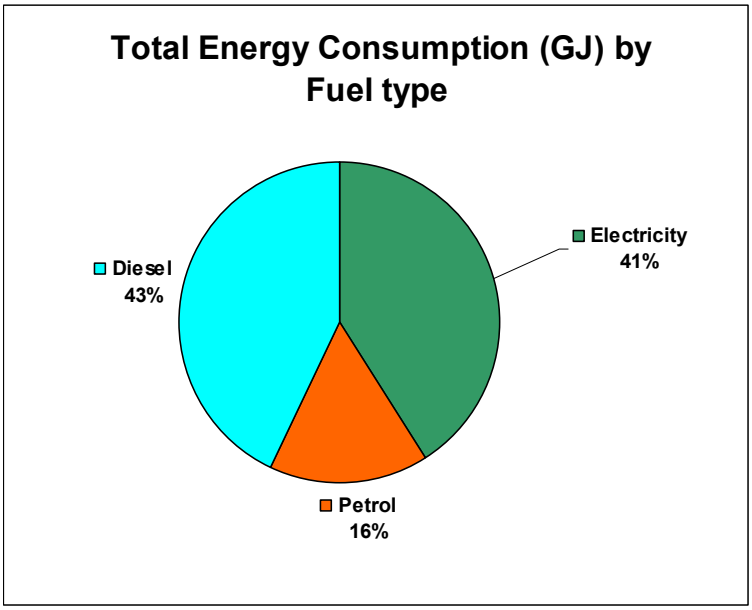
The total annual consumption of energy by the Local Authority is 1 784 679 GJ per year; 41% being attributed to electricity use and 43% to diesel use.

Table 7.2: Fuel and Electricity Consumption for Local Authority

Fuel	GJ/yr	%
Electricity	734,230	41%
Paraffin	0	0%
LPG	0	0%
Coal	0	0%
Petrol	280,738	16%
Diesel	769,711	43%
HFO	0	0%
Wood	0	0%
TOTAL	**1,784,679**	100%

Note: in order to avoid double accounting, coal and diesel used for electricity generation at Athlone Power Station and Roggebaai Gas Turbine are not included in this Table as they are accounted for in the electricity consumption tables.

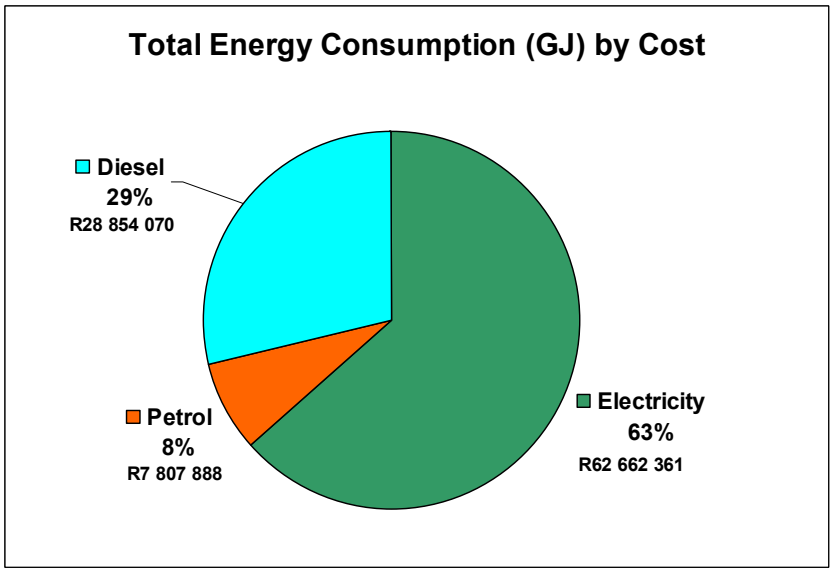
Figure 7.2: Total Energy Consumption for Local Authority by Energy Source



Cost of Energy

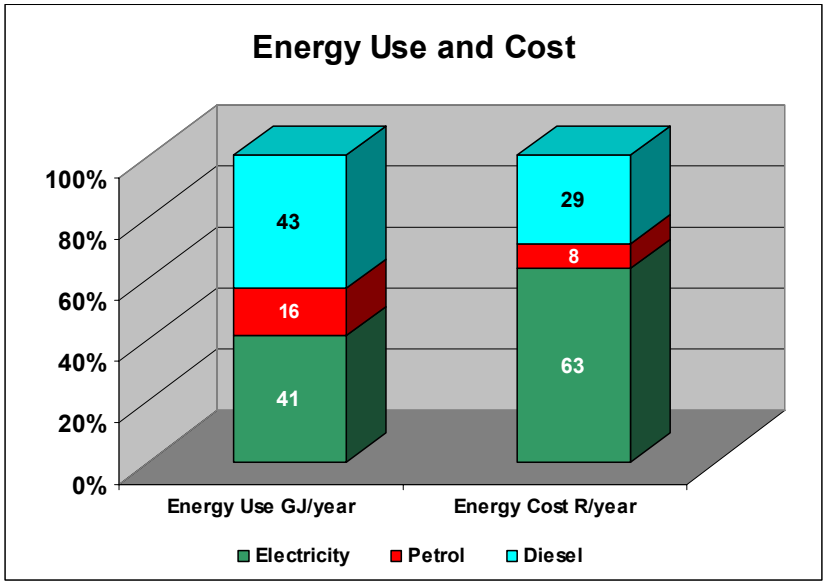
The City spends almost R100 million per year on petrol, diesel and electricity consumption. Energy saving measures therefore have direct and substantial money saving implications for the City. The figure below illustrates that, while diesel accounts for 43% of total energy use, it only comprises 29% of expenditure on energy, whereas electricity comprises the highest share of energy expenditure at 63%. This highlights the potential for financial savings linked to electrical energy efficiency initiatives.

Figure 7.3: Total Annual Cost of Energy Consumption for Local Authority[1]



[1] CCP database

Figure 7.4: Comparison- Local Authority Energy Consumption and Cost by Energy Source



Emissions

The Local Authority energy consumption has impacts on the local environment (petrol and diesel consumption and associated local emissions) and global environment (petrol, diesel and electricity consumption and associated CO2 emissions). The local air pollutants from electricity are not considered here as these are emitted at the coal power stations, which are mainly located in Gauteng and Mpumulanga.

Following is a table detailing the emissions by fuel type for the local authority's energy use. As discussed earlier in the report (see Energy Demand Section) the impacts of each local air pollutant differ. In terms of greenhouse gases, the local authority accounts for 313 675 tons of CO_2 , or 2.9% of total CO_2 emissions for Cape Town[2].

Table 7.3: Total Local Air Pollutants and Greehousegas Emissions for Local Authority [3]

Energy source	Annual Consumption GJ	Local air pollutants Tons per year			Global emissions Tons per year	
		Sulphur Dioxide	Nitrous Oxides	Particulates	CO_2	
Petrol	280 738	7 762	162 670	11 560	19 649	6%
Diesel	769 711	140 006	959 033	274 604	57 061	18%
Electricity	734 230	n.a.	n.a.	n.a.	236 965	75%
Total	**1 784 679**	**147 768**	**1 121 703**	**286 164**	**313 675**	**100%**

Note: The local air pollutants from electricity are not included as these are emitted at the coal power stations, most of which are located in Gauteng and Mpumulanga.

As shown in Figure 7.5, diesel use is responsible for the vast majority of local authority local emissions. In fact it is the primary contributor to the so called 'brown haze' of Cape Town, and therefore needs to be flagged for attention in efforts to improve air quality.

[2]Greenhouse Gas Inventory for the City of Cape Town (2002, draft): Research conducted by Sustainable Energy Africa in partnership with City of Cape Town's Environmental Management Department as part of the ICLEI Cities for Climate Protection (CCP) Campaign
[3] Greenhouse Gas Inventory for the City of Cape Town (2002, draft): Research conducted by Sustainable Energy Africa in partnership with City of Cape Town's Environmental Management Department as part of the ICLEI Cities for Climate Protection (CCP) Campaign

Figure 7.5: Local Air Pollutants from Local Authority Petrol and Diesel Use

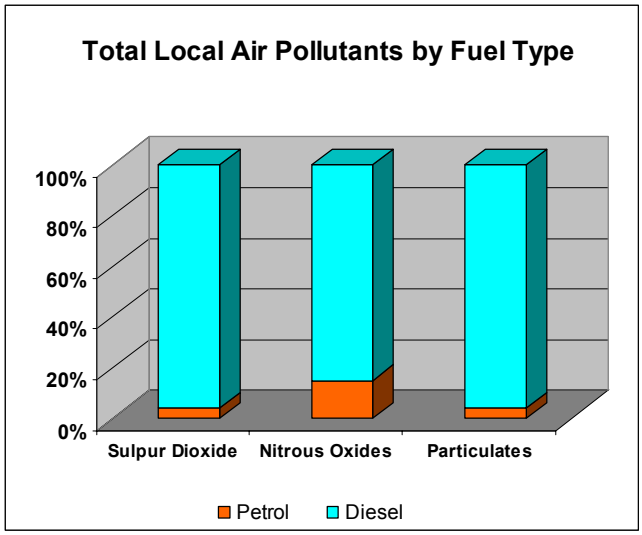


Figure 7.6: Local Authority share of Total Greenhouse Gas Emissions

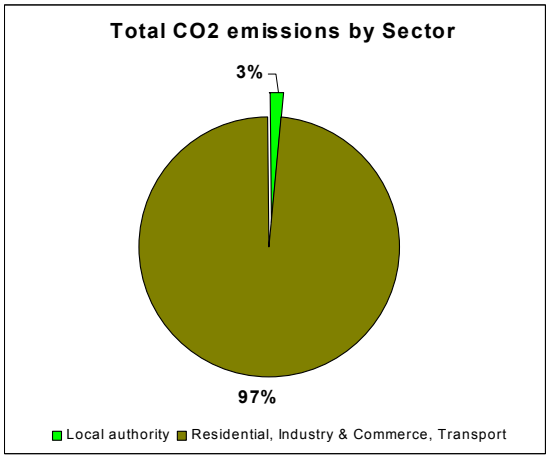
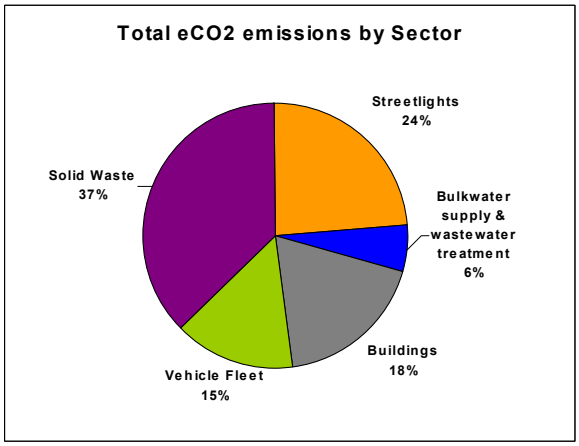


Figure 7.7: Total Greenhouse Gas Emissions for Local Authority by Sector (incl solid-waste non-energy emissions)

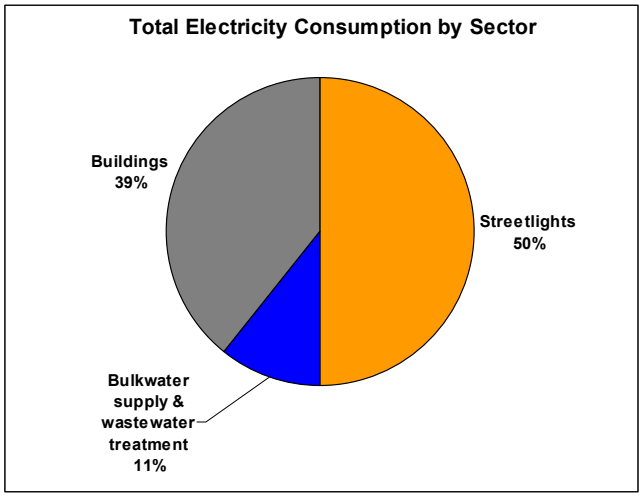


Total electricity use by the local authority is responsible for 47% of total GHG emissions – mainly from streetlights and buildings. The major greenhouse gas contributor from the *local authority's* operations is, however, not related to energy use, but to waste management – landfill methane releases 37% of total local authority greenhouse gasses[4] (more information on this potential energy source is given in Section 14 of the report).

In the local authority's operations, electricity is used in public buildings and facilities, streetlights, supply of bulk water and in wastewater treatment. The consumption of electricity by the various services, the associated emissions, and opportunities for savings are discussed below.

[4] Greenhouse Gas Inventory for the City of Cape Town (2002, draft): Research conducted by Sustainable Energy Africa in partnership with City of Cape Town's Environmental Management Department as part of the ICLEI Cities for Climate Protection (CCP) Campaign

Figure 7.8: Electricity Consumption for Local Authority by Sectors



Streetlights

For the year July 2000 to June 2001, streetlights accounted for 103 400 454 kWh, or 50% of the total electricity consumption for the local authority's operations. This represents a significant proportion of electricity consumption, and will continue to grow given the current housing backlog of around 250 000 households (increasing by about 10 000 households per year). Savings potential from more efficient street lighting is limited on existing streetlights as CCT has upgraded them all from mercury vapour (MV) lamps to high-pressure sodium (HPS) lamps. This has resulted in substantial electricity savings and reduced emissions.

Traffic lights

The use of light emitting diode (LED) signals at traffic intersections has significant potential for savings on energy use, financial savings and reduced emissions.

Savings from LED signals

Use of light emitting diode signals at traffic intersections present an opportunity for saving:

Electricity	2 700 000 kWh / year
Maintenance costs	R200 000 per year
GHG emission reductions	3 000 tons CO_2 per year

The capital costs of R4.5 million would be paid back over a period of 5 to 6 years.

Wastewater

The wastewater treatment works and supply of bulk water consumes 22 575 648 kWh of electricity per year. Scope exists to improve the energy efficiency of this operation through aeration system changes (see Table 7.6).

Table 7.4: Potential savings in wastewater treatment works

Waste Water Treatment Works	Annual Savings MWh	Annual Savings R	SOx emission reductions Tons per year	NOx emission reductions Tons per year	Particulate emission reductions Tons per year	CO_2 emission reductions Tons per year
Macassar	3 504	512 923	28	13	1.09	3 119
Zandvliet	2 313	367 551	18	8	0.72	2 058
Wildevoelvlei	1 226	226 958	10	4	0.38	1 091
Potsdam	1 367	185 334	11	5	0.42	1 216
Gordons Bay	259	48 801	2	1	0.08	231
Melkbosstrand	154	21 490	1	1	0.05	137

Source: Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, Energy Cybernetics (December 2002)

The City of Cape Town is also responsible for the supply of water. There is substantial potential for savings in electricity consumption, emissions and costs from the use of more efficient pumping technology (variable speed drives) and scheduling of pump running times.

Table 7.5: Impact of Variable Speed Drives on energy efficiency on water treatment plants

Water Treatment Plants	Annual Savings	Annual emission reductions tons per year			
	kWh	NOx	SOx	Particulates	CO_2
Wynberg	5 236 237	21	42	1	4 661
Silverstroom	3 072 870	13	25	0	2 733
Total	8 309 107	34	67	1	7 394

Source: Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, Energy Cybernetics (December 2002)

Buildings

The buildings which are owned and rented by the local authority consume 77 714 180 kWh of electricity which is 39% of the local authority's total electricity consumption. This contributes 89 022 tons of greenhouse gas emissions annually (18% of local authority total).

The Civic Centre, one of the largest LA buildings, has an energy management system (EMS) in place. A financial viability analysis on electricity and cost savings by replacing the current lighting system revealed that, while savings are significant, payback periods are lengthy (see box)[5]. However, savings potential in several other buildings are significant, and typically range from 15% to 35% of current electricity consumption. These opportunities are further discussed in section 7.4.

Savings in replacing 40W lamps in Civic Centre	
Electricity consumption	5 045 000 kWh per year
Monthly maximum demand	1 490 kW
Cost saving	R1 307 000 per year
Implementation cost	R15 561 500
Payback period	12 years

Vehicle fleet

The City of Cape Town has a vehicle fleet of 7728[6] vehicles which uses 8 257 373 litres of petrol and 20 803 313 litres of diesel per year. The consumption of diesel contributes to local air pollution (>80% of local authority total) and greenhouse gas emissions (18% of local authority total)[7]. There is significant potential for savings in total fleet fuel consumption, both through better management systems to reduce theft, and through alternative fuels such as LPG. These are further discussed in the following section.

7.4 TRENDS AND DEVELOPMENTS

Cities for Climate Protection programme

The City of Cape Town is a participating city in the Cities for Climate Protection (CCP) campaign, which is coordinated by the International Council for Local Environmental Initiatives (ICLEI). The broad objectives are to:

- Compile a greenhouse gas inventory
- Develop a local action plan
- Identify criteria to select projects
- Identify projects
- Implement projects

CCT has focused on local authority activities as it is in a position to initiate and implement projects within its functional areas and, by demonstrating successful implementation projects within the local authority, CCT will be in a better position to motivate and initiate projects externally.

Projects that CCT will implement as a part of this programme include the following:

[5] Source: Draft Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town Energy Cybernetics (November 2002)
[6] City of Cape Town Form of Tender for Electronic Fuel management System 2002
[7] see Table 7.3 for figures

- Energy efficiency retrofit and capacity building of Tygerberg Administration building (see next sections)
- Conversion of some CCT vehicles to run on LPG (see next sections)
- Bicycle path feasibility study in Michells Plain

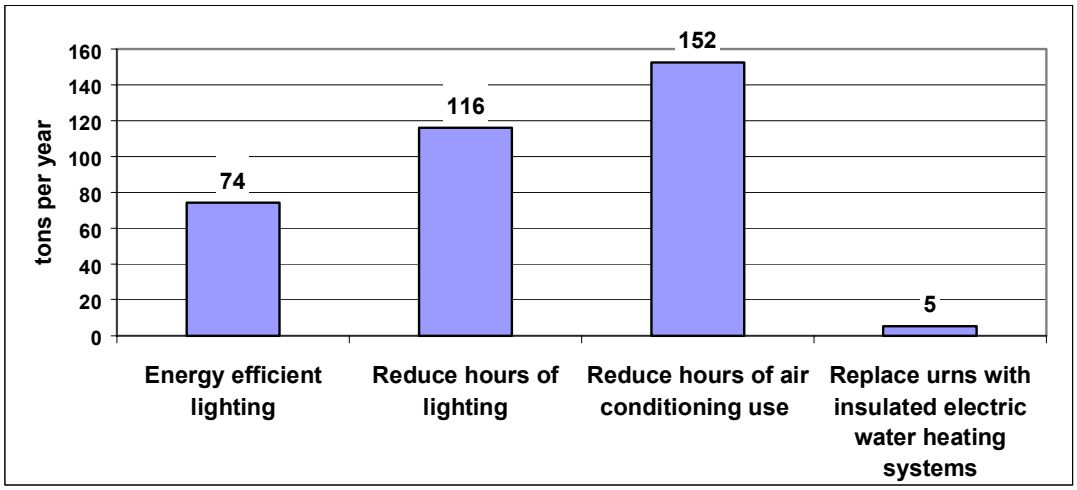
Energy efficiency in buildings

An energy audit was conducted at the Tygerberg Administration building in Parow by Sustainable Energy Africa[8]. Potential savings were found to be significant – around 30% of the current electricity bill. Very significant efficiency savings can be obtained from changing behaviour of users. Savings of up to 45% of total electricity consumption (about 350 tons CO2/year) appear to be realisable. Savings estimates are as follows:

- Reducing hours of use for lighting (8 789 kWh per month)
- Replacing inefficient lighting with CFLs (5 624 kWh per month)
- Reducing use of air-conditioning systems (11 535 kWh per month)
- Replacing hot water urns with insulated water heating systems (400 kWh per month)

The CCP Project is implementing the recommendations with Tygerberg Administration.

Figure 7.9: CO2 emissions reductions potential in the Tygerberg Administration building



Vehicle fleet

An asset registry was recently completed of the vehicle fleet of the City of Cape Town. Fuel consumption figures corresponding with the vehicle fleet will provide a more comprehensive picture of opportunities for efficiency savings.

The City of Cape Town is in the process of tendering for a single integrated fuel management system, which will track fuel sales throughout CCT and link them with the city's financial information systems. This will improve control over fuel sales and enable comprehensive information on fuel use to be more easily obtained.

As a part of the CCP programme (described above), two local authority petrol vehicles will be converted to run off LPG. This is expected to result in 26% reduction in CO2 equivalent emissions, 16% reduction in SO2 emissions and 40% reduction in hydrocarbon emissions. Retrofitting capital cost is repaid in less than 1 year. This technology is widely used around the world, and millions of cars run off LPG in other countries. A retrofit of the entire petrol fleet would result in reduction of CO2 equivalent emissions by about 5000 tons per year.

[8] Sustainable Energy Africa, Cape Town, 2002

Scoping investigation into local authority energy efficiency measures

A recently completed Scoping investigation[9] aimed to:

- Show how energy efficiency retrofits could achieve savings in operational costs in municipal services,
- Improve the existing quality of municipal services,
- Reduce local pollution and greenhouse gas (GHG) emissions from local authority activities

The findings of investigation are contained in Table 7.6.

Table 7.6: Energy efficiency opportunities and savings identified by the scooping investigation

CCT Department	Intervention	Potential cost savings	Potential emission reductions
Solid waste management (Near term)	Recovery of landfill methane gas with subsequent flaring or utilization as an alternative energy source.	Only cost effective with a sufficient demand for methane by industry or an investment in the GHG emission reduction credits.	Possibly in excess of 153,000 tonnes of CO_2-eq per annum. Increase with expansion of programme to other landfills
Bulk water supply (Near term)	Scheduling and installation of variable speed drives at Atlantis water undertaking	Wynberg: R785 436 per year; Silverstroom: R460 930 per year.	In excess of 7,300 tonnes of CO_2, 33 tonnes of NO_X, and 100 tonnes of SO_X per year.
Fleet management (Near term)	More stringent control over fuel expenditure and forced 10% fuel consumption reduction on annual basis	R 8-million per year	In excess of 4,933 tonnes CO_2 emissions per year
Property management	Energy efficiency improvements and scheduling of building systems	In excess of R 185,800 per year for all identified buildings combined	In excess of 700 tonnes CO_2 per year for all identified buildings combined
Housing (Near term)	Lighting retrofit to CFLs in 42,000 rental flats	R 5,598,377 per year	In excess of 14,131 tonnes of CO_2, 57 tonnes of NO_X, and 126 tonnes of SO_X per year.
Housing (Long term)	Installation of solar water heaters to provide domestic hot water & space heating for 42,000 rental flats	R16,590,000 per year, (Investment cost is estimated at R147,000,000. The payback period is 9 years)	In excess of 41,920 tonnes of CO_2, 170 tonnes of NO_X, and 373 tonnes of SO_X per year.
Housing (Long term)	Installation of ceilings and ceiling insulation for 42,000 rental flats	R2,898,000 per year, (Investment cost is estimated at R63,000,000. The payback period is 22 years)	In excess of 7,290 tonnes of CO_2, 30 tonnes of NO_X, and 65 tonnes of SO_X per year.
Property management (Long term)	Lighting retrofit in Civic Centre	R1,307,000 per year (Investment cost is estimated at R15,561,500. The payback period is 12 years)	In excess of 4,490 tonnes of CO_2, 20 tonnes of NO_X, and 40 tonnes of SO_X per year.
Public transport services (Long term)	Alter procurement and maintenance techniques and promote network integration	Detailed analysis required	Detailed analysis required
Wastewater treatment (Long term)	Aeration systems changes to Macassar and Zandfliet WWTWs	R880,450 per year (Investment cost is estimated at R3.4-million. The combined payback period is 3.9 years)	In excess of 5,179 tonnes of CO_2, 21 tonnes of NO_X, and 46 tonnes of SO_X per year.
Street lighting (N/A)	Street lighting already upgraded to energy efficient lamps and fittings prior to Scoping investigation	N/A	N/A

[9] Draft Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, Energy Cybernetics, 2002

Total estimated savings potential for the city

Although no comprehensive studies on energy saving potential in the Local Authority have been done, the scoping investigation and other studies make it clear that numerous substantial energy and money savings opportunities exist. Total financial savings potential is estimated at close to R13 million per year, and CO2 emissions reduction scope is close to 20 000 tons per year. Local air pollution improvements are also potentially significant (see Figure 7.12). The estimated savings potential for identified opportunities is summarized in Table 7.7.

Table 7.7 Summary of total identified energy savings potential within the local authority

Energy source	Savings method	Rand savings/yr	CO2 savings/yr
Petrol fleet	Improved management	R 2 642 000	1 943 tons
Diesel fleet	Improved management	R 5 825 000	5 688 tons
Building elect use	Lighting efficiency	R 2 792 000 Payback ~3 yrs	13 354 tons
Water supply & treatment elect use	Aeration efficiency and variable speed pumps	R 1 039 000 Payback ~4 yrs	4 970 tons
Street/traffic light elect use	LED traffic signal retrofit	R 595 000 Payback ~5 yrs	2 844 tons
TOTAL		**R 12 893 000**	**18 798 tons**

Sources: Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, Energy Cybernetics, 2002; CCP project database; Local Authority Energy Strategy Project database & analyses.

The savings potential from the interventions in Table 7.7 are illustrated graphically below.

Figure 7.10: Energy Savings from Local Authority Energy Efficiency Interventions

(% saving of current energy use in that sector)

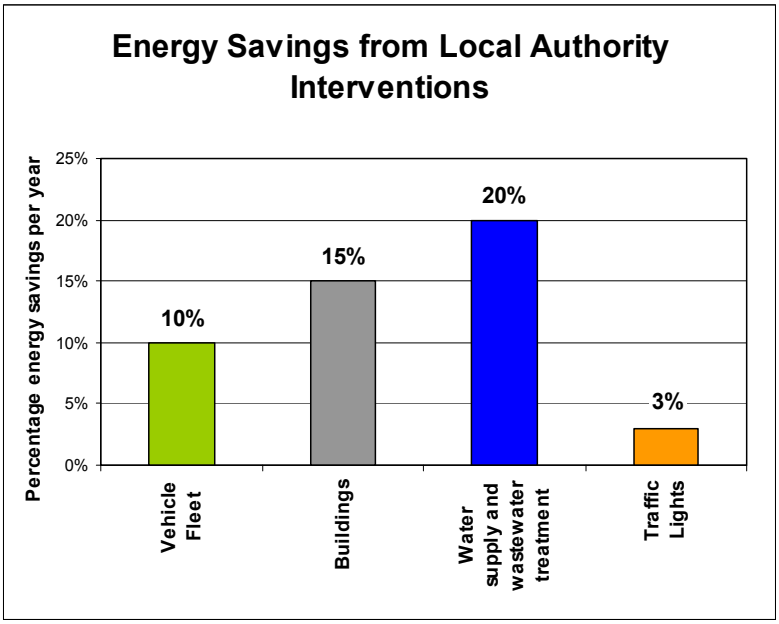


Figure 7.11: Cost Savings from Local Authority Energy Efficiency Interventions

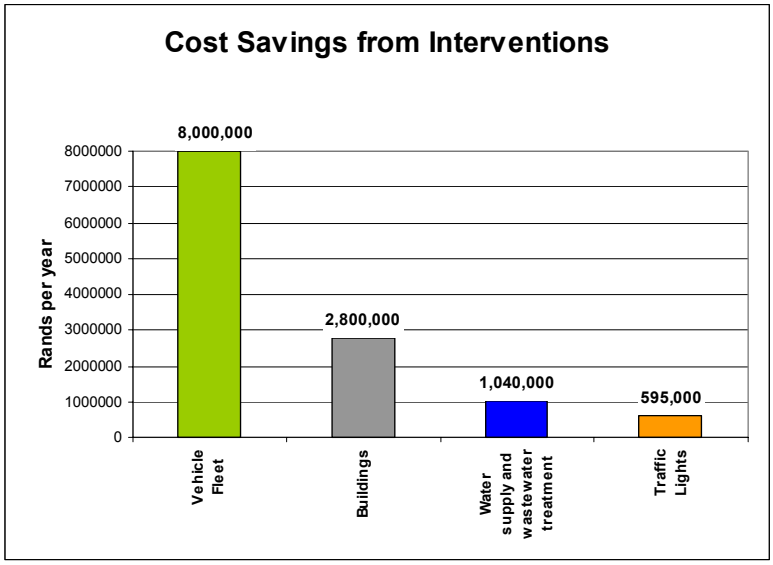


Figure 7.12: Local Air Pollutant Reductions from Fleet Management Interventions

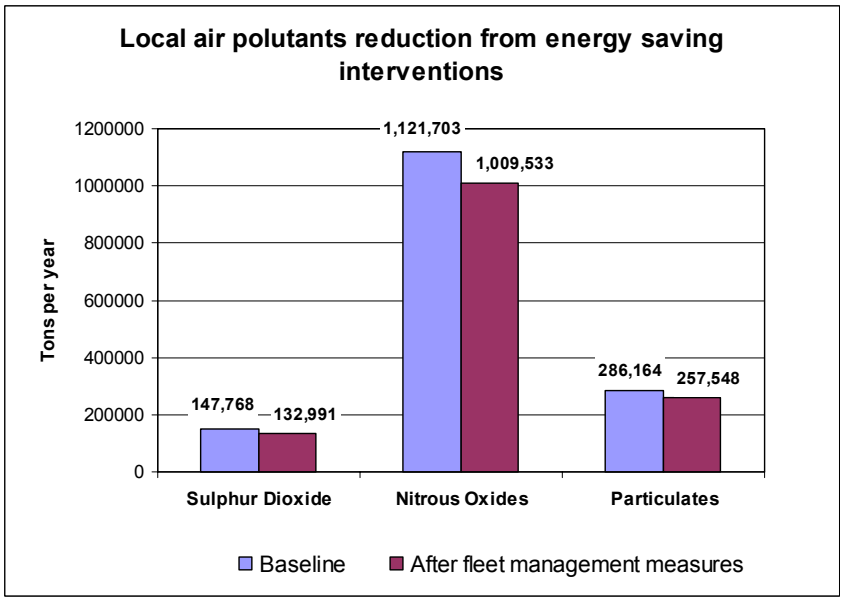
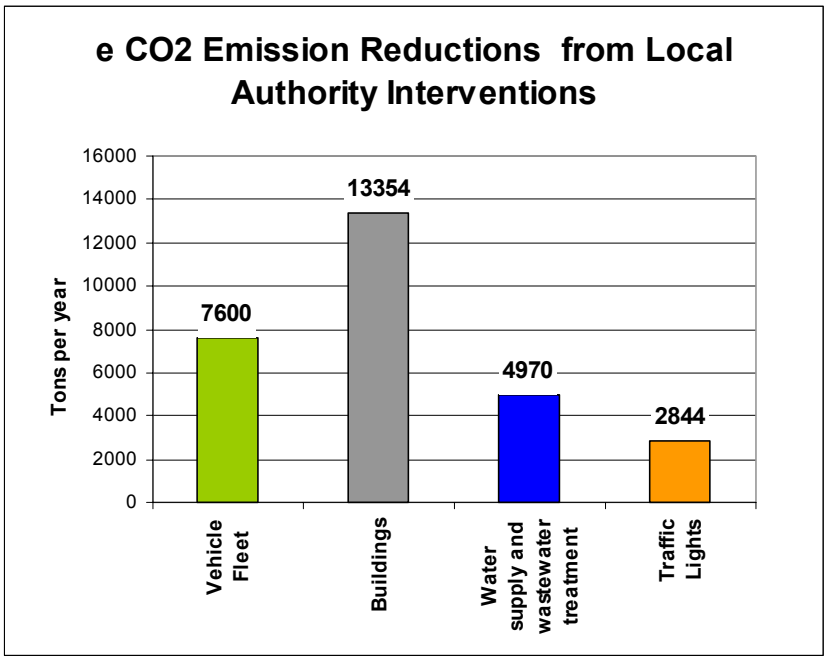


Figure 7.13 Equivalent CO2 Emissions Reduction from Energy Efficiency Interventions



Figures 7.10 to 7.13 illustrate that vehicle fleet management initiatives and building energy efficiency are amongst the most important areas of attention, as energy, money and emissions reductions potential in these sectors is substantial.

7.5 ISSUES

		Priority
Issue 7.1:	**While there is potential for very substantial energy savings in a number of areas of local authority operations, there is currently no strategy for implementing these.** Identified areas include: ❖ Local authority building efficiency ❖ Vehicle fleet fuel management ❖ LED signals at traffic intersections ❖ Efficient water supply pumping scheduling and technologies ❖ Wastewater aeration changes and variable speed motors	**MEDIUM**
Issue 7.2:	**The local authority is in a powerful position as the City's single biggest user, biggest employer and as the service provider, to implement far-reaching energy efficiency programmes.**	**MEDIUM**
Issue 7.3:	**There is a lack of policies, regulations and incentives promoting energy efficiency in the local authority activities, or within the City as a whole.**	**MEDIUM**
Issue 7.4:	**The City currently has limited capacity to address energy efficiency in the local authority's operations. There is no designated post responsible for addressing these issues in an integrated way.**	**MEDIUM**
Issue 7.5:	**The housing backlog in 2001 was estimated as 245 000 units[10] increasing at 10 000 units per year - substantial additional street lighting will be required as will appropriate energy supply to the houses.**	Normal

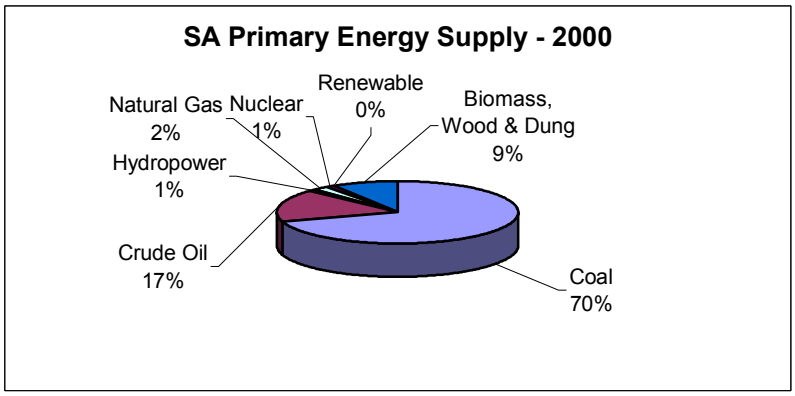
[10] State of Environment for the City of Cape Town, Summary – Year Four 2001, City of Cape Town

ENERGY SUPPLY

8. Supply Overview

As a major South African city, Cape Town's energy supply picture largely mirrors that of the rest of the country. South Africa's primary energy supply picture is overwhelmingly dominated by coal, which comprises 70% of primary supply. Solar, wind and wave renewable energy sources, nuclear, biomass (fuel wood, dung, bagasse) and hydro constitute only small components of the total energy supply. Only a small portion of this primary energy is consumed directly; through processes of energy transformation the majority (coal and oil particularly) is changed into other forms of energy, namely electricity and liquid fuels.

Figure 8.1: South Africa's Primary Energy Supply for 2000.



Source: ERI, Preliminary Energy Outlook for South Africa, October 2001.

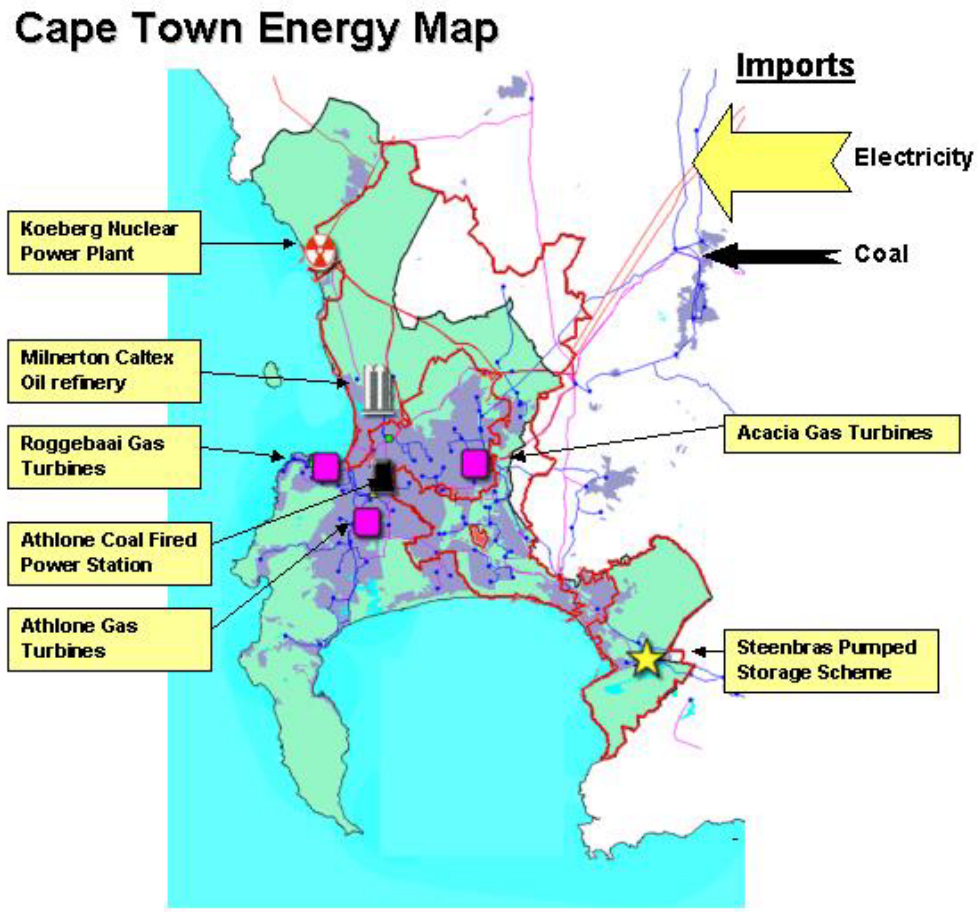
Cape Town's dependency on these fossil fuels which originate far from the point of use is expensive and poses issues of energy security.

Cape Town has a wealth of potential that could launch it as a national leader in sustainable energy use and supply. In particular, it has extensive untapped renewable resources – notably wind, small solar, and potentially wave applications – that offer considerable investment and growth potential. Natural gas reserves, which provide a cleaner and cheaper option to coal for electricity generation, are also being investigated. There is also plenty of potential for energy efficiency. Cape Town is home to various energy suppliers' head offices, energy research institutes and consultants, which form a well-established intellectual capital base which can help with energy development.

Cape Town has the opportunity to carve out a new role for itself in energy supply in South Africa and shape the future supply picture to meet the needs of its population in a sustainable manner. A key challenge is to address issues that arise from existing problems and inadequacies in the current energy mix, supply chains and distribution network. Another key challange is to respond creatively to emerging opportunities.

This chapter provides an overview of the energy supply picture for Cape Town. It covers national policy and legislation, and then discusses each energy source in terms of available resources, supply and distribution chains, and identifies related issues.

Figure 8.2: Cape Town Energy Map



As shown in Table 8.1, electricity and petrol are the most important energy sources for Cape Town. Electricity is responsible for the vast majority of CO_2 emissions for the city.

Table 8.1: CCT energy sources and CO_2 emissions

Fuel	GJ/yr	%	CO_2 tons/yr	%
Electricity	36,835,284	33%	11,256,863	68%
Paraffin	2,448,796	2%	175,579	1%
LPG	684,970	1%	43,153	0%
Coal	3,831,352	3%	361,680	2%
Petrol	40,687,369	37%	2,815,566	17%
Diesel	20,127,757	18%	1,487,441	9%
HFO	4,695,842	4%	362,519	2%
Wood	920,417	1%	0	0%
TOTAL	**110,231,787**	**100%**	**16,502,801**	**100%**

9. National Policy and Legislative Context

Before 1994, as a response by the National Party Government to sanctions imposed by the international community, the Energy Policy of South Africa was driven by social security, self-sufficiency and secrecy. As discussed in the next section, this resulted in an over-reliance on dirty, inefficient fuels, and inadequate supply of affordable and safe fuels to millions of poor households. The current policy and regulatory environment represents a significant change in direction, with substantial focus on improving access to energy and participation in energy sector operation by previously disadvantaged sectors of society. While the environmental sustainability theme clearly has greater focus than previously, it still is far from a central priority.

9.1 ENERGY WHITE PAPER OF 1998

The Energy White Paper of 1998 aims to increase access to affordable energy services, improve energy governance, manage energy-related environmental impacts, and secure supply through diversity. Amongst the overarching objectives are: Increasing access to affordable energy services; stimulating economic development – including encouraging energy sector actors to facilitate economic empowerment through the creation of SMMEs and by assisting previously disadvantaged people to gain entry to the energy sector; re-regulation in the liquid fuels industry to allow unrestricted market access; and managing energy-related environmental impacts. In general, the policy enforces a move to opening markets, promoting export industries, restructuring government assets, and re-regulating the energy industry.

Integrated Resource Planning

The White Paper advocates use of the Integrated Resource Planning (IRP) tool to guide strategic decision-making for all substantial new investments in energy infrastructure. Among its main functions, IRP supports demand-side needs and options being considered as well as supply-side options and includes social and environmental factors and externalities in the assessment of the way forward. In the case of Cape Town, the Electricity Department has produced a local IRP for the electricity sector in the metro area, which has been approved by Council.

9.2 MUNICIPAL SYSTEMS ACT NO 32 OF 2000

Section 23 of the Municipal Systems Act No 32 of 2000 requires municipalities to produce integrated development plans for the medium-term development of their municipal areas to meet the needs of their communities. The Act directs municipalities to provide sustainable services to their communities, promoting increased community involvement in the provision of energy services.

9.3 WHITE PAPER ON RENEWABLE ENERGY AND CLEAN ENERGY DEVELOPMENT (DRAFT 2002)

Deregulation and restructuring of the electricity supply industry is intended to open the market to opportunities for renewable production. In a recently released draft White Paper on 'Renewable Energy and Clean Energy Development', government recognises the important role of renewables in the long-term sustainability of South Africa's energy profile, and sets a ten-year target of increasing the use of renewable energy in final energy consumption. The purpose of the policy "is to set out Governments' principles, goals, and objectives for renewable energy. It furthermore commits Government to a number of actions to ensure that renewable energy becomes a significant part of its energy portfolio over the next 10 years."

However, in spite of the clear and promising purpose statement, the draft document provides little specific direction on promoting different renewables sources, and as it stands may be of limited help in moving to a more sustainable mix. In particular, two economically and environmentally sound options - solar water heating and passive solar building design - are not adequately stressed given their proven track record, financial feasibility and potential impact.

The next version of the policy document is expected soon, and hopefully will provide clearer guidance of how the very sound 'purpose statement' is to be translated into reality.

10. Coal

As Figure 8.1 illustrates, South Africa's energy supply picture is dominated by coal, which comprises 70% of primary energy supply to the country. Proven coal reserves total 61 billion tonnes, the seventh largest in the world. South Africa mines approximately 250 million tons of coal per year of which 60 million is exported and 50 million is discarded[1]. Coal with the highest ash content and lowest caloric value is used locally. More than half (57%) of domestic coal supply goes to coal-fired power stations for electricity generation, and 26% goes to Sasol for liquid fuels production. Only 17% is used by industry and the commercial and residential sectors (which use 75% and 25% respectively).[2]

10.1 COAL DISTRIBUTION NETWORK

Coal-fired electricity generation and Sasol synfuels plants are mostly located at major coalfields, and thus distribution networks are unnecessary for most of the country's coal. Coal for industrial, commercial and residential purposes is distributed largely by rail from mines to major distribution companies. From these depots it is then distributed by numerous smaller businesses, down to small street-level vendors who sell coal in small quantities to households. Transport costs are a major component of the final coal price in Cape Town, pushing the price up by 50 to 80% compared with Gauteng[3], and making coal largely too expensive for poor households in Cape Town. Table 10.1 shows the assumed extraction and distribution costs of different types of coals.

Table 10.1: Assumed costs of extractions and distribution (1995)

Type of Coal Mining	Cost ($/ton)
Export Coal	20.1
Coke Coal	38.1
Sasol Coal	8.8
Electricity Coal	8.8
Domestic Coal	17.6

Source: ERI, Preliminary Energy Outlook for South Africa, October 2001.

Approximately 320 000 tonnes of coal are used within the City of Cape Town area per year (excluding Athlone).[4]

10.2 COAL POLLUTANTS

Considerable pollutants are produced annually from the operation of coal power stations. Table 10.2 below shows approximate amounts of waste materials produced in one year from a coal power station of 1000MWe[5] capacity.

Table 10.2: Coal waste produced in one year from a 1000 MWe power station

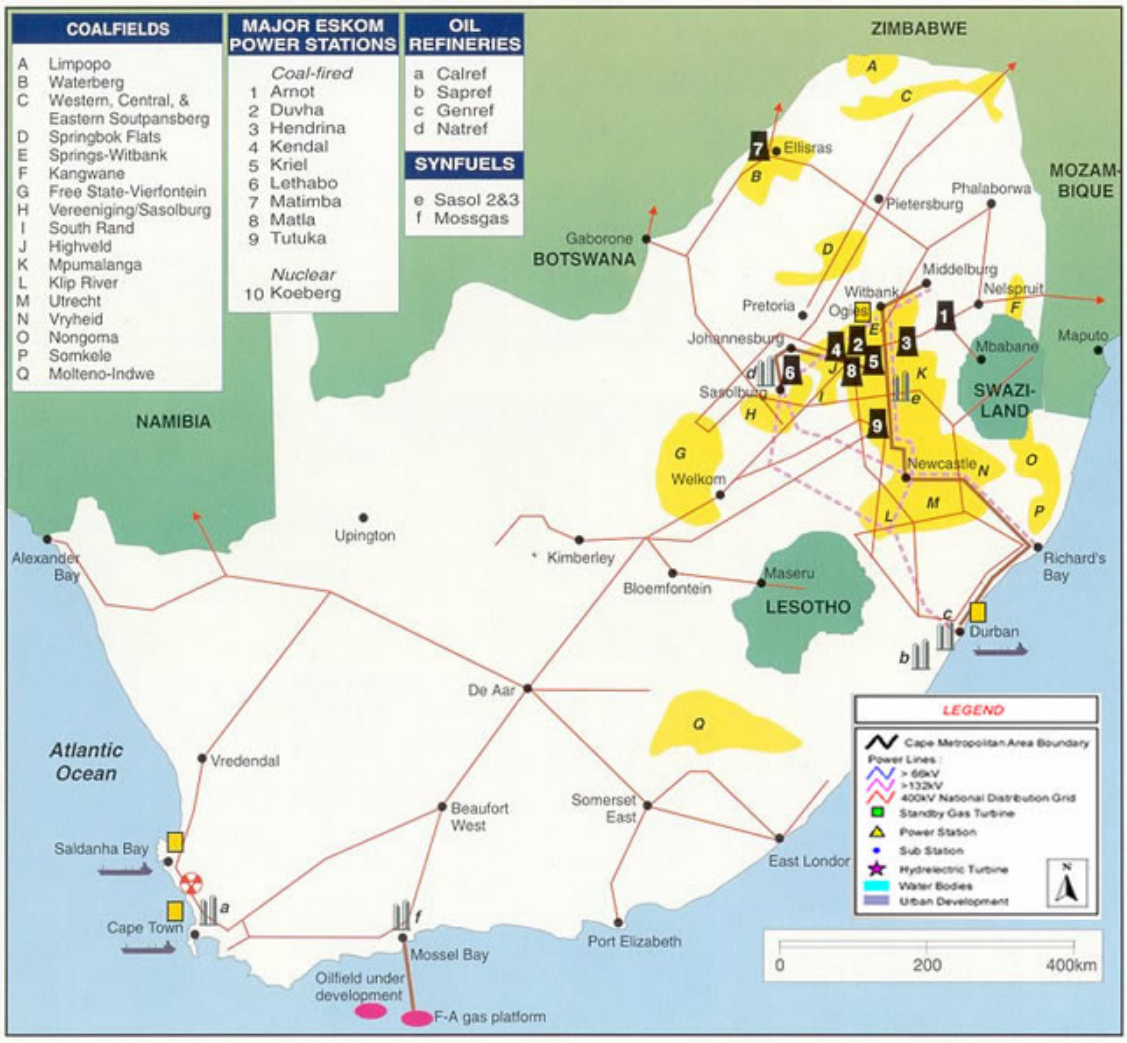
Quantity in Tons	Type of Waste
8	radionuclides eg.thorium (half-life:14 billion years)
42 000	SO2
21 000	N0x
5 000 000	CO2
2 000	Particulates
2 640	Heavy metals: lead, arsenic, strontium etc.

Data Source: ERI, Preliminary Energy Outlook for South Africa, October 2001.

Coal waste is either blown into the air or scattered into large ash heaps, and results in high gaseous emissions that severely impact local air quality, human health, and the greenhouse gas effect.

[1] Energy Research Institute (ERI), Preliminary Energy Outlook for South Africa, October 2001, pg. 59.
[2] Sarah Ward, The Energy Book for urban development in South Africa, 2002, pg. 18.
[3] Gauteng coal prices were around 30c/kg in 1997, to which transport costs added about 20c/kg for Cape Town.
[4] Barry van Dijk, Coal Brite Distributors, Personal Communications, Nov. 26, 2002.
[5] Megawatt equivalent

Figure 10.1: South African Energy Map



Source: Overview of the South African Energy Sector. DME, 1994

10.3 ISSUES

Priority

Issue 10.1: **Coal is an unsustainable, polluting energy source, yet the national and local energy picture is dominated by coal.** The range of coal-derived pollutants, largely from its use in electricity generation, are significant contributors to serious local and global consequences, including global warming and poor local air quality.

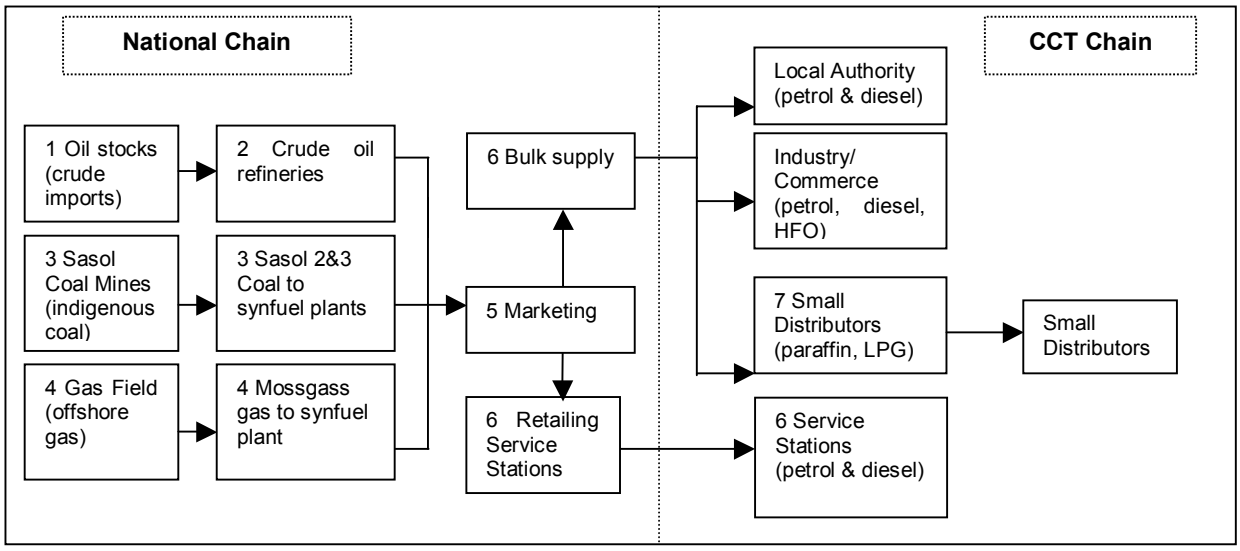
MEDIUM

Issue 10.2: **Coal and the coal-fired electricity power stations are located far from Cape Town.** This poses issues of security of supply.

Normal

11. Liquid Fuels and Natural Gas

The Liquid Fuel Supply Chain



11.1 OIL

Oil is South Africa's second largest primary energy source. The majority is imported, primarily in the form of crude oil. Small oil discoveries have led to the establishment of the Ocra oil production rig located 140 km offshore of Mossel Bay in the Southern Cape where two fields produce 25 000 barrels per day (7% of South Africa's crude oil requirements).

Crude Oil Refining

Crude oil is refined into a range of liquid fuels, including petrol, diesel, fuel oil, paraffin and LPG (liquefied petroleum gas). In 1964, government established the Strategic Fuel Fund, which acquired crude oil on behalf of the country and administered strategic fuel stockpiles. With the lifting of oil sanctions in the early 1990s, oil companies are now responsible for their own crude oil acquisition. As the South African Energy Map shows, Richards Bay Bulk Storage has storage facilities in Cape Town.[6]

As Table 11.1 below shows, South Africa has 4 crude oil refineries, of which Calref, the Caltex-owned refinery, is located in Cape Town. Calref is a complex refinery with a distillation capacity of 100 000 barrels per day and has a current replacement cost of about $1-billion.[7] It is unlikely that any more oil refineries will be built in South Africa; future demand above the current capacity is likely to be met by imports.[8]

Table 11.1:Total crude oil refining capacity in South Africa in 1995

Refinery	Crude oil capacity (barrels per day)	Crude oil capacity* (million barrels/yr)	Liquid fuels net capacity** (million barrels/yr)	Maximum long-term capacity (million barrels/yr)
Sapref	180 000	65.7	52.3	104
Enref	105 000	38	30.2	47.4
Calref	100 000	36.5	29	34.7
Natref	85 000	31	24.7	unlimited

Source: ERI, Preliminary Energy Outlook for South Africa, October 2001.
**Assuming 365 days production per year*
***Assuming 92% capacity availability, excluding 5.5% used for non-fuels production, 7% for fuel use, and 1% for losses.*

[6] Wesgro, Wesgro Background Report - The Petrochemical Industry in the Western Cape, 2000, pg. 6.
[7] Wesgro, Wesgro Background Report, The Petrochemical Industry in the Western Cape, 2000, pg.13.
[8] Energy Research Institute (ERI), Preliminary Energy Outlook for South Africa, October 2001, pg. 73.

Table 11.2 shows the fuel output mix of crude oil refineries calculated for 1995.

Table 11.2: Crude oil refinery combined product output mix (% energy basis)

Fuel	Calculated for 1995
Petrol	3.4
Diesel	32.1
Fuel Oil	19.9
Paraffin	4.4
Jet Fuel	6.8
Avgas	0.7
LPG	1
Refinery gas	0.8

Source: ERI, Preliminary Energy Outlook for South Africa, October 2001.

11.2 SYNFUELS FROM COAL

34% of the output from the coal mining industry goes to Sasol for synfuel production[9]. Coal-derived fuel comprises 22% of total liquid fuels produced.[10]

The future of coal to liquid fuel plants is uncertain. If the price of crude oil continues to rise, as seems likely, coal to liquid fuel plants offer a large savings in foreign exchange. However, the process is polluting and releases huge amounts of greenhouse gases. In future it is possible that some natural gas from neighbouring countries instead of coal will be used as synfuels feedstock, as it is much cleaner and more efficient.

11.3 NATURAL GAS

Natural gas is currently a relatively minor source of primary energy, accounting for about 2% of total supply. South Africa produces approximately 1.8 billion cubic meters per year of natural gas from the F-A field near Mossel Bay in the Bredesdorp basin off the South coast. The entire output is dedicated to the state-owned Mossgas liquid fuels synthesis plant.

Oil from Gas

Mossgas produces 5% of total liquid fuels produced.[11] In 1995 its crude oil equivalent capacity was 45 000 barrels per day, and actual output of finished liquid fuels was 30 200 barrels per day.[12] The output mix on an energy basis for 1995 was determined as:

Table 11.3: Mossgas product output mix (% energy basis)

Fuel	Calculated for 1995
Petrol	66.6
Diesel	31.9
Paraffin	1.5
LPG	0.5

Data Source: Source: ERI, Preliminary Energy Outlook for South Africa, October 2001.

Due to large natural gas discoveries in Mozambique, South Africa is poised to import substantial amounts of gas to the Gauteng area. This, combined with the reasonable possibility of further discoveries in local and neighbouring waters, may well shift the primary energy supply picture substantially towards gas. Recent discoveries off the West Coast of South Africa and Namibia hold promise for being piped to Cape Town for use in electricity generation (Althlone Power Station) and other applications. While the capacity of the discoveries is still being clarified, their potential impact on the Westerrn Cape's energy profile may be substantial. This is significant because natural gas is a cleaner energy source than coal-generated electricity, and thus represents one of the most promising interim steps to a more sustainable energy sector.

[9] Hilton Trollip, Overview of South African Energy Sector, 1996, pg. 2-8.
[10] Sarah Ward, The Energy Book for Urban Development in South Africa, 1992, pg. 18
[11] Sarah Ward, The Energy Book for Urban Development in South Africa, 1992, pg. 18
[12] Energy Research Institute (ERI), Preliminary Energy Outlook for South Africa, October 2001, pg. 73.

11.4 LIQUID FUELS POLICY AND REGULATORY CONTEXT

The DME is responsible for the administration of laws and government policies. Under the apartheid government the involvement of state-owned institutions in the liquid fuels sector was strong for security reasons. In recent years, the regulatory and policy environment has been substantially reformed and these institutions have been rationalised and redirected according to the current priorities of government:[13]

PetroSA

Petroleum Oil and Gas Corporation of South Africa (PetroSA), a new state oil company, was formed largely from a merger with Soekor and Mossgas. It owns and operates all of South Africa's government-owned oil and gas holdings and is mandated to explore and develop South Africa's natural resources of oil and gas in a competitive manner.

Central Energy Fund (Pty) Ltd

The new role of the Central Energy Fund (Pty) Ltd is, amongst other things, to facilitate access to energy amongst poor rural households.

Industry associations

The South African Petroleum Industries Association (SAPIA) was formed to promote the interests of the refining and distribution operations of the original, white-owned, companies. Recently an alternative association has been established to represent the interests of the black oil companies – the African Mineral and Energy Forum (AMEF).

The Paraffin Safety Association of South Africa (PASASA) is an oil company funded organisation which aims to promote the safety of paraffin use in households. The Liquified Petroleum Gas Association of South Africa (LPGSA) provides training and accreditation around LPG safety issues, undertakes LPG marketing, and represents the LPG industry to government where necessary.

Black Economic Empowerment

Greater black participation in the South African oil industry is an important factor for the new government of national unity.[14] The liquid fuels sub-sector has had specific policy guidance in this respect. The Energy Policy White Paper sets a goal of 25% participation by black groups in all facets of the industry. In November 2000, all oil companies signed an Empowerment Charter, which defines how the 25% participation is to be measured.[15] Many companies have already made significant progress in this regard.

Relevant legislation and guideline documents include:

- Central Energy Fund, 1977 (Act No. 38 of 1977), as amended
- Petroleum Products Act, 1977 (Act No. 120 of 1977), as amended
- The Energy White Paper of 1998
- Empowerment Charter of November 2000

The South African Gas Bill is currently being developed to provide a regulatory framework for storage, transmission, distribution and trading of gas. Key issues in the Gas Bill are the establishment of a regulator and access to transmission by third parties. Government is establishing a gas regulator to monitor and control key aspects of this energy sub-sector.

[13] Sustainable Energy Africa, Shell Foundation: Market Analysis of the SME energy sector, 2002, pg. 13.
[14] Wesgro, Wesgro Background Report - The Petrochemical Industry in the Western Cape, 2000, pg. 9
[15] Sustainable Energy Africa, Shell Foundation: Market Analysis of the SME energy sector, 2002, pg. 13.

11.5 LIQUID FUELS DISTRIBUTION NETWORKS[16]

Petrol and Diesel

Petrol and diesel are marketed by oil companies. Most petrol (92%) is sold by service stations while most diesel (85%) is sold in bulk. Road tankers transport petrol and diesel from the refineries to service stations throughout the country. Oil companies are increasingly outsourcing distribution functions as well as being engaged in affirmative procurement programmes.

A recent government intervention prevents oil companies from owning service stations (prohibition of vertical integration). However, conditions linked to supply agreements require service station businesses to keep to relatively demanding signage and service standards, which maintains oil company control. Local authorities impose further stringent land zoning and safety requirements. It is thus financially demanding to establish such a station. However, despite the great costs involved in starting up a petrol station, the current liberalisation of the diesel and petrol distribution system creates opportunities to develop the network and increase small business involvement.

Price regulation

Petrol and diesel prices are regulated down to the retail level, with maximum permissible selling prices issued by government for every magisterial district. The present maximum retailer markup is 31 c/l (Feb 2003). In 2002, the average price of petrol at stations was R3.92/l, and the average price of diesel was R3.48/l.[17]

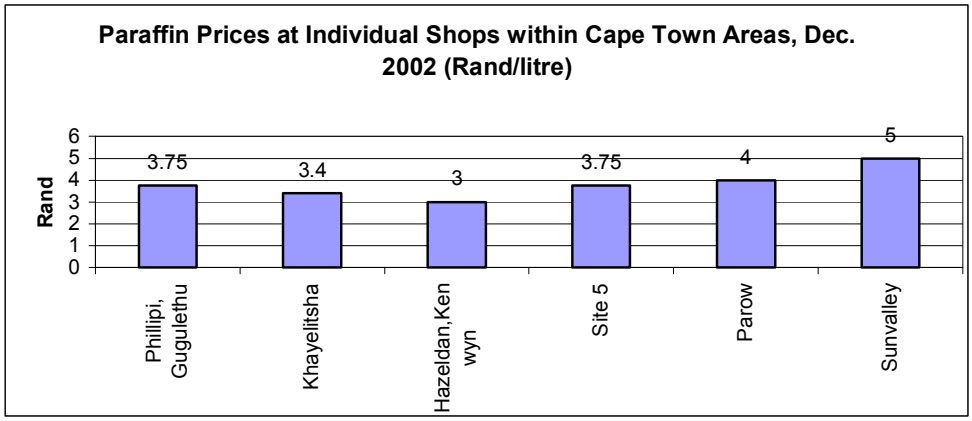
Paraffin

Paraffin distribution is not as regulated as petrol and diesel and is primarily market-driven. Paraffin is distributed from the refineries to oil company-owned bulk depots largely by road. Small transport companies take it from the depots to the numerous medium and small outlets in urban areas. In some areas service stations also sell paraffin.

The government regulates paraffin prices up to the wholesale level and thereafter recommends a retail price of at most a 40% mark-up on the wholesale price. It has also made paraffin VAT exempt to ease the burden on poor households. This is seen as an effective means of 'subsidising' such households, as a very high proportion of all paraffin sold is used by this income group.

Paraffin supply chains reach into all urban areas. A study undertaken in 1997 indicates that supply chains are not excessively long, and that price mark-ups are usually not overly high.[18] The average price of paraffin in South Africa in 2002 was R2.67[19] per litre, but as Table 11.4 below shows, prices can vary significantly.

Table 11.4: Paraffin Prices at Individual Shops within Cape Town Areas, December 2002



[16] Taken largely from Sustainable Energy Africa, Shell Foundation: Market Analysis of the SME energy sector, 2002.
[17] Deon Mannefeld, Caltex, Personal Communications, January, 24, 2003.
[18] Sustainable Energy Africa, Shell Foundation: Market Analysis of the SME energy sector, 2002 which sources Borchers & Ndou, Department of Minerals and Energy, The potential for improved rural energy supply via cooperatives and private entrepreneurs, 1997.
[19] Deon Mannefield, Caltex, Personal Communications, January, 24, 2003.

Because of its low cost and the fact that it can be bought in small quantities, demand for paraffin by poor households will likely continue. However, increased paraffin distribution can only be advocated with improvements to its safety record. Available containers such as beverage bottles are often used to store paraffin, leading to high paraffin poisoning levels in children who mistakenly drink it. The Paraffin Safety Association of Southern Africa (PASASA), have developed child-resistant paraffin safety containers to ensure that paraffin is dispensed safely from trading stores, but these containers have not reached all households, and poisoning continues.

Liquified Petroleum Gas (LPG)

LPG is transported from the refineries to large distributors and then to medium distributors. It is generally bottled at the refinery, although depots with mini-bulk tanks are becoming more common. LPG distribution is through most oil companies as well as Afrox.

The distribution network of LPG is not nearly as well developed as that for paraffin, for various reasons. For one, it is not easy for small outlets to establish themselves. Prospective new retailers need to undergo training and their premises need to comply with various safety requirements. Further, the necessary space for safe LPG storage is often not available in dense low-income settlements. LPG bottles are also difficult to transport to and from distant outlets, which imposes a cost on dealers. There is also limited demand as the poor households cannot generally afford the necessary bottles and appliances (the deposit on a gas bottle is R85, for example, while a full large gas bottle costs R300). The efforts by one large oil company to establish LPG depots in Khayelitsha in Cape Town were unsuccessful, partly because of the low LPG demand in the area, as well as the lack of business skills of the operators.[20]

There is currently no price regulation of LPG, although government is exploring this possibility. However such regulation is not imminent, and there seems to be little clarity on how this can be done so that the poor benefit.

LPG is much safer than paraffin. In Lloyd's analysis of LPG and paraffin-related safety and health incidents[21] he finds that annual incidents with LPG are at least two orders of magnitude lower than with paraffin for comparable quantities sold. However, the perception in poor communities is that gas is less safe than paraffin – this is partly born of a lack of familiarity with LPG. LPG is generally a cheaper (and more efficient) source of energy than paraffin for cooking and water heating.[22]

11.6 LIQUID FUELS IN CAPE TOWN

The Western Cape refineries of Calref and Mossgas account for about 22% of refining capacity in South Africa. Table 11.5 below shows the volume of liquid fuel produced by Calref – which is situated in the CCT area - and total sales in the CCT area.

Table 11.5: Liquid Fuel Supply and Demand in Cape Town - 2002

Liquid Fuel	Produced in CCT area by Calref refinery (million l)	Total sales in CCT (million l)
Petrol	1 486.77	1,082.83
Diesel	1 326.05	490.98
Paraffin	83.65	68.02

Data Source: Deon Mannefeld, Caltex, 2003.

These figures indicate that, in terms of quantity, the Calref refinery produces the majority, if not all of Cape Town's liquid fuel demand. The quantity of its petrol, diesel and paraffin production exceeds Cape Town's demand.

[20] Sustainable Energy Africa, Shell Foundation: Market Analysis of the SME energy sector, 2002, who sources L. Maritz, LPG Association, Personal Communication, 2002.

[21] PJD Lloyd, ERI, The Safety of Paraffin & LPG Appliances for Domestic Use, 2002.

[22] Sustainable Energy Africa, Shell Foundation: Market Analysis of the SME energy sector, 2002 which sources Borchers M, Energy and Development Group, Strategies to promote economically sound energy use in low-income households, 1997.

Table 11.6 below provides an overview of demand for LPG as well as other types of liquid fuels not covered in detail in this report.

Table 11.6: Liquid Fuel Demand for 1999

Product	S.A. (million litres)	Western Cape (million litres)	Western Cape (%)
Petrol	10 861	1 699	15
Diesel	5 993	886	15
Jet Fuel	1 995	233	12
Paraffin	1 054	94	9
Fuel Oil	561	149	27
LPG	540	133	25
Total	21 004	3 164	15

Source: Wesgro, Wesgro Background Report, The Petrochemical Industry in the Western Cape, 2000

This table shows that of total LPG demand in SA, 25% went to Western Cape customers. This represents high gas consumption relative to that of the rest of the country, possibly local households rely more heavily on gas for heating and cooking than those in the rest of the country, who rely more heavily on coal.[23]

11.7 ENVIRONMENTAL ISSUES RELATING TO LIQUID FUELS SUPPLY

*(This section covers supply-side environmental issues. Emissions through liquid fuel **use** are covered under the relevant demand sections such as 'transport' and 'commerce and industry'.)*

Oil spills

Oil spills can occur at various stages in the oil supply chain:

- The highest risk of oil spillage occurs during transfer operations in ports. SAPIA reported[24] that in 1998/1999 some 17 million tons of crude oil were imported through SA's ports for processing at the four local oil refineries, and 2,7 million metric tons of bunker oil were loaded onto ships in the country's harbors.
- Oil spillage can also occur along transport routes. Oil leaves the refineries by road or rail to depots, commercial sites and about 5,000 different service stations throughout the country.
- Once fuel reaches distribution points it is predominantly stored underground for safety. The storage tanks and pipes were historically constructed of welded steel coated with an epoxy. Some of these tanks have corroded and leaks have occurred, contaminating local groundwater.

Various initiatives have been introduced to prevent and minimize oil impacts, including:

- Each harbor has equipment to contain and recover spills as well as trained staff.
- The oil companies have positioned over 40 oil spill response trailers along major routes to provide rapid responses to leaks and spills.
- Oil companies have begun the mammoth task of eradicating leaks from oil storage tanks, giving the most vulnerable sites priority for protection. The aim is to remove the risk of leaks from underground tanks entirely. Meanwhile, new materials that do not corrode are being used to build tanks at new service stations.[25]

However, there is a demonstrated and ongoing potential for oil spills that threatens the sustainability of the environment and human health. Further, no legislative standards have been set for cleaning up contaminated sites. Although the oil industry has voluntarily introduced into SA the internationally recognized Risk Based Corrective Action (RBCA) program, clean ups of contaminated sites should be legislated.

Dumping Used Oil

Another environmental hazard associated with oil is dumping of old engine oil by thousands of users. This prompted the lubricating oil companies to form the ROSE Foundation (Recovery of Oil Saves the Environment), which had recovered 36 million litres of used oil by 1998/1999. More than 6 000 mini-collection tanks had been distributed to factories and workshops around the country, with another 1 600

[23] Roeleen Henning, Afrox, Personal Communication, January 10, 2003.
[24] SAPIA, Millennium Report, 2000, pg. 30.
[25] SAPIA, Millennium Report, 2000, pg. 30.

planned. While ROSE is expanding its network to increase the amounts of old oil collected, large quantities are still dumped, causing environmental damage.

Refinery pollution

Caltex was originally located away from urban areas, but over time suburbs have spread to the point where housing now surrounds the refinery. In recent years, Caltex has spent almost R1-billion ($289m) in upgrading and modernising the refinery, in part to reduce emissions. However, the issue of refinery pollution remains a concern among local environmental groups.[26]

Harmful Emissions from Petrol and Diesel Vehicles

Harmful emissions levels from largely petrol and diesel use are high by international standards due to the current non-stringent refining standards.

11.8 TRENDS AND DEVELOPMENTS

Vehicle Emissions Strategy

The Department of Environmental Affairs and Tourism is developing a draft national vehicle emissions strategy to mandate tailpipe standards for both petrol and diesel vehicles. The strategy is reliant on the cleaning up of petrol and diesel by, among other things, reducing the sulphur content in petrol and diesel and reducing the lead content in petrol.[27] (For more details on this initiative, see the Transport section).

Promoting Cleaner Alternatives

Liquid Petroleum Gas

LPG is a more desirable vehicle fuel from an environmental perspective as it does not contain benzene, lead, or sulphur and has low levels of nitrogen oxides. It also does not require a choke start (which results in harmful, unburnt petrol emissions). Kulani Africa Gas opened its first gas filling station in Cape Town in late 2002. (For more details on this option, see the Transport section).

Biodiesel

Biodiesel is a cleaner diesel fuel derived from plant oils or animal fats. It can be used either neat or blended with petroleum fuel. Uptake of biodiesel in South Africa is currently very minimal and has not begun in Cape Town. To encourage production and use of biodiesel, government has introduced a 30% reduction on the liquid fuel levy tax applied against other liquid fuels used for transportation. However, further policy initiatives are necessary to enable biodiesel to compete on a cost basis.[28]

Natural Gas

One of the most significant potential shifts in the liquid fuels sub-sector, and in fact the entire energy sector, is the potential for increased use of natural gas. Large natural gas discoveries in Mozambique and others in local or neighbouring waters, as well as the reasonable potential for further significant discoveries may well shift the entire energy supply picture substantially towards gas. This applies equally to CCT, as recent smaller discoveries off the west coast of South Africa and Namibia hold promise for being piped down to Cape Town for use in power generation and other applications.

Increased participation of historically disadvantaged groups

The government and oil companies are fast changing the profile of the liquid fuels supply industry in this regard. One of the potential implications an industry sub-sector less dominated by large multinational interests, and potentially more responsive to local economic development needs.

[26] Wesgro, Wesgro Background Report - The Petrochemical Industry in the Western Cape, 2000, pg. 13
[27] Melanie Gosling, Plan for Cleaner Fuel Hailed as Boost for Health, Environment, Cape Times, November 14, 2002.
[28] Anthony Williams, Personal Communication, February, 03.

11.9 ISSUES

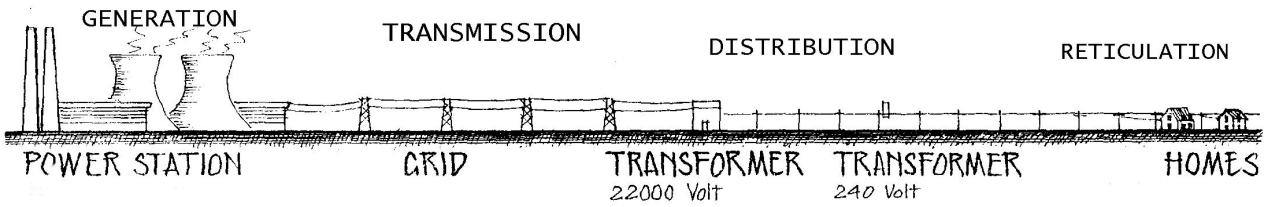
		Priority
Issue 11.1:	**Harmful emissions levels from largely petrol and diesel use are high by international standards due to the current non-stringent refining standards.** However, the introduction of low-sulphur diesel and catalytic converters for petrol vehicles together with increased unleaded petrol distribution should reduce emissions and bring South Africa in-line with international standards. These issues are being handled at a national level.	**HIGH**
Issue 11.2:	**Poor households suffer from unacceptably high levels of paraffin poisoning and fires** (this is discussed further in the 'households' section of the report)	**HIGH**
Issue 11.3:	**Potential for introduction of natural gas into CCT's energy supply picture represents an opportunity to move towards a cleaner supply mix.** Should the capacity of fields of the west coast prove adequate, it is likely to be feasible to pipe natural gas to the Western Cape, and Athlone power station is earmarked to be the anchor customer. This will shift CCT's dependence from dirtier coal-based electricity to some extent, and improve supply diversity.	**MEDIUM**
Issue 11.4:	**Potential for environmental damage exists through spills while distributing crude and refined product.**	Normal
Issue 11.5:	**South Africa's relative economic weakness in the global economy results in increasingly expensive liquid fuels.** The cost of oil imports for liquid fuel production is tied to foreign exchange. If the price of crude oil continues to rise, so too will the price of liquid fuels rise for Cape Town residents. This, in turn, will affect the local economy and household disposable income.	Normal

12. Electricity

Electricity distribution is divided as follows (see diagram):

- Generation – the power stations where the electricity is produced from coal or other primary source
- Transmission – the high voltage network transporting electricity cross-country or even cross-continent
- Distribution – the medium voltage network transporting electricity over short to medium distances ('farm' lines, or lines seen in urban areas are typically medium voltage)
- Reticulation – low voltage lines transporting electricity to the end-users (often over a maximum distance of around 200m)

Figure 12.1: Electricity transformation



The national electricity generation mix is dominated by coal-generation plants located near the coalfields, mainly in Mpumalanga and Gauteng. Around 95% of the national grid electricity is coal generated, about 5% from nuclear, and small amounts from hydro[1]. As South Africa's coal is very cheap, its electricity is very cheap – amongst the cheapest in the world. This factor has had a huge influence on South Africa's energy picture – it has discouraged energy efficiency and retarded the development of other supply options such as solar or wind energy.

12.1 NATIONAL LEGISLATIVE AND GOVERNANCE CONTEXT

The Department of Minerals and Energy's (DME) role in the electricity sector is primarily one of governance. However, the DME does have an active role in the implementation of the National Electrification Programme Phase 2, which it manages and funds, including funding of local authorities low-income household electrification. The NER is the DME's main agency for regulation of the electricity sector. The NER is responsible for the issuing of licenses and approving all tariffs (although there has been some confusion in this area as the Constitution suggests that local authorities also have the right to set tariffs).

Some relevant legislation and guideline documents are summarised below[2]:

- **The Electricity Act** No 41 of 1987 requires the National Electricity Regulator (NER) to issue licences for the generation, transmission and distribution of electricity.
- **The Electricity Distribution Industry (EDI) restructuring guidelines** (EDI Blueprint Report) makes recommendations on the rights and obligations of the future Regional Electricity Distributors (discussed later).
- **EDI Restructuring Bill** provides the legislative framework for the restructuring of the EDI.
- **Electricity Regulatory Bill** establishes the regulatory framework of the Electricity Supply Industry (ESI) and the powers of the NER, including issuing of licenses and approving all tariffs.
- **NER Electricity Efficiency Policy** - this draft document clarifies local authorities responsibilities regarding electricity efficiency.

12.2 ELECTRICITY GENERATION IN THE UNICITY

The City of Cape Town (CCT) generates very little of its own energy - the vast majority is purchased from Eskom (see Table 12.2). The city's generation plant comprises the Athlone power station (180MW capacity) and two gas turbines (40MW capacity each) situated at Roggebaai and Athlone respectively. CCT also owns a pumped storage plant at Steenbras, which pumps water to the Steenbras Dam in off-peak (cheap electricity) periods, and generates electricity from running the water down again in peak periods (i.e. hydro generation). All of CCT generation plants, including Steenbras pumped storage, is used for load

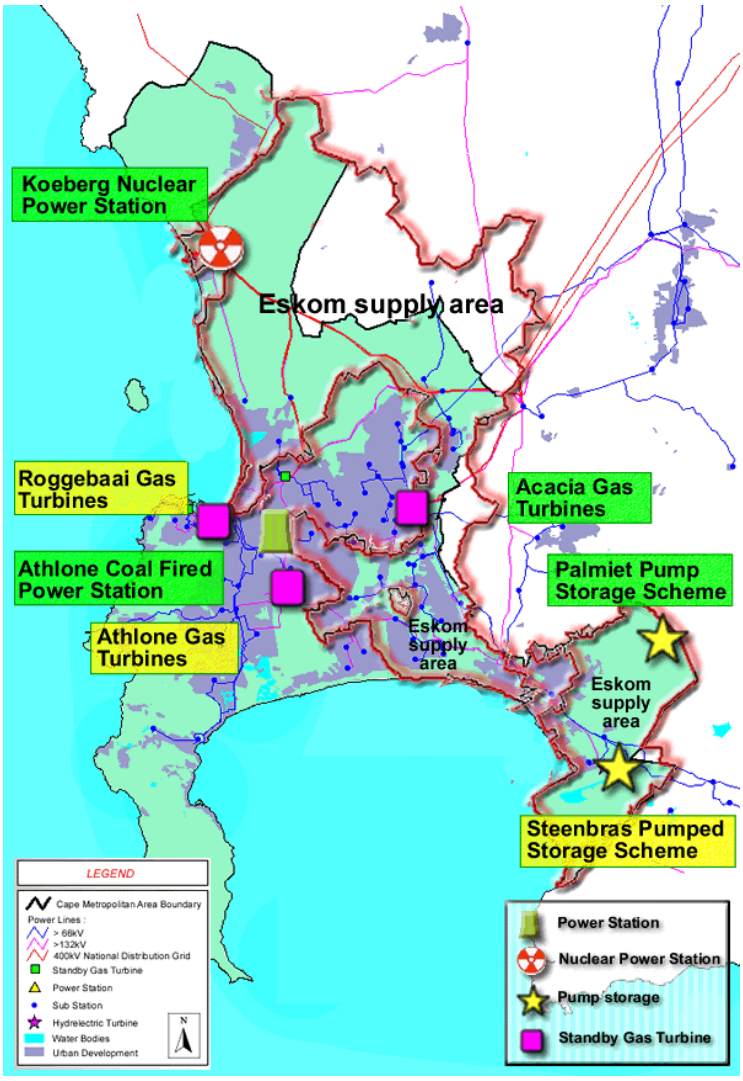
[1] Overview of the South African Energy Sector, DME, Pretoria, 1996

[2] Extracted largely from the NER IRP Policy Framework, NER, Johannesburg, 2002.

management or emergency duty rather than being base-load generators. Steenbras alone saves CCT about R2.5 million per month[3].

A study has been undertaken to assess the feasibility of building a pipeline from the West Coast offshore natural gas fields to Cape Town. Athlone power station is potentially an anchor customer in this venture, using gas to generate electricity (presently Athlone runs off coal transported all the way from Mpumalanga, and is thus not a very cost effective plant). Initially the Kudu gas field was thought to have sufficient reserves to consider such a pipeline, but recently it has been discovered that its capacity is less than previously thought. Now the Forest Oil gas field closer to the Cape Town is being focused on, and capacity of this field is currently being clarified. Should reserves prove adequate, the pipeline may be constructed, and Athlone power station sold off as a gas-fired Independent Power Producer. However, the development of gas distribution infrastructure linked to the West Coast fields is also a national issue, with talk of linking the gas field with Mossgas refinery, which has a limited lifetime with its current gas sources. Decisions regarding the introduction of gas to Athlone or Cape Town in general therefore are not entirely in CCT's hands.

Figure 12.2: Electricity generation for the Unicity



CCT's peak demand is around 2000MW at present (excluding Eskom distribution areas). CCT has recently focused on low-income household electrification as a part of the National Electrification Programme (discussed later). Typically this results in decaying load factors due to increased domestic load peaking, although this would have been ameliorated by the fact that Eskom undertook much of the low-income electrification within CCT's area of jurisdiction (see later). The exact situation regarding the load factor in the metro area is not known.

Table 12.1: Cape Town's electricity use in a national context (annual figures)

	National*	Cape Town metro	Cape Town %
Peak demand	35 324 MW	2 000 MW	6%
Total energy sold	176 649 GWh	10 232 GWh	6%
Number of customers	6 794 383	687 066	10%

** Source: NER Statistics for 2000.*

The Eskom imported electricity is sourced directly off the national grid. Eskom generation plant in the vicinity of Cape Town includes emergency gas turbines at Acacia (171MW capacity), Koeberg nuclear power station (1840MW capacity), and Palmiet pumped storage scheme for national grid load management (400MW capacity). Although in theory Koeberg could meet almost all of CCT's electricity demand, in reality it is merely one of a mix of generation plant feeding into the national electricity grid. Also, Koeberg comprises 2x920MW units, one of which is often down for maintenance or other routine reasons. Koeberg has 22 years of economic life left, and Eskom is looking to construct further nuclear capacity in the form of the Pebble Bed reactors in the vicinity of Koeberg, although final permission to proceed with this is yet to be granted by national government.

[3] Integrated Electricity Plan for CCT, 2002

Table 12.2: Electricity generation in the City of Cape Town

Electricity source	Total kWh sent out (2000/2001)	% of total kWh sent out	Cost of electricity (c/kWh sent out)	Rated capacity
Eskom imports from national grid (mainly coal, some nuclear)	5 257 117 361	98.6%	12.23 c/kWh	900 MW firm via 2 feeders
Athlone coal fired power station	73 692 200	1.4%	16.15 c/kWh	180 MW
Athlone gas turbines (oil-fired)	356 100	Minimal	142.96 c/kWh	40 MW
Roggebaai gas turbines (oil-fired)	1 027 900	Minimal	146.45 c/kWh	50 MW
TOTAL	**5 332 193 561**	**100%**		
Steenbras hydro-generation from pumped storage (net consumer, not generator)	274 977 440 (352 492 900 consumed)		8.7 c/kWh (operating cost)	Plant efficiency = 78% 180MW generating 200MW pumping

Source: City of Cape Town, Preliminary Electricity Statistical Report 2000/2001

12.3 MINIMIZATION OF SYSTEM LOSSES

Losses occur with within the CCT distribution system (i.e. electricity sold by CCT compared with electricity purchased from Eskom), as well as in supplying CCT via the national transmission grid (i.e. electricity reaching Cape Town compared with power generated at a coal-fired station in Mpumalanga) On the distribution side, both technical and non-technical[4] system losses currently average 6,5% of system sales per annum. Various methods are employed to curtail the non-technical losses.[5]

Due to the long transmission distances involved in supplying coal-generated national grid electricity to Cape Town, savings in transmission losses can amount to more than 20% of station sent out capacity, which is the highest in the country. This is a factor in favour of establishing new generation plant in Cape Town. [6]

12.4 DISTRIBUTION

From 1994 to 1999 the National Electrification Programme electrified about 2.5 million households all around the country. Eskom electrified about 1.75 million of these, and local authorities the remainder. Because of Eskom's often greater experience and capacity in low-income electrification, they electrified many areas which were formally within local authority jurisdiction. For this reason today Eskom is still the official distributor within much of CCT metro's jurisdiction area (see map). While this certainly facilitated achieving the mass electrification targets of the National Electrification Programme, there are various problems associated with having two distributors in one local authority area, including (1) different tariffs for the same consumer types (often just separated by a road), (2) difficulty of data collection on electricity for the whole of the CCT area (Eskom does not collect data on the basis of local authority boundaries), and (3) lack of influence of the local authority on electricity provision issues for people for whom they are responsible (for example the provision of free basic electricity).

12.5 CUSTOMER BASE

CCT has a total of 687 066 customers, as shown in Table 12.3. Cape Town has a relatively small industrial demand component, with no consumers categorised as 'energy intensive' (as per the definition of the Energy Intensive Users Group).

[4] typically non-payment and theft

[5] G.W.F. Munro, Integrated Energy Plan for the Western Cape – Draft Policy Document

[6] An Ingegrated Energy Outlook for South Africa, NER, 2002.

Table 12.3: Number of customers and total electricity use per customer category

Consumer category (tariff category)	Number of customers in category	Total annual energy use (kWh/yr)
Domestic – Conventional meters	215,877	2 005 004 690
Domestic – Energy dispensers	431,802	1 911 291 967
Commercial – Small 1 & 2	34,337	1 612 201 904
Large & Very Large	3,359	4 377 786 230
Off Peak	788	120 578 189
Other private	903	1 207 560
Municipal – general – streetlights		144 124 794 59 828 120
TOTALS	**687 066**	**10 232 023 454**

12.6 TARIFFS

Tariffs have only recently been unified along with the formation of the CCT unicity. However, in the CCT metro areas in which Eskom remains the distributor, the standard Eskom tariffs apply.

Table 12.4: CCT tariff categories

Tariff category	Description
Domestic 1	Consumption exceeding 500kWh/mth
Domestic 2	Consumption under 500kWh/mth
Commercial – Small Power Users 1	Consumption over 1000 kWh/mth
Commercial – Small Power Users 2	Consumption under 1000 kWh/mth
Large Power Users LV	Low voltage supply
Large Power Users MV	Medium voltage supply
Very Large Power Users	Over 3GWh per year
Off-Peak	Domestic of Commercial users >50kVA
Interruptible supply	Special agreement, typically fro steam generation purposes
Time of use tariff	By special agreement only

Table 12.5: Eskom tariff categories

Tariff category	Description
HomePower	Medium to hi domestic use (cheaper for over 282kWh/mth)
HomeLight (60A or 20A options available)	Low-use, single phase domestic use (cheaper for under 282kWh/mth)
BusinessRate	For maximum demand of max 100kVA
MiniFlex	Max demand of 100kVA to 5MVA, with time of use charge differentials
MegaFlex	Max demand over 1MVA, with time of use charge differentials
NightSave	Max demand greater than 25kVA, with peak and off-peak periods.
Rural tariffs: Eskom also has a range of tariffs applicable to rural areas	

12.7 TRENDS AND DEVELOPMENTS

Integrated Resource Planning

The Energy Policy White Paper requires that Integrated Resource Plans (IRPs) are developed for all substantial new investments in energy infrastructure. Although the policy applies to all energy sub-sectors, it is particularly relevant to the electricity sub-sector. Amongst the main functions of IRPs are to ensure that demand-side options are considered prior to supply-side options (i.e. a new generation plant is not built without first exploring whether load management or efficiency are more economically sensible options), and also that social and environmental factors and externalities are considered.

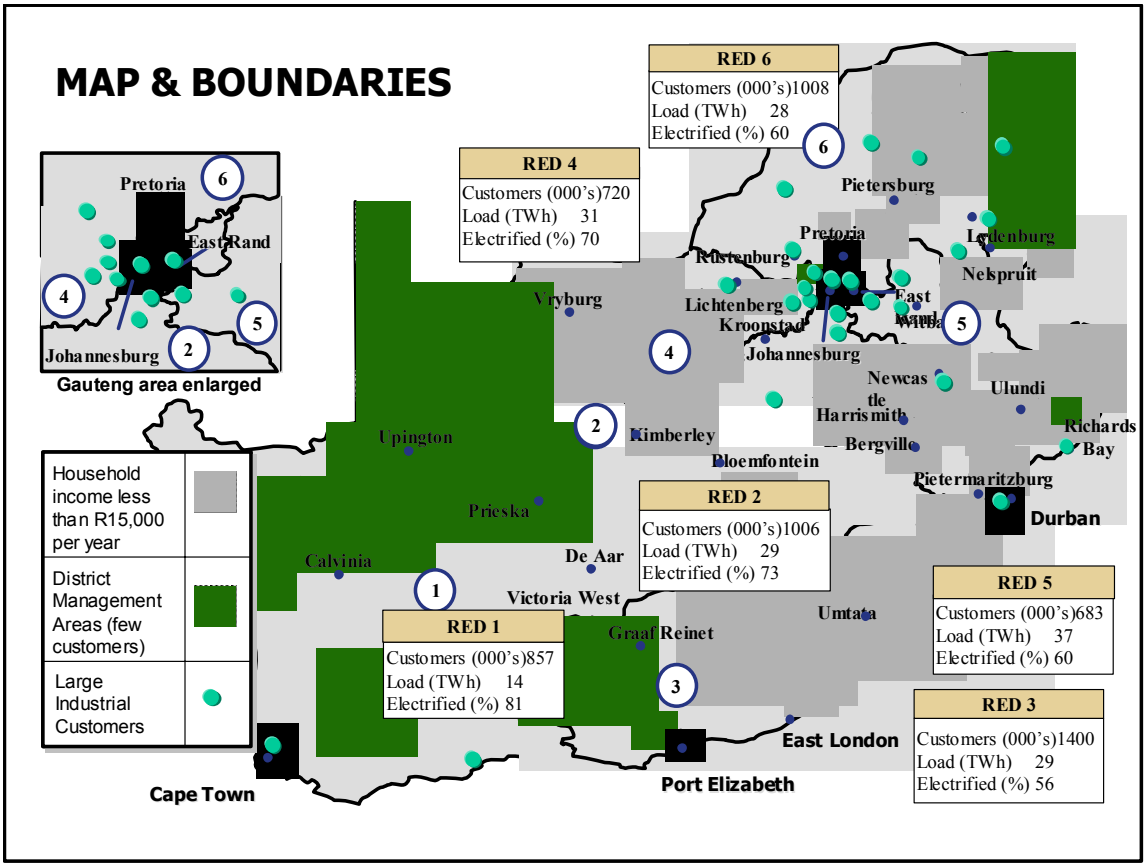
The NER has produced a draft IRP (or Integrated Electricity Outlook) based on Eskom's Integrated Strategic Electricity Plan No 8. The specific objective of the NER IRP is " to optimise the supply-side and demand-side mix to keep the price of electricity to consumers as low as possible". Social and environmental considerations are given little attention. The main direction given by the IRP is that coal is likely to remain the cornerstone of generation into the medium-term, but that diversification away from this dependence needs to be given increasing attention. Wind generation is identified as having potential for being part of the future generation mix, but is acknowledged to be expensive currently.

CCT Electricity Department has also produced a local IRP, or outlook for the electricity sector in the metro area. Here the possibility of natural gas (via Athlone power station) and the Darling wind IPP contributing to the generation mix are raised. The document has been approved by Council as a 'status quo' report.

Restructuring of the electricity industry

The Energy Policy White Paper (DME 1998) prompted the restructuring process of the electricity sector. Generation, transmission and distribution functions are to be separated, and eventually, generation may be broken up into individual competing power stations. Independent Power Producers are now able to sell directly into the national grid, and a few such IPPs around the country have already been granted licences by the National Electricity Regulator to operate. CCT's Athlone power station may also become an IPP, pending the firming of natural gas resources off the west coast and thus the feasibility of converting Athlone to natural gas. Another imminent IPP that may sell electricity to CCT is the wind farm at Darling.

Figure 12.3: Map of proposed new RED boundaries



Source: NER 2002

As a part of industry restructuring, national distribution functions are to be divided up into six Regional Electricity Distributors (REDs). For several years slow progress has been made to the establishment of the REDs, and the holding company for them has recently been set up. At present it is estimated that the REDs will come into existence in 2005. While the NER's perspective is that they will definitely go ahead, others feel that the benefits of establishing the REDs are unclear, and it remains to be seen whether in fact they come into being.

The implications for CCT of transferring all electricity distribution functions to the Western Cape RED are significant. The RED covers a huge geographic area (refer to the map), and while Local Authorities will be

represented on the RED board, there is no clarity on what their rights regarding electricity provision or policies will be within their areas of jurisdiction. It seems likely that CCT will be a small player in the RED, and thus have limited influence on their operations. It seems that this will inevitably result in a loss of control by the local authority over one important means to serve their constituency – provision of electricity.

A second implication relates to the contribution of electricity to the finances of the local authorities. This has been identified by the NER as a significant issue, and a study on the topic is expected to be commissioned. A third, and very important implication relates to changes in the way CCT optimises its load management with local generation stations. REDs may not own generation capacity, and thus the current system whereby the distributor (CCT) can use generation plant to optimise their load curve and thus save huge amounts of money will have to change. How this will happen is unclear, and potential cost implications for the players involved (including customers) is unknown, but potentially significant.

Another important implication for CCT is that, in the period leading up to the formation of the Western Cape RED, medium and long-term planning becomes difficult. The Electricity Department of CCT is likely to be absorbed into the RED to some extent, leading to further uncertainty and potential stagnation in department operations in the lead-up period. To give a specific example, at present it is difficult to collect data on electricity customers and use patterns for the whole unicity due to its being located in several different administrations, and with Eskom. In the light of the potential incorporation into a RED does it make sense to try and establish a unified electricity information system just for CCT as is currently needed? If it is established, it may not be compatible with that of the RED, for example.

Demand-side management initiatives

CCT electricity Department has implemented five separate domestic geyser ripple-control[8] demand-side management pilot projects, and success has been notable. Geysers are switched off at peak load periods (7-10am and 6-8pm), resulting in an estimated saving of 23MW in total. Potential savings are as high as 40MW if all geysers in the project are switched off.

There are plans to expand this programme significantly in conjunction with Eskom as a part of the local authority's energy efficiency drive. The NER is currently working on a draft policy which clarifies local authorities obligations regarding electricity efficiency.

Small independent power producers

CCT Electricity Department is starting to explore suitable technical and administrative arrangements to enable small-scale power generation to link to the grid. A few small pilot projects are expected to start early in 2003.

12.8 ISSUES

The following issues arise from the overview of the electricity supply situation in Cape Town: **Priority**

Issue 12.1: **CCT may have reduced ability to effectively meet the energy needs of its constituency under the proposed RED.** It is unclear what the rights of the local authority will be towards ensuring adequate and affordable electricity supply for its constituency when incorporation into the RED. **HIGH**

Issue 12.2: **Electricity accounts for the majority of CO_2 emissions for CCT (68%), and thus measures to improve efficiency of use and alternative cleaner generation are of added importance in moving to sustainability.** **HIGH**

Issue 12.3: **Uncertainties around likely incorporation of CCT Electricity into the RED make planning difficult.** The likely incorporation of CCT electricity functions into the Western Cape RED, including much uncertainty in timeframe, makes it difficult to engage in any sort of medium- or long-term planning for the electricity supply sector. Potential inefficient or uneconomic supply mix may result. **MEDIUM**

Issue 12.4: **Data on electricity use and customers in the CCT metro area is extremely inaccessible.** There is an urgent need to have a unified electricity data collection **MEDIUM**

[7] Geyser ripple-control system is where domestic geysers can be switched off by sending a hi-frequency 'ripple' down normal 220V AC electricity supply cables feeding into households.

	system regarding electricity customers and sales, as currently it is fragmented amongst the different distributors as well in Eskom, and much of it is not kept in useful or quickly accessible format. Planning and analysis without data is difficult.	
Issue 12.5:	**The pilot residential demand-side management programme of CCT shows great potential for this type of intervention.** Such programmes are to be encouraged from an environmental and economic point of view – roll-out to all other suitable areas should be encouraged.	**MEDIUM**
Issue 12.6:	**It is unclear whether Cape Town will be able to use its local generating capacity to optimise its load profile under the proposed RED.** Incorporation of CCT electricity functions, excluding generation, into the REDs may reduce CCT's ability to use local generation plant to optimise their load profile, which currently saves them vast amounts of money. There is a huge lack of clarity on this issue at present.	Normal
Issue 12.7:	**Having Eskom as the official distributor in much of CCTs area of jurisdiction has resulted in multiple tariffs and fragmented responsibilities.** This situation also potentially leads to an inability for the local authority to implement policies to address the perceived needs of their constituency (such as the free basic electricity tariff).	Normal
Issue 12.8:	**CCT should ideally undertake an annual IRP to ensure optimum economic supply mix.** Such an IRP should evaluate economic best-mix of supply and demand-side components and guide investment in this regard. It can also assess the potential for local generation in the light of national transmission losses and expected lack of capacity. However this is a demanding function, and currently the capacity may not exist for such a comprehensive exercise – although potential economic benefits are substantial. The uncertainty about incorporation into REDs also discourages the undertaking of such exercises, or developing Departmental capacity in this regard. However, the expected greater capacity in the RED may facilitate the undertaking of IRPs.	Normal

13. Nuclear

Nuclear power supplies approximately 1% of S.A.'s primary energy, and 5% of total electricity generation, but because of the large amounts invested in the industry and the large public funding of the industry, it is considered important to the energy sector.[9] The uranium enrichment process was closed in 1995, and the industry now relies on nuclear fuel imports. South Africa's only nuclear power plant is the Eskom-owned Koeberg Power Station, which is located to the north of Melkbosstrand in Cape Town. The electricity generated at Koeberg Nuclear Power Station is sent to the national grid for general distribution.

13.1 POTENTIAL ENVIRONMENTAL IMPACTS AND HEALTH HAZARDS

The effect of nuclear power generation on human health and environmental sustainability is a highly contentious issue that is widely debated locally and internationally. These issues are of utmost important to Cape Town in particular, as the country's only nuclear reactor is located within CCT boundaries. A proposal to develop a second nuclear reactor, the Pebble Bed Modular Reactor, adds urgency to the need for Cape Town to formulate a clear position. Although the debate on the appropriateness and sustainability of nuclear power is far from resolved, there is a strong anti-nuclear lobby active internationally and nationally. Key criticisms centre around the following:

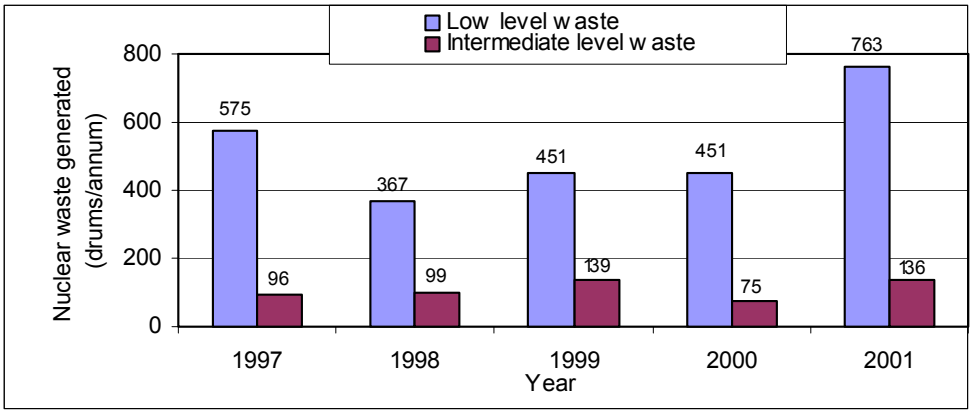
Radioactive waste

Nuclear power generation produces wastes that cannot be disposed of. These wastes are encapsulated and buried, but remain radioactive for thousands of years. Wastes at the Koeberg Power Plant are divided into spent nuclear fuel, low-level waste and intermediate-level radioactive waste.

Highly radioactive spent nuclear fuel is currently stored on-site until suitable long-term storage can be found. To date, 1132 spent fuel assemblies are stored in the Koeberg Spent Fuel Pools, and an additional 112 spent fuel assemblies are in temporary storage in four spent fuel transport casks following re-racking of the spent fuel pools.[10] Storage of high-level waste is considered an unresolved issue, and it is significant that there are no approved high-level waste storage facilities anywhere in the world at present.

Low-level and intermediate-level radioactive waste is transported to a disposal site at Vaalputs in the Northern Cape. As figure 13.1 shows, 2001 saw a considerable rise in both low-level and intermediate level waste. That year, inspection and repair activities to safety systems piping resulted in the generation of large volumes of low-level waste, while scheduled refuelling outages on units, as well as the unplanned shut-downs for piping inspections and repairs, and grid and transformer outages produced intermediate-level waste.[11]

Figure 13.1: Amount of Radioactive Waste generated in drums/annum by Koeberg Nuclear Power Station



In addition to radiation from the storage of wastes, uncontrolled leakages – i.e. releases of radioactive effluent that are unquantified or that bypasses the monitored liquid or gaseous effluent pathways - occur

[9] Hilton Trollip, Overview of South African Energy Sector, 1996, pg. 2-4.
[10] Dave Thomas, Eskom, Personal Communication, January, 2003.
[11] City of Cape Town, City of Cape Town State of Environment Report Year 4, 2001.

during regular plant operations. Table 13.1 shows the number of reported leakages of radioactive material per annum.

Table 13.1: Number of reported leakages of radioactive material

Year	Number of reported uncontrolled releases	Radioactive dose impact
1999	0	0
2000	1	No radioactive dose impact
2001	2	Within regulatory limits

Source: City of Cape Town, State of Environment Report for Cape Town, 2001

Eskom claims that stable waste storage and low radioactive dose impacts present no danger to people or the environment. A widely-held counter argument is that there is no evidence of a 'safe' dose of radiation, nor is it proven that a dose received slowly is less dangerous than one that is received quickly.

Evacuation plans

Several criticisms are leveraged against nuclear-induced evacuation plans, the first being that insufficient resources are available to evacuate people at risk in the given time period. In the event of a hazardous radiation release, Eskom and the DME, through the national nuclear regulator, call for at least a 10 km zone to be evacuated. However, since radiation will travel at an average wind speed of three meters per second, giving people less than two hours to evacuate,[12] many point out that it would be impossible to evacuate people at risk in time. Multiple means of communications have not been devised to inform people of an incidence, and would not ensure everyone would be reached anyway; people have not been informed on where to go in the event of an evacuation; there is no planned assembly point for those who do not have private transport; and there is no indication of how the required number of buses necessary for transporting people would be acquired.

Another criticism involves the proposal for residents to stay indoors and close all doors and windows. Since radiation is windborne and gamma particles will penetrate concrete, this proposal fails to assure residents of their safety.[13]

Further, there is widely-held scepticism that the evacuation team would execute a successful evacuation. During Cape Town's previous evacuation exercise, the team got the wind direction wrong, and drove people into the radiation. [14]

Transportation of nuclear fuel and waste

Eskom's position is that comprehensive emergency planning is in place for all aspects of the transport of radioactive waste.[15] However, criticisms against these claims include the following: First, the container designed for the transport of uranium imported from overseas is only "safe" if it does not fall more than 9 metres; if its fall exceeds that distance, a nuclear catastrophe would occur.[16] Second, communities located along fuel transportation routes do not have capacity to manage nuclear accidents. [17] Even Durban, one of the most sophisticated cities in S.A., has asked the minister to halt all nuclear transport through Durban, as they cannot cope with accidents.[18]

13.2 ISSUES

		Priority
Issue 13.1:	**With the existing and intended further nuclear generation plant located within CCT area of jurisdiction, CCT is seriously affected by these issues.** There is widespread contention as to the safety and appropriateness of nuclear generation as an energy source, with strong arguments for and against. Although decisions regarding further nuclear capacity are being dealt with at a national level, residents of Cape Town will be fundamentally affected by these decisions, and thus have a right to input strongly into this process.	Normal

[12] Earthlife Africa – Johannesburg, What You Need to Know about South Africa's Nuclear Programme!, 2002, p12.
[13] Muna Lakhani, Earthlife Africa, Personal Communications, January 13, 2003.
[14] Muna Lakhani, Earthlife Africa, Personal Communications, January 13, 2003.
[15] Dave Thomas of Eskom, Personal Communication, January 9, 2003.
[16] Muna Lakhani, Earthlife Africa, Personal Communications, January 13, 2003.
[17] Earthlife Africa – Johannesburg, What You Need to Know about South Africa's Nuclear Programme!, 2002, pg.9
[18] Muna Lakhani, Earthlife Africa, Personal Communications, January 13, 2003.

14. Renewable and Sustainable Energy

South Africa is endowed with vast renewable[19] energy resources, yet it forms a relatively small part of our national energy mix. The potential for solar and wind renewable electricity generation in particular is huge, yet the price of such clean sources is still far from being able to compete with the very cheap, but very dirty coal-fired generation. These renewable energy sources currently comprise less than 1% of total installed capacity. Although not necessarily renewable, biomass energy (woodfuel, dung, bagasse and pulp) provides the majority of energy traditionally classified as 'renewable'. A large proportion of the rural population, mainly in the old 'homelands', still rely on woodfuel for core energy needs.

Because the current national and local energy mix is not sustainable in that it contributes to many local and global environmental problems, this section explores the current and potential role of cleaner, more sustainable forms of energy for CCT.

14.1 POLICY AND INSTITUTIONAL ENVIRONMENT

White Paper on Renewable Energy and Clean Energy Development

Deregulation and restructuring of the electricity supply industry is intended to open the market to opportunities for renewable production. In a recently released draft White Paper on 'Renewable Energy and Clean Energy Development', government recognises the important role of renewables in the long-term sustainability of South Africa's energy profile, and sets a ten-year target of increasing the use of renewable energy in final energy consumption. The purpose of the policy "is to set out Governments' principles, goals, and objectives for renewable energy. It furthermore commits Government to a number of actions to ensure that renewable energy becomes a significant part of its energy portfolio over the next 10 years."

However, in spite of the clear and promising purpose statement, the draft document provides little specific direction on promoting different renewables sources, and as it stands may be of limited help in moving to a more sustainable mix. In particular, two economically and environmentally sound options - solar water heating and passive solar building design - are not adequately stressed given their proven track record, financial feasibility and potential impact.

The next version of the policy document is expected soon, and hopefully will provide clearer guidance of how the very sound 'purpose statement' is to be translated into reality.

The Municipal Systems Act No 32 of 2000

The Municipal Systems Act requires that municipalities provide sustainable services to their communities. This includes energy provision, and opens the door to steadily increasing the role of cleaner energy sources in the CCT energy picture.

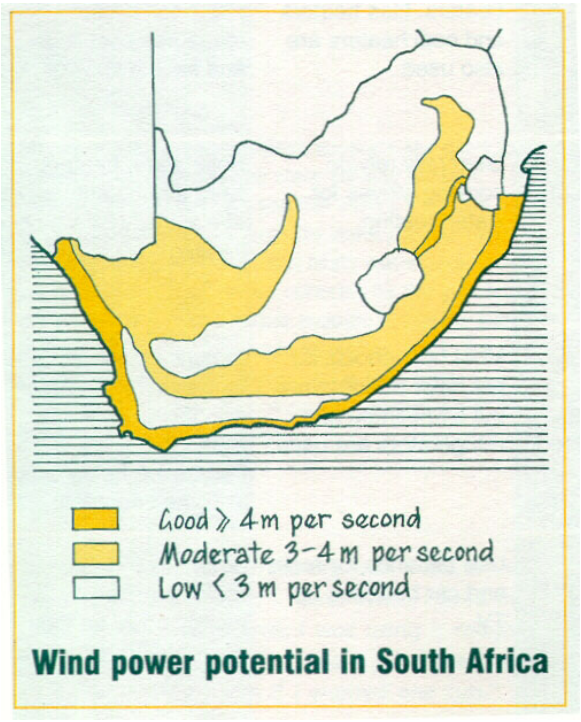
14.2 WIND ENERGY

World installed wind electric generating capacity rose from 17,500 megawatts (MW) in 2000 to 24,000 MW in 2001—a dramatic one-year gain of 37%. [20] In contrast, the use of coal — the principal alternative for generating electricity— peaked in 1996 and has declined by 6% since then.

In South Africa, wind energy has so far mainly been used for water pumping on farms and game reserves, with approximately 860 small-scale (500W) remote installations installed country-wide.[21] However, utility-scale developments are under construction in the Western Cape: an independent power producer is developing the first commercial utility-scale windfarm for grid electricity generation in Darling, and Eskom is developing a demonstration windfarm in Klipheuwel. The focus of wind-power developments is on Cape Town because of the more favourable wind regimes here.

[19] Although biomass and hydro energy are often not renewable, they are included in this section for simplicity.
[20] Earth Policy Institute website: http://www.earth-policy.org/Indicators/indicator10.htm, 2002
[21] Sarah Ward, The Energy Book for Urban Development in South Africa, 1992, pg. 25.

A wind atlas for South Africa was compiled in 1993, but with the availability of additional and more reliable data, Eskom and the DME have undertaken the development of a new wind atlas[22], although detailed findings are not publicly available.



Based on earlier wind power assessments, wind power potential has been estimated to be good along the coast with mean annual speeds greater than 4 m/s and localized areas where the value of 6 m/s is exceeded.[23] During a telephone interview, Kevin Nassiep of Eskom[24] confirmed that wind speeds at the Eskom wind farm in the Western Cape are about 6.5 m/s.

There is a large discrepency in wind resource development potential estimates for South Africa. Eskom conservatively estimates the wind resource in South Africa to be capable of providing between 500 MW to 1000 MW of wind-generated electricity. [25] The South African Wind Energy Association, on the other hand, are negotiating a target for implementation of wind energy in South Africa, which they think will settle around wind energy supplying 7 to 10% (3000 MW) of South Africa's electricity by 2020.[26] In terms of the Western Cape, a local energy expert estimates that conservatively the coast-line around the Western Cape is suited to 1500 to 2000MW of wind generation, and quotes studies by the World Bank and others indicating a potential of 5 700 to 26 280 GWh per year.[27]

Internationally, the cost of wind-generated electricity at prime wind sites has fallen dramatically. In the United States, for instance, prices over the last 15 years have dropped from 35¢ per kilowatt-hour in the mid-1980s to 4¢ per kilowatt-hour in 2001[28]. The South African Wind Energy Association[29], claims that wind energy is becoming increasingly competitive on a cost basis in South Africa as well. They explain that when external costs of conventional generation and distributed generation are taken into account, such as the cost of poor health due to air pollution, wind energy at around 24 to 30 cents (generation cost) is already reasonably competitive in South Africa, particularly in niche applications. They estimate that within 10-15 years, wind energy will be one of the cheapest forms of electricity generation in South Africa as technology improvements continue to bring down the price of wind energy.

[22] Kevin Nassiep, Eskom, Personal Communications, Dec. 19, 2002.
[23] Hilton Trollip, Overview of South African Energy Sector, 1996, pg. 4-71.
[24] Kevin Nassiep, Eskom, Personal Communications, Dec. 19, 2002.
[25] Eskom Enterprises, TSI Division, Environmental Impact Assessment for the Eskom Wind Energy Demonstration Facility in the Western Cape: Final Environmental Impact Report, pg. 3
[26] South African Wind Energy Association website: http://www.icon.co.za/~sawea.
[27] Davin Chown, One World Sustainable Investments, Personal Communications, January 16, 2003.
[28] Earth Policy Institute website: http://www.earth-policy.org/Indicators/indicator10.htm, 2002
[29] South African Wind Energy Association: http://www.icon.co.za/~sawea

An independent wind power producer is about to construct a generation facility at Darling, north of Cape Town, called the DARLIPP Wind Project. The electricity from the project will cost a premium of 27,27 c over and above the 9,63c/kW.h. cost of delivery of electricity by Eskom to Cape Town, [30] totalling 36,9c. For the Eskom wind project sited at Klipheuwel, the cost is 40-45c/kwh, using a fully imported system (although, costs could come down if wind technologies were produced locally).[31]

Wind energy and employment creation

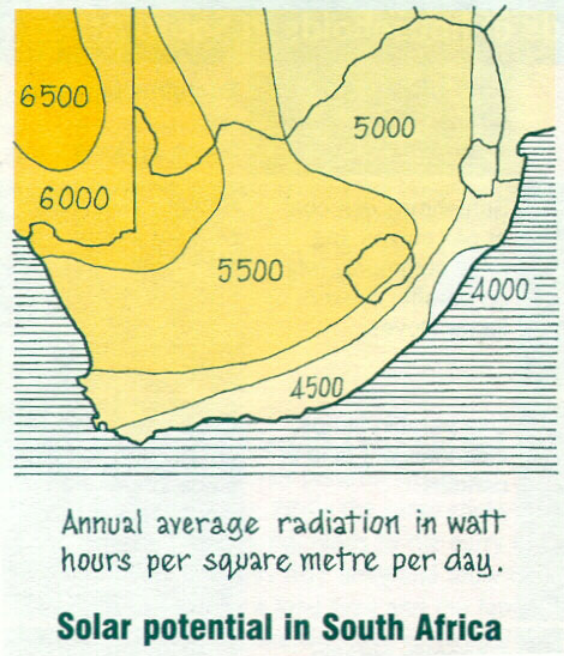
Employment creation is a national, provincial and local issue that is promoted in all sectors, including the energy sector. Therefore, the employment potential associated with various energy supply options needs to factor into decision-making. Key considerations such as the fact that a wind industry employs ten times more people per kWh than nuclear and four times more than coal power stations [32] need to be taken into account.

Micro grid-connected wind-electric systems

With the recent changes in legislation to facilitate IPP participation in electricity generation, CCT is exploring the technical feasibility for small grid-connected renewable energy systems such as wind and solar generation. While these are still relatively expensive options, and are thus unlikely to proliferate in the short to medium term, they represent one option for environmentally conscious individuals or organisations to become less dependent on dirty coal-fired electricity generation.

14.3 SOLAR ENERGY

The international solar electricity industry is currently worth more than US$ 1 billion in annual sales. The European Photovoltaic Industry Association/Greenpeace scenario show that, by the year 2020, photovoltaic systems could be generating enough solar power to satisfy the electricity needs of 30% of the entire continent of Africa.[33]



South Africa experiences amongst the highest solar radiation levels in the world with daily solar radiation levels in the range of 5.5 to 8.5 kWh/m2/day[34]. Only a tiny part of the potential offered by this resource has been realised: the current total installed capacity in South Africa is just over 8MW[35] - which is approximately equal to the amount of radiation falling on just 1km^2 (although conversion of direct solar energy to electricity or heat introduces losses which would need to be factored in for a more useful comparison).

As the solar map shows, the Northern Cape Province has a considerable sun resource base. While no overall resource potential estimate was obtained during the research of solar energy, the preliminary results of Eskom's Solar Thermal Electric Project suggest substantial potential for bulk electricity generation, and a promising solar future for South Africa in international terms. This project found that:

- A pilot-scale Concentrating Solar Power (CSP) plant built in South Africa could produce the lowest cost solar electricity in the world to-date.
- The Upington site (in the Northern Cape province) selected as the baseline for the plant evaluations appears to offer one of the best solar resources in the world.
- CSP plants can be designed to meet evening peak loads in South Africa.
- Either the trough or power-tower plant represents a reasonable choice for a pilot plant.

[30] G.W.F. Munro, Integrated Energy Plan for the Western Cape – Draft Policy Document
[31] Kevin Nassiep, Eskom, Personal Communications, Dec. 19, 2002.
[32] South African Wind Energy Association: http://www.icon.co.za/~sawea
[33] African Energy, Solar Power is Booming, September-October 2002, Vol. 4, No. 5, pg. 23
[34] A.Eberhard, Solar Radiation Handbook for South Africa. 1992 Elan Press, Cape Town
[35] Sarah Ward, The Energy Book for Urban Development in South Africa, 1992, pg. 24.

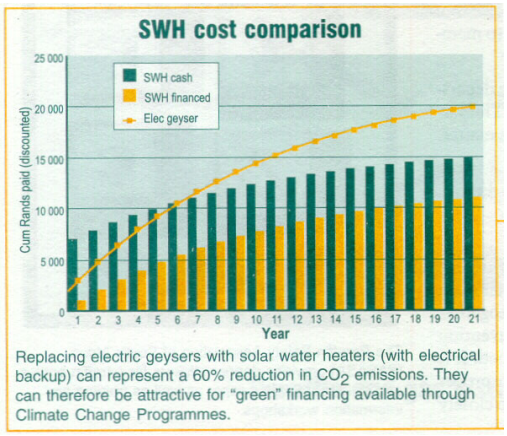
The map shows that Cape Town has a solar resource potential of around 5 kWh/m^2/day. The solar values for Cape Town are lower than most other regions of South Africa partly due to the relatively cloudy winters associated with the Mediterranean climate. Cape Town is therefore not best placed for some solar applications. However, it is important to note that huge potential exists for passive solar design and solar water heating, which are financially and environmentally sound options for CCT.

The following technologies are suitable for use in Cape Town:

Solar Water Heating (SWH) Systems

SWHs are a well established technology in SA with many types manufactured locally. There are eight listed solar water heater manufacturers in the CCT area, some of which have been operating for many years (many also supply solar heating for swimming pools).

SWHs are a cost-effective and environmentally sound option for heating water in urban households and institutions (e.g. boarding houses). Mid-income households, for example, use approximately 30 to 50% of their total electricity consumption on heating water in a conventional geyser. A SWH can be expected to cut this in half at least. This technology represents one of the most feasible opportunities to move to a more sustainable energy mix. However, although financial savings make SWHs a sensible investment, uptake to date has been minimal due to the relatively high capital cost. Conventional systems typically cost from R6000 to R12000. The industry has recognized the need for SWHs in the low-income sector, and models specially suited to this market have been developed. However, such units with hot water storage may cost around R3000, which is still unaffordable to most of the target group. With suitable financing the use and impact of this technology could be huge. Benefits include financial savings for customers, improved local environmental performance, and reduced need for peak and base-load generation plant. SWHs can be used with geyser ripple-control DSM measures and timers.



Replacing electric geysers with solar water heaters (with electrical backup) can represent a 60% reduction in CO_2 emissions. They can therefore be attractive for "green" financing available through Climate Change Programmes.

Passive solar building design

The potential energy savings through designing buildings with passive solar features are huge. In offices, space heating and cooling typically consumes half of the total electricity bill, and lighting most of the remainder (30 to 40% of the total). Yet with more sensible solar design, these heating, cooling and lighting needs can be drastically cut - by 50% or more. Space heating and cooling in mid-income households may consume around 15% of the total electricity bill, and lighting around 20%. Again, a sensible passive solar design can reduce such energy needs greatly. In low income households it has been estimated that the installation of a ceiling – a basic passive thermal measures – reduces heating needs by as much as 70%, as well as leading to a healthier and more pleasant home environment in general.

Including many passive solar considerations in house or office design costs little or nothing, and saves the occupants money for the entire life of the building as well as reducing the environmental impact of energy consumption. All that is needed is an awareness amongst designers of these features. Other passive design features cost more, but are recouped in savings in a few months or years. Retrofitting passive features, for example suitable window shading, often falls into this category. Overall passive solar design of buildings represents a major opportunity to improve the sustainability of CCT's energy mix from a social, financial and environmental point of view.

Table 14.1: Illustrative electricity savings of widespread solar water heater and passive thermal design implementation

Consumer group	Number of consumers*	Savings from SWH installation**	Savings from passive thermal design***	Total savings	Total CO2 reduction/yr	Potential peak load reduction****
Household savings	200 000	30 GWh/mth	18 GWh/mth	48 GWh/mth	633 000 tons	200 MW (Athlone is 180MW)
Commercial savings	34 000	-	47.6 GWh/mth	47.6 GWh/mth	570 000 tons	340 MW

* *this is the approximate number of mid-to high income households in CCT (25% of 800 000 total households), and includes all commercial electricity users.*

** *assumes household electricity consumption of 600kWh/mth, and 25% saving from SWH*
*** *assumes space heating and lighting electricity consumption reduced by 50% (household consumption assumed at 600kWh/mth of which 30% for space heating/cooling and lighting; commercial consumption taken as 4000 kWh/mth and space heating/cooling and lighting consumption taken as 70% of total consumption)*
**** *assumes 1kW ADMD reduction for households (geyser element is 3kW) and 10 kW ADMD reduction for commercial buildings.*

Grid-connected solar-electric systems

With the recent changes in legislation to facilitate IPP participation in electricity generation, CCT is exploring the technical feasibility for small grid-connected renewable energy systems such as solar and wind generation. While these are still relatively expensive options, and are thus unlikely to proliferate in the short to medium term, they represent one option for environmentally conscious individuals or organisations to become less dependent on dirty coal-fired electricity generation.

Other solar technologies

Solar cookers and stand-alone solar-electric systems generally have very limited application in electrified urban areas. The market for both of these technologies is generally rural non-electrified areas.

14.4 WAVE ENERGY

Eskom's SABRE-Gen Wave Project is currently conducting a resource assessment of the potential of wave energy along the South African coastline. However, earlier assessments maintain that the coastline is potentially very favourable for wave energy with an estimated 56 000MW available.[36] In addition, a feasibility study of wave power potential in the Saldahna area indicates that 770MW of potential exists, is technically viable, and is cost-competitive with coal and nuclear options[37]. Another indication of potential is the interest experts from the UK have shown in wave energy development along the Western Cape coast, and various discussions have been held in this regard.[38]

A customised, locally manufactured wave installation is currently under development, which has potential to favourable impact the cost of locally generated wave energy.[39] Overall, the technical and financial feasibility of wave generation is presently unclear, but developments should be tracked in this regard to determine its potential role in a more sustainable energy mix.

14.5 HYDRO-ELECTRICITY

With an average rainfall of 500mm S.A. is generally a dry country with relatively little hydropower potential. However, SA has 9 operating hydro-electricity stations and two pumped water storage schemes. Electricity also used to be imported from the Cahora Bassa hydro power station in Mozambique and will be resumed when the connecting transmission line is repaired.[40] It is noteworthy that sub-Saharan Africa has vast hydropower potential, and it is said that the potential for generation from the Inga site on the Congo river alone could meet most power needs for the entire African continent. However, political instability makes the prospects of developing a dependable Southern African hydro-based grid unlikely in the medium-term. The Western Cape, although having higher average rainfall than the dry interior, has limited potential for cost-competitive hydro-generation partly because of the lack of substantial perennial rivers.

14.6 BIOMASS ENERGY

Approximately 40MW of biomass energy is generated in South Africa.[41] Some industries, notably pulp and paper and sugar refining, use biomass to raise steam to generate electricity. In pulp mills, the bark from the logs and the 'black liquor' from the digestors is burned in boilers for process heat and electricity. In sugar refineries, bagasse (husks from the sugar cane) is used in the same way.

Woodfuel is largely gathered by users from natural woodlands, but commercialisation is increasing.[42] Some areas face severe shortages from wood over-harvesting.

[36] Sarah Ward, *The Energy Book*, pg. 25
[37] Davin Chown, One World Sustainable Investments, Personal Communication, February 2003.
[38] G.W.F. Munro, Integrated Energy Plan for the Western Cape – Draft Policy Document
[39] Davin Chown, One World Sustainable Investments, Personal Communication, January 16, 2003.
[40] Department of Minerals and Energy (DME) website: http://www.dme.gov.za/home.asp?menu=energy/liquid_fuels.htm
[41] Davin Chown, One World Sustainable Investments, Personal Communications, January 16, 2003.
[42] Energy & Development Group, Finesse – South Africa Country Study, June1997, pg. 2-4

Eskom's SABRE-Gen Biomass Project investigates the potential of using biomass energy for bulk electricity generation in South Africa. This project is evaluating a broad range of commercial and emerging biopower technology options as well as assessing the natural resources (wood, bagasse, agricultural crops, waste) available in South Africa.

Biomass resource potential in general for the Cape Town area is 1-50GJ/ha/yr, and could constitute alien vegetation, municipal solid waste, organic matter, and sewage. Overall the technical and financial feasibility for biomass generation on any scale is unclear for the CCT area. There are no pulp or bagasse producing industries in the area.

While it is known that woodfuel is used by numerous low-income households, comprising largely alien vegetation on the Cape Flats, the extent to which the supply matches the demand is not known due to the lack of recent research in this area. In addition, extensive alien clearing is being undertaken around the Cape Peninsula, which may impact on the supply to low-income households. Again, this situation is unclear due to lack of recent research on household energy use.

Biomass (sewerage) conversion

There may be substantial potential for conversion of sewerage to slurry for use power generation. Technology patents for this are currently held by Environmental Partners. This solution could help ameliorate the city's sewage load problems, although its financial feasibility still needs to be clarified.

14.7 LANDFILL GAS

In recent years the CCT has experienced a steady increase in the amount of waste being disposed of at Council-owned landfill sites. It is estimated that CCT's industrial, commercial and residential sectors produce approximately 1.6-million tonnes of waste per year with that figure steadily growing at 6% per year[43]. In waste management, opportunities exist to recover landfill gas to promote alternative energy sources.

As Table 14.2 shows, the City of Cape Town owns and operates one hazardous landfill and five general waste landfills of which four are earmarked for closure in the next five years.

Table 14.2: City of Cape Town landfill information

Landfill	Information	Expected closure date	Annual disposal rate (Tonnes / year)
Coastal Park Landfill	Large general waste landfill	2016	337,746
Bellville Landfill	Large general waste landfill	2006	309,489
Swartklip Landfill	Large general waste landfill, replaced by transfer station to feed Vissershok landfill	2000	233,644
Brackenfell Landfill	General waste landfill	2004	221,768
Faure Landfill	Large general waste landfill, replaced by transfer station to feed Vissershok landfill	2002	219,810
Vissershok Landfill:	Hazardous& general waste landfill	2015	134,047

Source: Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, Energy Cybernetics

No methane recovery is presently taking place at any of the CCT landfill sites. However, a recent study which investigated energy efficiency projects for the CCT, concluded that methane recovery from waste management has potential for alternative energy applications.[44] One pilot project is currently under development by South-South-North (SSN) to capture the landfill gas of the Bellville Landfill for the generation of green energy (thermal and/or electrical) for use by the adjacent industrial community. It is estimated that

[43] Project design document. The recovery and use of landfill gas at Bellville South landfill site, October 2002.

[44] Energy Cybernetics, Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, 24 November 2002.

the landfill site will generate between 143,000 to 163,000 tonnes of CH_4 gas per year (153,000 tonnes average), which could supply four to seven MW electricity generators[45]. The supply of gas and electricity is expected to last for 10 years.

Energy Cybernetics was unable to determine the quantities of CH_4 that can be recovered from landfills other than Bellville without conducting tests at each landfill, but they concluded that the CCT should consider expanding the landfill gas recovery and utilisation project to other landfill sites. They recommended that the initial focus be place on the Coastal Park Landfill and Vissershok Landfill site since they receive (or are expected to receive) the largest quantities of waste and are expected to have the longest remaining life of all the remaining landfill sites.

14.8 FUEL CELLS

This new technology could have a dramatic impact on the whole electricity distribution industry in the long term. World-wide research is proceeding apace with various prototypes currently on test. Commercial units should be available shortly which will be evaluated when they come on the market.

Low-cost electricity from wind, for example, brings the option of electrolyzing water to produce hydrogen, which can be stored and used to fuel gas-fired turbines in backup power plants when wind power ebbs. Over time, hydrogen produced with wind-generated electricity is the leading candidate to replace natural gas in gas-fired power plants as gas reserves are depleted.

Hydrogen is also the ideal fuel for the fuel-cell engines that every major automobile manufacturer is now working on. Honda and Daimler-Chrysler both plan to have fuel-cell-powered vehicles on the market in 2003.

According to the Earth Policy Institute, wind energy in the form of electricity and hydrogen can satisfy all the various energy needs of a modern economy, and it promises to become the foundation of the new energy economy. They indicate that the shape of this new economy is emerging as wind turbines replace coal mines, hydrogen generators replace oil refineries, and fuel-cell engines replace internal combustion engines[46]. Fuel Cells remain an area of huge potential in the medium-term and developments should be closely tracked.

14.9 ENERGY EFFICIENCY

Energy efficiency is sometimes referred to as an additional source of energy and is one of the strategies by which Cape Town can use energy in a more sustainable manner. In the supply and distribution of electricity, energy efficiency can offer benefits to electricity utilities, consumers and society as a whole. The benefits to utilities occur as a result of reduced operating costs in the generation, transmission and distribution of electricity and reduced capital costs due to deferred construction of new generation plants and upgrading of existing transmission and distribution systems. Consumers benefit from lower electricity bills and improved quality of supply. Societal benefits include the reduction of environmental impacts, efficient use of natural resources, and reduced reliance on imported fuels.

There is almost no incentive for customers to be more energy efficient. South Africa has such cheap (but dirty) coal-fired electricity that energy generally is a small consideration in consumer decisions. The experience of other countries suggest that successful energy efficiency programs require incentives to promote energy efficiency. As an electricity distributor, the CCT has considerable scope for intervention in this area.

Compact Fluorescent Lights (CFLs)

An organisation called Bonesa has for some years been promoting the use of CFLs for domestic, institutional and commercial applications. CFLs can last up to ten times longer and use about a quarter of the electricity for the same light output compared with normal incandescent ('bulb') lights, which use most of the electricity to produce heat rather than light. CFLs are more expensive, but costs are quickly recovered in electricity and light replacement savings. Table 14.3 uses illustrative values to indicate electricity savings possible if all medium to high income households used CFLs instead of conventional incandescent lights.

[45]Energy Cybernetics, Scoping Investigation Report on Energy Efficiency and Greenhouse Gas Mitigation Projects for the City of Cape Town, 24 November 2002.
[46] Earth Policy Institute website: http://www.earth-policy.org/Indicators/indicator10.htm, 2002

Table 14.3: Illustrative savings by widespread use of CFLs in households and commerce

	Number of users*	Total av. Elec use per month	Saving/hh by using CFLs	Total savings	CO2 savings/yr
Households (med-hi-income)	200 000	600 kWh/mth	67.5kWh/mth**	13.5GWh/mth	178 000 tons
Commercial	34 000	4000 kWh/mth	264kWh/mth***	8.9 GWh/mth	118 000 tons

* *this is the approximate number of mid-to high income households in CCT (25% of 800 000 total households), and all commercial electricity consumers.*

** *assuming lighting accounts for 15% of total household electricity bill, and CFLs reduce this by 75%*

*** *assuming 30% of commercial energy use is for lighting, of which 30% is incandescent lighting and CFLs reduce this by 75%.*

CFLs are widely available from all supermarkets and electrical stores, yet they are not widely used yet, in spite of their obvious financial (and environmental) benefits. Users are probably not well informed in this regard, and Bonesa's advertising campaign on national TV may have had little effect. Nevertheless, the use of CFLs is one of the most cost effective and easy to implement opportunities to move to more sustainable energy use.

Bonesa completes project at University of Natal

Bonesa, the South African efficient lighting initiative, recently completed a landmark pilot project at the University of Natal to retrofit all six floors of the University's EG Malherbe Library with compact fluorescent lamps. The previous lighting infrastructure utilised a 2 x 36 W open channel with magnetic ballast, giving lighting levels of approximately 500 lux at 1.5 m and approximately 300 lux at 0.5 m. The replacement uses a 1 x 36 W luminaire with a triphosphor lamp and electronic control gear, giving a lighting level of 800 lux at all heights. The project outlay was R800,000, but due to the improved energy efficiency a return on investment within three years is expected, with an average energy saving of R250 000 per year.

Efficiency in Commerce and Industry

As a generalisation, energy savings of 10% can often be realised with no cost implication, and 15 to 20% with cost implications with short-term payback. Commercial savings potential lies in heating/cooling and lighting savings, where potential for reduced energy use is substantial (for more details see section on 'passive solar design'). Industrial energy efficiency opportunities vary greatly with the nature of the operation, but are often also substantial (see demand section on commerce and industry for more details).

14.10 RENEWABLE AND SUSTAINABLE ENERGY BUSINESS IN CAPE TOWN

Cape Town has high resource potential in some renewable energy options, as discussed in the previous sections. Further, Wesgro estimated [47] that in 2000 the Western Cape was responsible for 26% of the value of South Africa's renewable energy industry, making it a centre of energy expertise. It determined that about eight primary commercial firms were involved in the input, production and installation of solar water heating (SWH) and renewable energy (RE) technologies, while many other small companies undertook ad hoc RE work. Wesgro calculated that approximately R4 million is spent annually at Western Cape institutes on RE research, technical, policy and regulatory issues.

Table 14.4: Potential for renewable and sustainable energy business in Cape Town

Sector	South Africa – Spending in R million	Western Cape		
		Spending in R million	Share of National Total	No. of Firms
Solar Water Heating	22	5	22%	4
Remote Area Power Supply	157	39	25%	5
Independent Power Producers	Not yet realised			1
NGOs and Section 21	10	4	40%	3
Consultancies	Not yet realised			6
Total	189	48	26%	

Data Source: Wesgro, Cape Sector Factsheet, 2000

[47] Wesgro, Cape Sectoral Fact Sheet, 2000.

In addition to figures captured in the above table, Wesgro also reported that energy consultancies are attracting international development funding in the order of approximately R10 million in once-off contracts to Southern Africa, with exported RE skills and labour earning an additional R1-2 million annually for Western Cape institutes.

Cape Town is well positioned to become a national leader in the development of an innovative energy sector in South Africa. Factors that make it a strong base for building an energy sector include:

- As a port city located on a major trade route with a vibrant economy and well-developed infrastructure, it is well positioned for the location of export-oriented industries.
- It already has a well-established conventional energy sector corporate presence - it is the chosen location for the headquarters of most international exploration and oil refining companies operating in South Africa. Caltex, Shell, BP and Engen have their head offices in the City. Cape Town also acts as a base for oil and gas exploration on the South African coast. Pioneer Natural Resources, Energy Africa, Soekor E&P, and Phillips Petroleum all have their regional headquarters in Cape Town. Many of these organisations face the issue of long-term sustainability of their operations beyond a fossil-fuel based energy economy.
- The City has a strong base of intellectual capital spanning the academic, to civil society to private companies, which is capable of contributing substantially to the development of an energy sector. These include:
    - Organisations such as Sustainable Energy Africa (SEA), South South North (SSN), Development Action Group, Energy and Development Group (EDG), AGAMA Energy, One World Sustainable Investments, etc.
    - CCT-SEED (Sustainable Energy for Environment and Development – a programme of SEA's) partnership which has provided the City with significant energy capacity
    - Research institutes such as Energy Research Institute (ERI) and Energy for Development Research Centre (EDRC) at UCT
    - UCT's Masters in energy and development program
- The City's vibrant tourism industry which attracts large amounts of foreign spending is ideally positioned to capitalize on environment-related energy investments.
- Further, the Western Cape's eco-tourism and abundant nature reserves are potential markets for green/efficient energy generated by or within the CCT.

The conditions are therefore in place for CCT to develop into a pioneering locality in the field of sustainable energy, and the metro authority can lead the way in this regard. However, there are various challenges facing the local RE industry such as the cost of imported technologies; increasing local production against small economies of scale; market barriers to implementation of high capital cost RE technologies; internationally-funded projects that capture the local market for foreign suppliers; and the low-cost, primarily coal-fired electricity from ESKOM.

14.11 TRENDS AND DEVELOPMENTS

Trends and developments relating to sustainable energy are dealt with in various demand and supply sections of the report. The below trends are specific to renewable/sustainable energy supply.

CDM and renewable energy supply

Renewable energy industries will qualify for international funding from numerous sources through the Clean Development Mechanism (CDM), which allows industrialized countries to meet part of their greenhouse gas-reduction quotas by transferring clean technology to the South. Currently EDRC and SSN are investigating how CDM could work in South Africa. This mechanism could provide an opportunity for, at minimum, the incremental costs attached to RE to be covered.

Wind energy

The DARLIPP Wind Project at Darling, north of Cape Town is the first wind-energy IPP in South Africa. CCT is in discussion with them regarding the purchase and resale of green energy with the CCT electricity distribution area. Eskom also has a pilot wind-generation farm. Following the three-year demonstration period of its wind farm, Eskom will develop a business case for future strategies. Two of the identified five potential options are to continue to run the facility in partnership with a municipality or IPP or to sell the

facility to a municipality or IPP. As the city in closest proximity, Cape Town could be a strong candidate for taking over some or all of the ownership of the wind farm. [48]

As medium and large scale grid connected wind generation is amongst the most cost effective renewable generation options, and is likely to be cost competitive when the externalities of coal generated power and the falling international cost of wind-power are taken into account, this development is of particular interest.

Landfill gas

South-South-North (SSN) is developing a project to capture the landfill gas of the Bellville Landfill for the generation of green energy (thermal and/or electrical) for use by the adjacent industrial community (see 'Landfill gas' section for more details).

Potential for community-based energy generation

In the past, decision making around energy supply options was based on the fact that energy supply was a national function. However, with the recent focus on liberalisation and decentralisation of the energy sector, local authorities are mandated to play a larger role in service delivery, and IPPs become more feasible. As a result, one of the factors that needs to be integrated into decision making around energy supply options is the suitability of technologies to more locally-based energy generation. For example, nuclear power stations have high capital costs due to their complicated safety and often have long construction and commissioning periods, making them more suited to development by large utilities. Wind farms, on the other hand, are well-suited to local ownership, as they can be implemented on a modular basis, and expanded as needed. It is thus possible for local authorities or other local organisations to finance and own generation capacity.

Energy efficient low income housing

There are a number of projects in the Cape Town area which demonstrate or pilot energy efficiency. These include the 300 SWHs in the Lwandle Hostels-to-Homes Project, the Kuyasa Build and Live Safe/SEED Pilot which is now a CDM pilot with SSN and many of the DAG housing projects. National government has recently introduced a housing subsidy top up of R1004.00 in areas with wet winters for making housing more energy efficient and damp proof.

14.12 ISSUES

		Priority
Issue 14.1:	**Not considering externalities in costing energy supply options has resulted in an economically inefficient supply mix and makes renewable and energy efficiency options uncompetitive.** When environmental, health and safety costs are not included, the country's large coal reserves appear to enable production of some of the cheapest electricity in the world, and distort the comparative costs of other resources. For economic efficiency in supply mix, externalities need to be included.	HIGH
Issue 14.2:	**The potential for energy efficiency through passive solar design of buildings, or even retrofitting, is substantial, but passive solar principles are rarely applied.** Standard practice amongst architects and builders includes little or no passive solar consideration in spite of the obvious and immediate benefits to occupants. Offices are typically built with unshaded windows and heavy airconditioning systems to compensate, and low-income houses without ceilings, condemning occupants to higher energy expense and less comfortable and healthy homes for the entire life of the house.	MEDIUM
Issue 14.3:	**The potential for energy efficiency through widespread use of CFLs is substantial, yet they are not yet widely used.** Although the benefits of CFL use is clear, it is not yet widely known, and businesses and households are generally reliant on less efficient, more expensive forms of lighting.	MEDIUM
Issue 14.4:	**CCT has amongst the best wind-generation potential in Southern Africa, and the support of CCT can play a significant role in promoting this option.** Wind-generation is amongst the most cost-effective renewable electricity	MEDIUM

[48] Eskom Enterprises, TSI Division, Environmental Impact Assessment for the Eskom Wind Energy Demonstration Facility in the Western Cape: Final Environmental Impact Report, pg. 55

	generation options.	
Issue 14.5:	**The potential for energy savings through widespread use of SWHs is substantial, yet uptake remains low largely due to lack of suitable financing.** Without suitable financing, for example incorporated in the house bond, SWHs will remain unaffordable in spite of their being a cost-effective option over the medium term. Also, relatively few households are aware of the benefits of SWHs.	**MEDIUM**
Issue 14.6:	**The woodfuel supply situation in and around CCT is largely unknown.** Outdated research indicates that many low-income households still use fuelwood, however the current degree of this dependence and sustainability of supply in this regard is unknown.	Normal
Issue 14.7:	**There is significant potential for CDM funds to implement pilot sustainable energy projects for CCT.** Although the timeframe and mechanisms for the availability of funds is unclear, it appears likely that carbon-saving energy projects will be able to source substantial support through CDM. CCT is well placed to maximise the use of this opportunity, with the support of organisations such as South*South*North.	Normal
Issue 14.8:	**Cape Town has the potential to become known as a 'green energy' city.** Factors in its favour include superior wind-generation potential, important tourist profile and existing energy expertise (corporate and NGO). CCT's taking the lead in projects such as the IMEP and Energy Strategy development also place it well for developing such a profile.	Normal