ENERGY FIRST PAPER

The Scope of the Energy Industry in the Western Cape

ACCESS MARKET INTERNATIONAL (PTY) LTD
SOUTH AFRICA

Paulina Kowalik

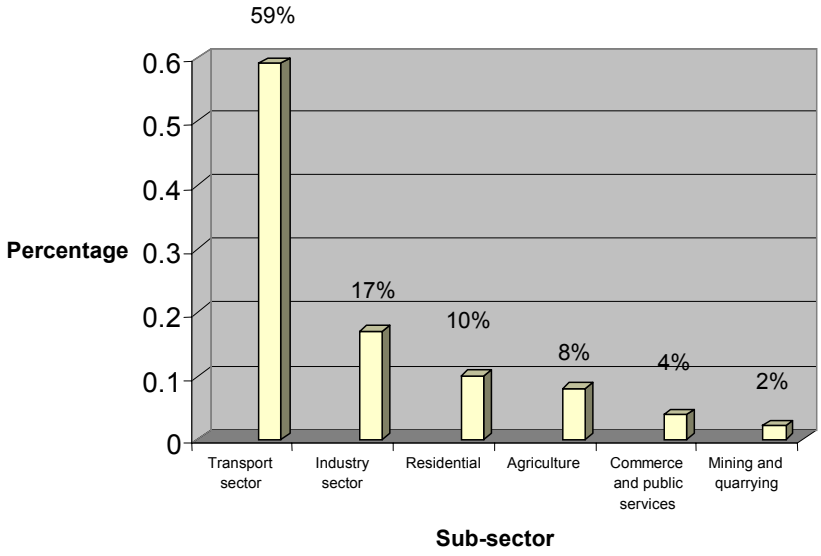
Kobus Coetzee

EXECUTIVE SUMMARY

In South Africa the energy sector is predominantly fuelled by coal. Since the Western Cape does not have a readily available coal resource base, other avenues have been identified to meet the region's energy needs. It is envisaged that the Western Cape will be able to capitalise on the use of these alternative resource bases to meet the projected energy demands in future.

The graph below gives an indication of proportionate energy demand in the various sub-sectors.

Figure 1: Current demand in the various sub-sectors



Source: DME Provincial energy balance, 2000

According to the relevant data on the subject, the transport sub-sector has the greatest demand for energy and fuels, followed by industry, residential, agriculture, commerce and finally mining and quarrying.

In the absence of coal resources, various options have been identified as having the potential to contribute to an energy mix in the Western Cape that will meet the demand and ensure sustainable energy development in the province.

These options also have the potential to attract foreign direct investment and to create additional job opportunities directly/indirectly in the sector. The table below highlights the options investigated.

Table 1: Summary of scope within the energy sector

Energy source	Potential/opportunities	Sustainability issues
Natural gas	High, providing that sufficient resources of gas are discovered. Importation of LNG is an option if sources are insufficient.	Cleaner fossil-fuel-based option than coal. Less controversial than nuclear power and will provide base load capacity. Options for local job creation high.
Wind energy	Resource to be confirmed but high potential (1500 MW approx.) in W. Cape. Costly technology & capital costs high. Maintenance low. Darling wind farm pilot project Eskom Klipheuwel wind farm pilot project	Clean option. Intermittent nature and issues concerning storage to be resolved. Cannot supply base load. Plays a key role in providing generation capacity that can be quickly installed in areas needing new supply.
Solar radiation	Medium to high. Radiation varies from 6,501- 7 000 MJ/m2/pa across the province. Technology expensive. Solar water heating manufacturers and initiatives	Significant potential for SWH projects either on a large residential scale or at individual level.
Biomass and biofuels	Medium: 1 to 50 Gj/ha/pa. Insufficient assessment of commercial potential in W. Cape. Opportunities for small biomass and biofuel projects, particularly in forestry and agricultural industry. No clear assessment of other biomass potential e.g. sewage waste.	Renewable resource. Job creation in downstream and upstream industries. Lower emissions if sound technology used. Off-take directly by producers therefore lessening their own demand on grid.

Energy source	Potential/opportunities	Sustainability issues
Nuclear energy	Significant yet costly. Long development lead times will not see plants on stream in time to meet envisaged shortages in the W. Cape by 2006.	Nuclear energy is viewed as controversial yet is seen as cleaner than coal. No clear, acceptable strategies and options for disposal of radioactive waste. Decommissioning extremely costly. Heavy subsidisation necessary. Public resistance may increase development lead times.
Wave energy	The potential is high. There are significant resources along the west coast (Cape Town and Cape Agulhas)	This is a renewable energy source. Has no CO2 emissions but the availability of proper technology is still to be assessed.

Adapted from: Brenbol et al, 2003

A detailed SWOT analysis was conducted in order to identify the strengths, weaknesses, opportunities and threats in the Western Cape that could affect its energy resources.

The table below provides a summary of these attributes:

Table 2: SWOT analysis for the Western Cape Energy Sector

STRENGTHS	**WEAKNESSES**
High rate of solar radiation Skilled in servicing oil rigs and refineries on West coast Strong wind capacity off the West coast High rate of innovation in renewable energy sources Only proven nuclear power generation expertise in the country Skilled in nuclear technology	Coal main source of energy but no coal resource base in WC High CO2 emissions Low levels of natural gas fields High demand for energy Low skill development High rate of skill gaps Low rate of commercialisation of the innovations
OPPORTUNITIES	**THREATS**
Kyoto Protocol	Environmental concerns

Contracts to service oil rigs and refineries Potential for Solar Water Heaters Development of wind farms Developed oil and fuel refineries The current development of the Pebble Bed Modular Reactor has been identified by Eskom and governmental heads as an opportunity The manufacture of renewable energy technology in SA Discovery of new natural gas fields off the West coast Wave technology	Kyoto Protocol Running out of capacity Low cost of electricity diminishes the potential of alternative sources of energy Development of 1st Regional Electricity Distributor (RED) in WC High labour and input costs Cheaper to import products such as gas cylinders and solar panel material from China Low economies of scale for renewable energy – technology too expensive

Technology base

- The wind turbines used for wind energy are currently being imported from Denmark and powered by Nacelle technology.

- Wind technology requires a higher initial investment than fossil-fuelled generators, yet the life-cycle cost is significantly less, because it requires no fuel and few operating expenses.

- All types of SWHs appropriate for relatively mild climates, but including freezing conditions, are manufactured in South Africa so the country does have the potential and capabilities to develop and design the technologies locally.

- Multinational companies in South Africa include Shell, BP, Caltex and Total Elf Fina so the potential and capacity to create biofuel refineries already exist.

- The South African PBMR includes unique and patented technological innovations that make it particularly competitive. There are export potentials should this technology and project be completed.

- Adoption of nuclear technology poses a significant challenge due to the controversy surrounding nuclear contamination and its lethal effects on all forms of life

Sector labour conditions

- Jobs in the coal sub-sector are showing a pattern of decline.
- Should the potential of natural gas be exploited, the possibility of creating employment opportunities is most likely in areas like drilling and testing, developing gas delivery systems and bringing the gas to the market.
- Massive employment gains could be achieved quickly and easily within the renewable energy sector, especially in SWH and biofuels, while showing good returns on a limited investment by government.
- There is a high rate of illiteracy but nevertheless a good deal of skills development in South Africa and there are a number of skills requirements which have been identified, particularly amongst scientists and researchers, managers, professionals and experienced technicians, engineers as well as artisans.
- There are a number of initiatives and institutions that provide the necessary skills in the energy sector, namely:
    - The University of Cape Town
    - The University of the Western Cape
    - The University of Stellenbosch
    - ESETA
    - The Cape Peninsula University of Technology
    - The South African Petroleum Studies Programme
- At the time of compiling this study, data was not available on how many people are being trained, the number of skills gaps in relation to employment requirements, as well as the extent of training relative to the need. Owing to this lack of data, a thorough evaluation of the actual situation against the needs of the sector could not be conducted.

Barriers to entry

Various barriers to entry have been identified when it comes to accessing the energy market in the Western Cape:

- The high capital cost of renewable energies is a major barrier to expanding the market. The initial installed price of an electric water heater, for example, is approximately half that of its corresponding SWH.
- Prices of renewable energies are high due to low sales volumes, therefore economies of scale would greatly assist in reducing manufacturing costs and lowering the need for high profit margins.
- As mentioned above, the domestic electricity price in South Africa is among the lowest in the world, which makes it very difficult for renewable energies to compete.
- The domestic tariff varies from one local authority to the next. It is hoped that the National Electricity Regulator (NER) and the Department of Minerals and Energy (DME), in association with local authorities, will implement a single national domestic electricity tariff.
- The DME has suggested a poverty alleviation tariff of zero cents per kWh for the first 50kWh/month, and it is further suggested that a stepped tariff should be introduced for the remaining domestic electricity consumption.
    - A second level should be set of approximately 30cents/kWh for consumption between 50 and 400 kWh/month, and more than 50cents/kWh for usage over 400kWh/month.

Government has realised that these barriers exist and is therefore considering a number of measures in order to overcome the problem. A decision has therefore been taken to institute measures to support independent producers (IPPs) of renewable energy and to promote the use of alternative forms of energy through government initiatives and policies.

Investment initiatives and Foreign Direct Investment

Most investment in the energy sector is in the form of foreign direct investment from venture capitalists, international governments such as the Dutch and Danish

International Development Assistance (DANIDA), Danish Government Funding Agency (DANCED) and the Development Bank of Southern Africa (DBSA).

Funding is also provided by South African organizations such as CEF (Pty) Ltd and the Energy Development Corporation (EDC) - a division of CEF.

During interviews with the South African organizations that fund various projects in the energy sector, it became apparent that the funding is provided with the intention of commercialisation and gaining a return on investment, rather than merely providing a grant for a project.

Sector Conclusions and Recommendations

- There is a lack of detailed market share and demand-side data at a provincial level. Data on electricity is more readily obtainable than data on other fuels, but is not adequate.
    - It is likely that adequate data collection will need to precede proper energy planning and micro-economic strategy development. The data presented in this report should be viewed in this light, and is interpreted so as to highlight areas of known inaccuracy.
    - A complete province-wide energy audit is recommended for the Western Cape. This quantitative data would be important to help develop future scenarios and options that will inform the strategy and define the key initiatives.
    - The process of the audit would be similar to the methodology used in formulating the integrated sustainable strategy for Cape Town that was done in 2003. It should entail a process of contacting the various municipalities and energy-related organisations in the Western Cape to assess the energy requirements, demand and sources of supply.
- Demand-side management initiatives are being undertaken at a number of municipalities. Strengthening these and developing relationships with Eskom, as well as all the other organizations involved in energy conservation initiatives, should be a priority.
    - This includes providing the people with sound education concerning the implications of energy efficiency and demand-side management.

- The Government will need to play an active role in promoting energy efficiency amongst the population. For example, it would help if the approval of EIAs, which is normally a prolonged process, were to be speeded up, since delays retard the progress of potential projects like the Darling wind farm.

- The Government departments, institutions and organizations that are active in the energy sector need to ensure that they are in alignment and should consider forming a partnership, in order to develop and roll out a sound, integrated energy strategy across the province.

    - A fully integrated approach to provincial energy security and energy strategy should be developed and implemented.

- The Western Cape has considerable advantages in the energy sector that are currently under-utilized. With the correct planning and support from Government as well as private parties, these alternative energies have the potential to generate additional employment, particularly in the sphere of renewable energy such as wind, solar and biofuels.

    - The Western Cape has some of the highest levels of solar radiation in the world, which means that there is considerable potential for SWH and even solar photovoltaic power generation.

    - Volume production would be achieved if the use of SWH was mandatory, as is the case in many other parts of the world. For example, in Israel, use of SWH as the main source of energy for heating domestic hot water is mandatory, and today, more than 60% of domestic water heating is provided by the sun.

    - A start could be made by legislating for all houses funded by the Reconstruction and Development Program (RDP) to use solar energy as the prime source of energy for domestic water heating. This action would provide the industry with a ‘base-load’.

    - The Western Cape has prevailing winds coming from two directions, namely from the south-east as well as the west and, usefully, they tend to blow during peak electricity consumption periods. These winds have the potential to generate 10 times the official national wind energy estimates and, coupled with vast tracts of open land and

good infrastructure, the Western Cape has the potential to become a 'wind powerhouse'.

- The Western Cape has access to energy crops such as sunflowers, soya beans, canola seeds and Jathropha tree seeds, which are used to manufacture bio-diesel. Several opportunities have been identified to catalyse this existing sector with co-investment in commercial products that will also support job creation in rural areas.

- South Africa has a significant competitive advantage in the form of the Cape Town and Saldanha harbours, which are well situated to service the drilling rigs and floating production platforms operating off the West coast of Africa.
  - South Africa also has the engineering expertise and other resources like capital infrastructure to provide a world-class service.
  - Industrial development and expansion in Saldanha Bay will see a rise in the demand for energy and will necessitate provision of bulk supply.
  - The city is already servicing oil rigs and service vessels, and it was estimated in 2002 that the oil fields off West Africa were sustaining about 5 000 jobs in South Africa.
  - Cape Town has sophisticated banking and communication systems in addition to other resources, so the city is well placed to become a service hub to the industry.

- The Western Cape Government's stated objectives of developing public-private partnerships, broad-based BEE, and investing in infrastructure can be met through facilitating investment in new energy projects through innovative partnerships

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

TABLE OF ACRONYMS AND DEFINITIONS

B&B		Bed and Breakfast
BEE		Black Economic Empowerment
BIT		Bilateral Investment Treaty
CABEERE		Capacity Building in Energy Efficiency and Renewable Energy
CCGT		Combined Cycle Gas Turbines
CDM		Clean Development Mechanisms
CEF		Central Energy Fund
CER		Certified Emission Reductions
CFL		Compact Fluorescent Light Bulb
CoCT		City of Cape Town
COGSI		Cape Oil and Gas Supply Initiative, a clustering initiative of the DEDT
DBSA		Development Bank of Southern Africa
DEAT		Department of Environmental Affairs and Tourism
DEDT		Department of Economic Development and Tourism of the PGWC
DFA		South Africa's Department of Foreign Affairs
DME		National Department of Minerals and Energy which, amongst other SOEs, owns PetroSA
DNA		Designated National Authority
DPE		National Department of Public Enterprises which, amongst other SOEs, owns ESKOM and Transnet

DTI		National Department of Trade and Industry
EDC		Energy Development Corporation
EDF		Electricite de France
EDRC		Energy Development and Research Council
EEDSM		Energy efficiency and demand-side management
EIA		Environmental Impact Assessment
EMIA		Export Marketing and Investment Assistance Scheme
EPRD		European Programme for Reconstruction and Development
ESETA		Energy Sector Education and Training Authority
EU		European Union
FDI		Foreign Direct Investment
GATT		General Agreement on Tariffs and Trade
GDP		Gross Domestic Produce
GGP		Gross Geographical Produce
GWh		Gigawatt per hour
HFC		Hydro-fluorocarbon
HTR		High Temperature Reactor
IDC		Industrial Development Corporation
IFC		International Finance Corporation

IMF		International Monetary Fund
IPP		Independent Power Producer
ITED		International Trade and Economics Division
kWh/m2		Kilowatts per hour per square metre
kW		Kilowatt
MDG		Millennium Development Goals
MFN		Most Favoured Nation
MW		Megawatts
NEPAD		New Partnership for Africa's Development
NER		National Electricity Regulator
NGO		Non-Governmental Organisation
NT		National Treatment
OCGT		Open Cycle Gas Turbines
O&M		Operations and Maintenance
pa		per annum
PBMR		Pebble Bed Modular Reactor
PGWC		Provincial Government of the Western Cape
PFC		Per-fluorocarbon
RDP		Reconstruction and Development Program

RED		Regional Electricity Distributor
RE		Renewable Energy
SA		South Africa
SAPP		South African Power Pool
SARS		South Africa Revenue Services, a division of the National Treasury responsible of collection of taxes and excise revues.
SDA		Supplier Development Agency, an implementation component of the SDP
SECCP		Sustainable Energy and Climate Change Partnership
SMME		Small and Medium Enterprise
SMEDP		Small and Medium Enterprise Development Programme
SOE		State-Owned Enterprise, such as ESKOM or PetroSA
Stats SA		Statistics South Africa
SWH		Solar Water Heating
TISA		Trade and investment South Africa
TJ		Terajoules
TRIMS		Trade-Related Investment Measures
UCT		University of Cape Town
UNDP		United Nations Development Programme
VAT		Value added tax

Wesgro		Western Cape Investment and Trade Promotion Agency
WSSD		World Summit on Sustainable Development
WTO		World Trade Organisation

1 NATIONAL OVERVIEW OF THE ENERGY SECTOR

The energy sector is critical to the South African economy and contributes about 15% of GDP and employs about 250 000 people nationally. South Africa's GDP is the 26th highest in the world, but has a primary energy consumption which ranks 16th. Its energy intensity is above average, with only 10 other countries having higher commercial primary energy intensities.

South Africa's primary energy source is coal. The availability of this resource has allowed the energy sector's contribution to the GDP to be so high because it has been able to support major investments in heavy industry and mining, which shape the economic and energy structure of the country.

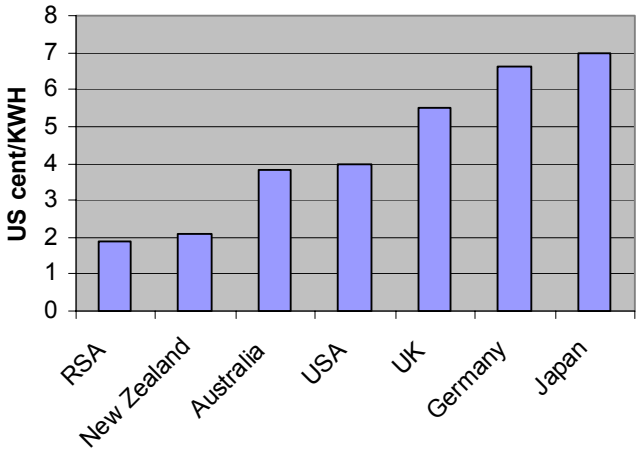
Much of the manufacturing sector is also linked to mining activities through minerals beneficiation and metals production. All of these activities are energy-intensive and rely on the availability of coal for electricity production.

[1]Eskom currently produces 95% of South Africa's electricity requirements and also supplies electricity to neighbouring countries. In 2003, peak demand was around 31 500MW and national installed capacity is around 38 000MW. This capacity is fuelled 88% by coal, 2% by hydro-electric power, 5% by nuclear power, 4% by pumped storage and 1% by oil-fired gas turbines (Eskom, 2004). The remaining 5% of the requirements is provided by municipalities, Independent Power Producers (IPP's) and imports from the South African Power Pool (SAPP).

South Africa's electricity is amongst the cheapest in the world. The difference in cost of electricity is shown in the figure below, which provides a comparison between 7 countries.

[1] www.eskom.co.za

Figure 2: Electricity costs in different countries



Source: The dti, 2005

The comparison concludes that electricity in South Africa is by far the least expensive, followed by New Zealand, whilst countries like Germany and Japan have the most expensive electricity. This cheap electricity is attributed to South Africa's readily available coal resources and to excess capacity that was initially installed through previous government.

1.1 NATIONAL ENERGY MIX

[2]SA has a highly developed synthetic fuels industry, as well as small deposits of oil and natural gas.

Oil and Natural Gas

South Africa has a well-developed refining and downstream oil sector and is one of the major refining nations in Africa. The country's crude oil refining capacity is 466 547 bbl/d. Products are sold in local markets and exported, mainly to East Africa. However, unless large commercially viable oil fields are discovered, South Africa will become increasingly dependent on imported crude oil for liquid fuels production.

[2] http://www.waih.co.za/archives/southafricacountry.pdf

Multinational companies in South Africa include Shell, BP, Caltex and Total Elf Fina. As a result of Government's initiative to bring about greater representation in the sector, a number of the multinational oil companies have done deals to bring in black empowerment companies as minority shareholders. By the end of 2001, historically disadvantaged South Africans owned or controlled just less than 14% of the liquid fuels sector.

South Africa's prospects for natural gas production increased dramatically in 2000, with the discovery of offshore reserves close to the Namibian border. These reserves, known as the Ibhubezi Prospect, contain three trillion cubic feet of oil.

Coal

Coal accounts for 75% of primary energy consumption. Most of the coal is used to generate electricity. A significant amount is also channelled to synthetic fuel and petrochemicals operations.

Sasol and PetroSA are the two major players in the synthetic fuel market. Sasol is the world's largest manufacturer of oil from coal, gasifying the coal and then converting it into a range of liquid fuels and petrochemical feed stocks. Sasol has coal liquification plants at Secunda (oil) and Sasolburg (petrochemicals).

Nuclear energy

Nuclear energy does not play a major role in the energy sector (accounting for only 3% of all energy used), but is being investigated as a future potential energy source and alternative to coal.

Eskom is currently developing a nuclear technology called the 'Pebble Bed Modular Reactor' (PBMR). The initial phase of the project was approved in 2000, but was subject to passing an Environmental Impact Assessment (EIA), a positive licensability statement and a positive, detailed feasibility study, before further decisions were taken.

The envisaged plant is located in the Western Cape where most sources of fuel for the reactor are found. Once the proper checks and balances are in place, the government will decide on the future of the PBMR Project.

In order to fulfil its international obligations, South Africa (SA) serves on the Board of Governors of the International Atomic Energy Agency, as it is the most advanced African country in the field of nuclear technology.

Renewable energy

Technological feasibility studies are now being conducted into viable renewable energy resources. These include grid-connected wind farms and solar energy. With most areas enjoying more than 2 500 hours of sunshine per year and average daily solar radiation levels ranging between 4.5 and 6.5 kWh/m2 in one day, solar energy could well prove to be a feasible renewable energy source. Consequently local production of solar equipment is developing rapidly.

1.2 INCREASE IN GENERATION CAPACITY REQUIREMENTS

[3]As a result of the country's economic growth, the overall electricity demand in South Africa has increased significantly, by 15% per annum, which means that by 2007 peak-period demand will exceed the utility's ability to supply electricity during these periods. This will cause a deficit between supply and demand. Long-term projections show that South Africa will require an additional 20 000MW of electricity by 2025. By 2010 additional base-load capacity will be required.

In view of the time it takes to commission new plants, the current energy and electricity generation system is regarded as being vulnerable, and alternative sources of generation are required to ensure security of supply. The managing of security of supply is being undertaken through initiatives from a demand-side management as well as supply-side management perspective.

1.2.1 Demand-side management (DSM)

[4]Demand-side management refers to providing energy-efficient products and services that save electricity and money. The aim of DSM is to save 4 255 MW over 20 years and influence consumption patterns, particularly at peak times. Residential, business (commercial and industrial sectors) and school markets are being targeted so that awareness of the importance of savings levels can be sustained.

The National Department of Minerals and Energy (DME) and the National Electricity Regulator (NER) established the DSM policy and agreement in 2004. Thirty-nine DSM

[3] http://www.citypower.co.za/News_monitor/Power%20management%20saving%20SA%20billions.html

[4] http://www.citypower.co.za/News_monitor/Power%20management%20saving%20SA%20billions.html

projects are currently being implemented. An overall saving of 12% by 2014 is envisaged, according to South Africa's Energy Efficiency Strategy.

Another means of DMS is *load shifting,* which encourages customers to use electricity at times that benefit the utility system, and is achieved primarily through time-of-use tariffs, real-time pricing and geyser load management.

1.2.2 Supply-side management (SSM)

The Government has indicated that in order to ensure security of supply in South Africa, a co-ordinated effort is required between Eskom and the DME, in order to establish new generation capacity over the next 5 years. Government also intends supplying electricity via the diversification of primary energy sources.

Eskom has announced a substantial investment programme to re-commission power stations that were mothballed some years ago, and to build at least one new power station over the next ten years.

Government has also announced a R6 billion tender for the development and building of 2 new gas-fuelled stations by 2008. Eskom has committed to signing a 15 year Power Purchase Agreement (PPA) with the IPP's in order to make the investment more inviting and to decrease the perceived risk of investing into South Africa. Subsequently the PPA will virtually create a ready-made market for the winning bidder.

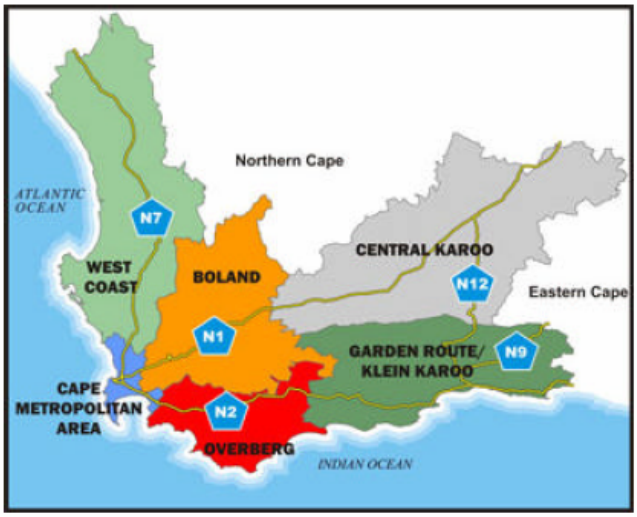
The tender requires the preferred bidder to build two new open cycle gas turbine peaking power stations which are expected to come into operation by October 2008. The exact location of these turbines have not yet been determined, but the most probable areas are Durban and Port Elizabeth, in order to cater for the growing needs.

The development of new peak load and base load power stations are expensive undertakings (a new power station can cost up to R30-billion) and the cost will eventually be borne by the consumer, in the form of increased electricity tariffs.

2 STATUS QUO OF THE ENERGY SECTOR IN THE WESTERN CAPE

The Western Cape is situated on the south-western tip of the African continent, covering an area of 129 386 km². There are approximately 4.5 million people living in the province, the majority of whom are Afrikaans-speaking. The other official languages are English and Xhosa.

Figure 3: Spatial location of Western Cape Province



According to Wesgro (2004), the Western Cape economy accounts for 14.3% of South Africa's Gross Domestic Product (GDP), which makes it the third-highest contributor to the country.

In addition to the Western Cape being one of the highest contributors among South Africa's nine provinces, it also has the fastest-growing economy. The growing economy can be attributed to the province's balanced diversity of primary activities, namely agriculture, fishing and forestry, plus an equally diverse range of manufacturing sub-sectors, as well as a vibrant tourism sector.

2.1 ENERGY DEMAND-SIDE MANAGEMENT IN THE WESTERN CAPE

The DME Provincial Energy Balances for 2000 were used as a first-pass approximation of the macro-energy situation in the province at present. All data in these energy balances

was unclassified and therefore to a certain degree inaccurate. It must also be noted that the DME has not produced provincial energy balances since 2000, but the data nevertheless provides an indication of what the energy requirement is in the various sectors of the Western Cape.

Table 3: Summary of the energy requirement in Western Cape according to DME

		Western Cape		
Sector	**Petroleum product (TJ)**	**Electricity (TJ)**	**Total (TJ)**	**% of National**
Industry sector	6 085	21 791	27 877	2.4%
Mining and quarrying	1 366	2 325	3 691	2.6%
Transport sector	95 254	2 500	97 753	16.8%
Agriculture	9 233	3 834	13 067	10.7%
Residential	2 144	15 259	17 402	6.3%
Commerce and public services	57	6 100	6 156	6.7%
Total	**114 138**	**51 808**	**165 946**	**7.1%**

Source: DME, 2000

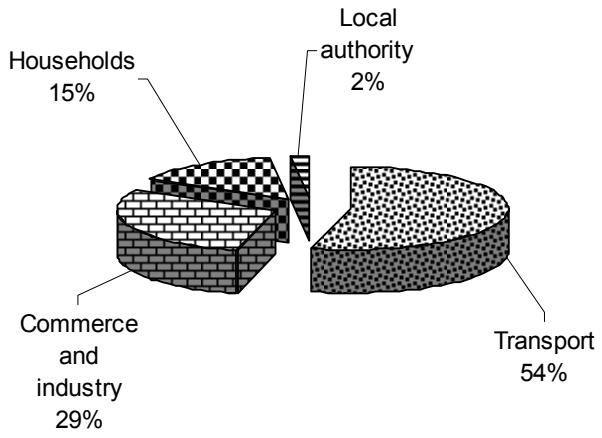
Note: A measurement of Terajoules (TJ) indicates the energy requirement

The Western Cape uses a wide range of resources to fulfil the energy requirements in the province. Cape Town is the acknowledged hub of the Western Cape, accounting for 75% of the Western Cape's GDP and can therefore be used to indicate the energy landscape within the province as a whole.

A study done for the city of Cape Town to assess the state of energy (2003), showed that the 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%). The energy use division is illustrated in the diagram below.

Figure 4: Energy use in the Western Cape



Source: Cape Town Integrated strategy, 2003

The Western Cape uses a range of fuels and energy sources to fulfil the energy requirements of its population and industry. The greatest energy demand is for liquid fuels for use in the transport sector, but there is also a demand for liquid fuels in industry, commerce, agriculture, mining and the residential sector.

The Western Cape is a centre of energy expertise, and its petrochemical industry produces liquid fuels almost exclusively. Oil and gas discoveries have been made off the Western Cape coast, and aggressive exploration programmes are now under way.

Demand-side management

Owing to the size of the industrial and transport sectors, the opportunities for demand-side management and energy efficiency are vast.

- The transport sector is economically inefficient and not environmentally sustainable, due to the predominance of private transport and the lack of adequate public transport facilities.
    - Therefore the largest energy efficiency potential in the energy sector appears to lie within this area.

- Transport mitigation factors have been taken into consideration through the Department of Transportation and the 1997 Western Cape Provincial Transport Policy. Although this policy was written in 1997, the thinking behind the mitigation factors have not changed
    - Developing the public transport infrastructure within the Western Cape has been placed on the table as a form of curbing the heavy use of transportation within the province
    - Increasing the use of energy efficient fuels and substitutes such as biodiesel as well as other renewable biofuels.
    - Development and use of cleaner fuels through initiatives that are in accordance with the Petroleum Act Bill, which calls for cleaner fuel and less CO2 emissions through exhausts

- Other demand-side management methods to save energy include provision of efficient lights (CFLs), designing and structuring the buildings in a way that is environmentally sound and energy-efficient (e.g. SEA building), and an increase in solar water heater use.

2.2 CURRENT ENERGY MIX IN THE WESTERN CAPE

The energy sector in the Western Cape is unique in that the province does not have any coal resources of its own. Therefore the province draws all of its major energy supply from the north as well as from Koeberg Nuclear Power Station.

2.2.1 Electricity

Electricity is currently supplied from a number of sources, as summarised in the table below.

Table 4: Current Electricity resources in the Western Cape

Power Plant	Location	Licensed Capacity (MW)	Effective* Capacity (MW)	Load Factor (%) on maximum power
Eskom Gas Turbine Power Plants – Acacia	Cape Town	171	54	0.0
Eskom Nuclear Power Plant – Koeberg	Cape Town	1 800	1 930	70.8
Municipal/IPP Coal-fueled Power Plants – Athlone	Athlone	180	121	7.3
Municipal Gas Turbine Power Plants - Athlone	Athlone	40	38	0.3
Municipal Pumped Storage Power Plants – Steenbras	Gordon's Bay	180	174	18.0
Total		**2 371**	**2 317**	**96.4**

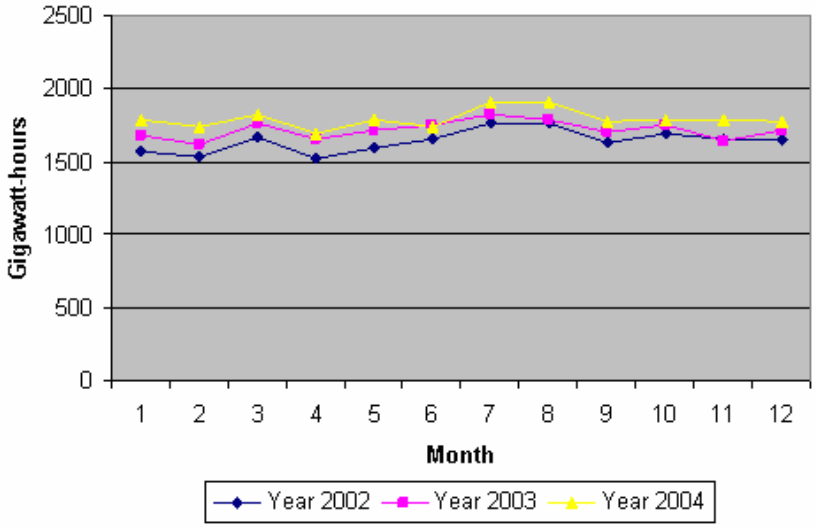
The Athlone power station operated by the Cape Town Unicity Municipality is no longer regarded as a secure supply and consequently the municipality has decided to close that power station down. The municipality also has the Steenbras pumped storage facility.

The purchase of electricity from Eskom provides for most of the load requirements of the Western Cape.

According to the NER, the total electricity consumption for the Western Cape in 2003 was 19 177 GWh and it has a projected growth of 2-3% per annum. However, this projection does not take into consideration the proposed industrial development along the West Coast at Saldanha (Wesgro, 2004). This development, along with others, will result in the projected generation capacity having to be increased.

The figure below provides a graphical representation of the electricity distribution industry in the Western Cape as indicated by Eskom.

Figure 5: Electricity distribution for the Western Cape by Eskom 2002-2004



Source: Adopted from Stats SA and Eskom, 2004

The graph above proves that there is an annual increase in electricity distribution in the province. This annual increase is indicative of a rise in energy demand and the additional need for alternative resources to provide security of supply.

2.2.2 Liquid fuels

The transport sector in the Western Cape is the largest consumer of energy in the form of liquid fuels, which include petrol, paraffin, diesel and heavy fuel oil. The Western Cape petrochemicals industry centres on the Caltex oil refinery (Calref) in Cape Town and the Mossgas gas refinery in Mossel Bay. Virtually all the products of these refineries are liquid fuels, and a large portion of the supply of refined liquid fuels for the Western Cape comes from the Caltex refinery at Milnerton, which has the capacity to supply 100 000 barrels a day.

As has been mentioned, oil and gas discoveries have also been made off the Western Cape coast and aggressive exploration programmes are under way. Apart from these local explorations, several strategic initiatives are currently being implemented way in the Western Cape to facilitate the creation of an oil and gas hub that could service not only the South African market but also the expanding West African oil and gas reserves. These strategic initiatives will focus on the opportunities in the different sub-sectors in the oil and gas sector.

In addition, several options exist to extend the life of the Mossgas Refinery, which could provide feedstocks (i.e. primary resources for energy generation) for a downstream chemical industry.

Although the importance of oil and gas cannot be underestimated and some mention of it has been made in this report, a detailed exposition of oil and gas falls outside the scope of this paper.

A separate oil and gas study has been done for the same MEDS project, entitled 'Oil and Gas MEDS study', addressing the issues and opportunities pertaining to the Western Cape oil and gas sector.

2.3 FACTORS INFLUENCING THE WESTERN CAPE ENERGY SECTOR

There are numerous factors that influence the Western Cape energy sector and the future energy mix. Two important factors are the trend towards increased demand as well as the Kyoto Protocol.

2.3.1 Growth in Energy Demand

A study done by the Energy Development and Research Centre (2003) has identified a number of trends that will lead to an increase in energy demand in the Western Cape. These are discussed in this particular section and subdivided into the various sub-sectors.

The trends as identified by the Energy Development and Research Centre (EDRC) in 2003 are as follows:

[5]The industrial sub-sector (including manufacturing and mining)

- The share of electricity used in mining is likely to increase.
- Iron and steel: It is likely that in future more steel will be produced in electric furnaces and that gas will be used instead of coal for making iron and steel. Overall, production is expected to grow more slowly than GDP.
- In the chemical sector, gas is likely to replace coal as a feedstock. This is already happening at Sasol. Sector growth may be higher than GDP.

[5] Energy futures in South Africa - http://www.erc.uct.ac.za/publications/South%20Africa's%20energy%20future%20-%202003.pdf

- More energy-intensive titanium and aluminium smelters are being considered or are already in operation. Zinc smelters are also likely to be built.

- South Africa's pulp and paper industry is likely to grow with GDP and to become more energy-efficient in future.

The commercial sub-sector

- Demand is likely to grow more quickly than GDP. This sector is likely to need a higher share of energy in the form of electricity in future.

- There is considerable scope for improved energy efficiency in this sub-sector, including better design of buildings, more efficient lights (especially changing from incandescent to fluorescent lighting), more efficient air conditioning and heating, and better management of energy use.

The residential sub-sector

- Demand will grow as the population grows.

- The trend of a progression from traditional fuels through transitional forms of supply to electricity is likely to continue in the future.

- Electricity makes for more efficient energy use than coal, wood and paraffin, but more energy will be consumed for water heating.

The transport sub-sector

- The demand for private vehicles is likely to grow as GDP increases.

- In future, energy demand for land freight and sea transport is likely to grow at the same rate as GDP but energy demand for land passenger transport and air transport is likely to grow much more quickly

The trends outlined above show that there is a clear pattern of increasing energy demand in the Western Cape and, as a result, alternatives other than coal are required to meet the province's needs. The Western Cape has considerable advantages in the energy sector that are currently under-utilised. With the correct planning and support from Government as well as private parties, these alternative forms of energy have the potential to meet the required energy demand.

2.3.2 Kyoto Protocol

The **Kyoto Protocol** is a very significant and far-reaching environmental treaty that has recently been introduced worldwide. In terms of this treaty, which took effect on Wednesday, 16 February 2005, 54 industrialised countries are now legally bound to reduce the pollution that is causing global warming.

The treaty requires industrialized countries in general to reduce carbon-dioxide gas emissions by 5.2% before 2012 as compared with their 1990 levels. Targets have been set individually for each nation.

The United States and Australia are the only major industrialized countries that have refused to ratify the Kyoto Protocol. These two countries combined, account for 30% of global greenhouse gas pollution.

The treaty seeks to reduce emissions of carbon dioxide, the by-product of burning oil, gas and coal. It also seeks to reduce emissions of methane (mostly the result of agriculture), nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride.

The developing world has no obligations under the treaty as yet. As a 'non-Annex 1 country' to the Protocol, South Africa does not have any concrete reduction targets for greenhouse gas emissions. It is, however, required to put policies and measures in place to reduce greenhouse gas emissions and it can benefit from implementation actions such as the Clean Development Mechanism (CDM). One of the first CDM projects in the country has been implemented in the Western Cape in Kuyasa, Cape Town.

The various industry experts who were interviewed were all in agreement that South Africa is 14th highest in terms of world carbon dioxide (CO_2) emissions. This is largely attributed to South Africa being the largest user of coal (95% of electricity is generated from coal) and to the fact that transportation plays such a large role in energy consumption.

Consequently, it is believed that in 2012, the commencement date of the second commitment period of the Kyoto Protocol, South Africa will be forced to sign the treaty to significantly reduce CO_2 emissions and receive carbon credits as incentives.

This will result in an increase in strict environmental management requirements and regulations governing access to alternative sources of energy such as solar, wind, biomass, natural gas and biofuels, rather than coal.

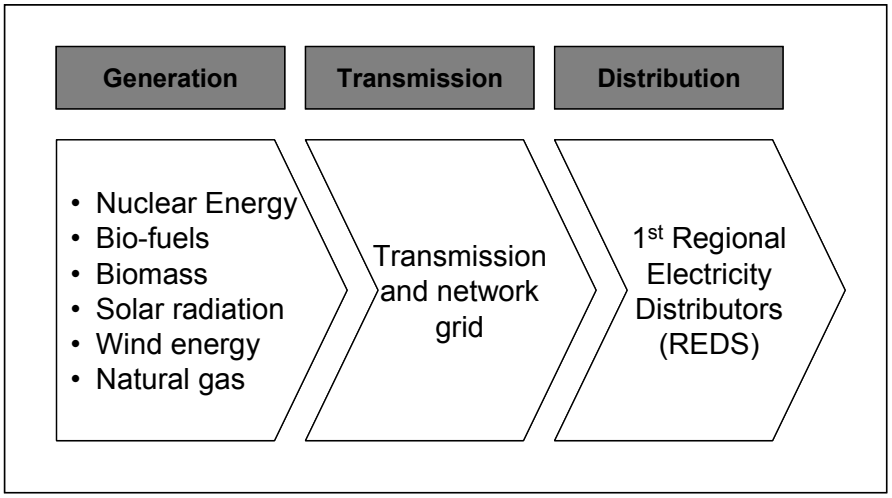
3 FUTURE OF THE WESTERN CAPE ENERGY SECTOR

The Western Cape is uniquely positioned to capitalize on the use of an alternative resource base in order to meet projected future demands.

3.1 POTENTIAL ENERGY MIX

The figure below provides an illustration of the value chain of this energy mix. The value chain typically consists of generation, transmission and distribution.

Figure 6: Value chain of energy mix



3.1.1 Generation

The table below provides a summary of the potential future energy supply mix in the province. These areas also have the potential to attract foreign direct investment and to create additional labour directly/indirectly in the sector.

Table 5: Summary of the future energy supply mix

Energy source	Potential/opportunities	Sustainability issues
Natural gas	High, providing that sufficient resources of gas are discovered. Importation of LNG is an option if sources are insufficient.	Cleaner fossil-fuel-based option than coal. Less controversial than nuclear power and will provide base load capacity. Options for local job creation high.
Wind energy	Resource to be confirmed but high potential (1500 MW approx.) in W. Cape.	Clean option. Intermittent nature and issues concerning storage to be

	Costly technology & capital costs high. Maintenance low. Darling wind farm pilot project Eskom Klipheuwel wind farm pilot project	resolved. Cannot supply base load. Plays a key role in providing generation capacity that can be quickly installed in areas needing new supply.
Solar radiation	Medium to high. Radiation varies from 6,501- 7 000 MJ/m2/pa across the province. Technology expensive. Solar water heating manufacturers and initiatives	Significant potential for SWH projects either on a large residential scale or at individual level.
Biomass and biofuels	Medium: 1 to 50 Gj/ha/pa. Insufficient assessment of commercial potential in W. Cape. Opportunities for small biomass and biofuel projects, particularly in forestry and agricultural industry. No clear assessment of other biomass potential e.g. sewage waste.	Renewable resource. Job creation in downstream and upstream industries. Lower emissions if sound technology used. Off-take directly by producers therefore lessening their own demand on grid.
Nuclear energy	Significant yet costly. Long development lead times will not see plants on stream in time to meet envisaged shortages in the W. Cape by 2006.	Nuclear energy is viewed as controversial yet is seen as cleaner than coal. No clear, acceptable strategies and options for disposal of radioactive waste. Decommissioning extremely costly. Heavy subsidisation necessary. Public resistance may increase development lead times.
Wave energy	The potential is high. There are significant resources along the west coast (Cape Town and Cape Agulhas)	This is a renewable energy source. Has no CO2 emissions but the availability of proper technology is still to be assessed.

Adapted from: Brenbol et al, 2003

The above energy resources will now be discussed and explained in more detail.

Natural gas

In the trends analysis above, gas is likely to replace coal as a resource base. Consequently it would be beneficial to identify natural gas fields in South Africa and in the close vicinity of South Africa.

Government and various other organizations such as Sasol have identified this growth opportunity and identified some potential for using natural gas as a source of energy

instead of coal, but future gas projects would depend on the discovery of adequate gas reserves, creating a sufficient and sustainable market demand, as well as providing cost-effective transmission of the gas from the field to the market.

With the development of the appropriate infrastructure and the realization of the full market potential of the gas available to South Africa, the percentage of gas in the energy balance could increase from less than 2% to 7%, bringing with it investments and economic growth.

There have been specific projects and discoveries dealing with the aspect of natural gas as a source of energy. These initiatives will be highlighted in the next section, in which the major developments in the sub-sectors are discussed.

Wind energy

The Western Cape has prevailing winds coming from two directions, namely from the south-east as well as the west and, usefully, they tend to blow during peak electricity consumption periods. According to various pioneers in the wind power revolution such as Herman Oelsner (pioneering electricity producer at the Darling wind farm and chairman of the Darling Independent Power Producer company), these winds have the potential to generate 10 times the official national wind energy estimates and, coupled with vast tracts of open land and good infrastructure, the Western Cape has the potential to become a 'wind powerhouse'.

Although the above may be true, the technology is still very new. A study called *Capacity Building in Energy Efficiency and Renewable Energy* (CABEERE), commissioned by the Department of Minerals and Energy (DME), indicated that South Africa will have to contribute 2 000MW of its renewable energy from the wind source as part of meeting the 10 000GWh target within the next 10 years.

If permission should be granted for the development planning of these projects, and should they prove viable, companies such as Saldanha Energy (20MW), Benguela Energy (150MW), DarlIPP (20MW), WindpowerSA (45 MW), and the Beaufort West Municipality (1.2MW) could make a significant contribution to clean energy options.

Wind energy is highly favoured by green lobbyists but there are several problems pertaining to it that will have to be overcome. Wind energy costs three to four times as much as coal-generated power. Experts say a thousand wind turbines would have to be built to replace the output of the Western Cape's Koeberg Nuclear Power Station.

However, Hermann Oelsner (2003) maintains that the West Coast alone has the potential to generate 10 000 MW of wind power, and wind farms can be built relatively quickly. For

instance, the estimated time to build a farm that can produce a capacity of 100MW is one year.

Various initiatives and projects have been set up in order to launch this technology and possibly leverage it as a renewable energy resource in the Western Cape. The topic is dealt with in more detail in the next section of the report, in which the major developments that have occurred in respect of this energy source are addressed.

Solar energy

In the trends analysis it was mentioned that demand is likely to grow more quickly than GDP and that the commercial and residential sectors are likely to require a higher share of energy in future. Therefore it is apposite to consider another alternative energy source that has the potential for growth, namely solar energy. Solar energy can be used to generate electricity, heat water and to heat or cool buildings. South Africa and the Western Cape experience some of the highest levels of solar radiation in the world.

A particular technology and market with growth opportunities is the Solar Water Heating (SWH) market, which has considerable potential to leverage electricity savings, increase employment opportunities, improve electricity demand management and reduce greenhouse gas emissions.

There are various projects that have either already been implemented or are about to be implemented with the intention of catalysing the use of solar technologies. These are also aimed at addressing the barriers that block the uptake and full commercialisation of selected solar technologies. These projects will be highlighted in the next section, which addresses developments within the sub-sector.

One of the main challenges in the solar energy market is to ensure that the products introduced are of a high standard to ensure that consumers can put their trust in these products, so that existing barriers can be addressed and an enabling market environment created. Although a wide range of products is available on the market, the industry is faced with severe limitations in terms of standardisation, awareness, affordability and financing, which prevent widespread technology adoption.

Biomass and Biofuels

The main sources of biomass energy are sugar bagasse, pulp and paper waste used to generate electricity and biofuels from energy crops such as sunflowers, soya beans, canola seeds and jathropha tree seeds used to manufacture bio-diesel.

Several opportunities have been identified to catalyse this existing sector with co-investment in commercial products that will also support job creation in rural areas. These opportunities are highlighted in the section below.

Nuclear energy

Nuclear energy does not as yet play a major role (accounting for only 3% of all the energy generated), but is being investigated as a future potential energy source and alternative to coal.

Eskom is currently developing a nuclear technology called the Pebble Bed Modular Reactor (PBMR). The initial phase of the project was approved in 2000, subject to it passing an Environmental Impact Assessment (EIA), the issuing of a positive licensability statement and a positive, detailed feasibility study.

The envisaged plant is located in the Western Cape where most sources of fuel for the reactor are found. When the provisos have been met, the Government will decide on the future of the PBMR Project.

Wave energy

[6]The potential for using wave energy as a renewable energy source is high. Waves contain an enormous amount of power. It is estimated that at a sea depth of 40m to 50m, the average wave can contain about 50kW of power per lineal metre of wave frontage. This power is progressively dissipated as the wave approaches the shore. Wave power has advantages over wind or solar power, as it is constant and available 24 hours a day, and does not occupy large areas of land. It is also silent and the equipment need not be unsightly or obstructive. The Western Cape has significant resources along the west coast off Cape Town and Cape Agulhas.

3.1.2 Distribution

As regards the distribution of energy, the Western Cape has been chosen as the first province that will implement integrated electricity distribution, known as the Regional Electricity Distributor (RED). The RED should be initiated in mid-2005.

During assessments of the readiness of municipalities to participate in REDs, Cape Town and eThekweni emerged as the frontrunners in terms of the assessment criteria.

The operation of REDs will ensure that free basic electricity is provided as widely as possible. The fragmentation of the electricity industry and different tariff structures contribute to inefficiencies and blackouts in the province. The consolidation of the industry is aimed at ensuring greater efficiency in distribution and usage.

The criteria met by Cape Town include proper revenue management evidenced by collection levels, customer performance, being a ring-fenced anchor Metro and a ring-fenced Eskom region, and also the existence of network configuration complexity.

The RED for the Western Cape Region is planned to be the largest of the six national REDs and is set to improve the financial viability of the City of Cape Town and result in high-quality electricity infrastructure and supply to meet the needs of the developing Western Cape region, and its growing economy and population.

The REDs are being created with the intention of providing a regulatory regime whereby they will purchase generation and transmission services by means of a regulated Wholesale Pricing System (WEPS). The WEPS will contain separate generation and transmission components, both of which will be regulated. Once the wholesale energy market is established, the REDS will be allowed to purchase from it.

The regulatory regime will provide REDS with an incentive to minimise the cost of energy purchased on behalf of their customers, and should limit cross-ownership between REDS and generation companies, so as to encourage making energy purchases on a fully commercial basis.

The outcome of the REDS is at this stage still unknown.

A SWOT analysis has been identified which highlights the strengths, weaknesses, opportunities and threats pertaining to the Western Cape, as regards the future energy mix.

The table below provides a summary of the above factors that could affect energy resources in the Western Cape.

[6] Hunt M, 2003, Diaphragm pump harnesses wave power, www.engineeringnews.co.za

Table 6: SWOT analysis for Western Cape Energy Sector

STRENGTHS	**WEAKNESSES**
High rate of solar radiation	Coal main source of energy but no coal resource base in WC
Skilled in servicing oil rigs and refineries on West coast	High CO2 emissions
Strong wind capacity off the West coast	Low levels of natural gas fields
High rate of innovation in renewable energy sources	High demand for energy
Only proven nuclear power generation expertise in the country	Low skill development
Skilled in nuclear technology	High rate of skill gaps
	Low rate of commercialisation of the innovations
OPPORTUNITIES	**THREATS**
Kyoto Protocol	Environmental concerns
Contracts to service oil rigs and refineries	Kyoto Protocol
Potential for Solar Water Heaters	Running out of capacity
Development of wind farms	Low cost of electricity diminishes the potential of alternative sources of energy
Developed oil and fuel refineries	Development of 1st Regional Electricity Distributor (RED) in WC
The current development of the Pebble Bed Modular Reactor has been identified by Eskom and governmental heads as an opportunity	High labour and input costs
The manufacture of renewable energy technology in SA	Cheaper to import products such as gas cylinders and solar panel material from China
Discovery of new natural gas fields off the West coast	Low economies of scale for renewable energy – technology too expensive

Wave technology	

3.2 MAJOR DEVELOPMENTS IN THE ENERGY SECTOR

3.2.1 Natural gas

There have been specific projects and discoveries dealing with the aspect of natural gas as a source of energy. These initiatives are highlighted in this section, in which the major developments in the natural gas industry of the energy sector are discussed.

- South Africa moved another step closer to diversifying its energy sources recently when Sasol opened an 865km natural gas pipeline from Mozambique.
    - This follows an agreement signed with the Mozambican Government for the development of natural gas fields in the country and the construction of a pipeline to South Africa.
    - This gas pipeline from Mozambique to Sasol's Mpumalanga plant raises South Africa's use of natural gas as a primary energy source from 1.5% to 4.3% of total demand, with the supply formerly only having come through the state-owned, natural-gas-to-fuel refinery in Mossel Bay.
- At the same time it seems likely that natural gas (rather than coal) will be the energy source for a new multi-billion rand power station that is in prospect.
    - The intention of the Department of Minerals and Energy (DME) is that private companies should tender for the construction and operation of a new power station geared to supplement the power supply for electricity parastatal Eskom.
    - Various options are still being considered but it is likely that natural gas will be the plant's primary energy source.
- South Africa's prospects for natural gas production increased dramatically in 2000, with the discovery of offshore reserves close to the Namibian border. These reserves, known as the Ibhubezi Prospect, contain three trillion cubic feet of oil. Production was scheduled to commence in 2004, and would be channeled to regulate electricity production.

- This project to introduce natural gas was in line with the recommendations of the 1998 White Paper on Energy Policy, which proposed, amongst other things, the diversification of primary energy supply sources and the development of gas as having the least negative environmental impact of the fossil fuels.

- The Ibhubezi Gas Field is presently the only one off the West Coast with the potential to produce commercially viable gas volumes.

- This gas would be supplied to a gas-to-electricity project in the Western Cape and to the PetroSA manufacturing plant in Mossel Bay.

- However, the volume of gas discovered in the Ibhubezi Gas Field is too small to guarantee a production life of 20 years, which is needed to meet market demand. Nevertheless these wells, if successfully exploited, could increase the volume of gas found to a level that would, temporarily at least, match the market demands, while further natural gas sources are sought.

- In 2001, state oil and gas company PetroSA completed a project to bring the EM gas fields off Mossel Bay onstream, giving the plant an additional eight years of gas life.

3.2.2 Wind Energy

As mentioned before, the Western Cape has strong winds and vast open tracts of land that could make it a 'wind powerhouse'. Subsequently the South African Government has recognised the importance of encouraging the use of wind energy and has asked the Energy Development Corporation (EDC) to become a co-sponsor of the Darling National Demonstration Wind Farm Project. This project will generate 5.2MW and has secured a favourable Power Purchase Agreement with the City of Cape Town.

The EDC is also positioning itself to have a meaningful stake in the establishment of a second- phase project. The EDC intends playing a leading role in facilitating the establishment of viable wind projects. The strategy of the Central Energy Fund (CEF) in relation to the Wind Generation industry is to co-invest with local and international partners in order to develop the industry in South Africa.

There are currently two key pilot wind power projects in South Africa: at Klipheuwel and Darling, both in the Western Cape.

Klipheuwel

Klipheuwel, funded by electricity parastatal Eskom at a cost of R42 million, is the biggest wind farm in sub-Saharan Africa. It is a three-year experimental project that, at least initially, will deliver enough power for 2 500 households.

However, it is one of the options being considered by Eskom to provide wide-scale, clean, renewable energy in the future. The farm consists of three huge wind turbine towers, the biggest one being 60 metres high, with a blade length of 33 metres. It delivers 1.75MW of electricity.

Darling Wind Farm

The second wind power project is located further up the West Coast, at Darling - the country's first commercial wind farm. The Darling wind farm project has secured R70 million to build four wind turbines capable of producing 13.5 GWh a year.

One of Darling's first 'green power' clients will be the City of Cape Town. While the Western Cape consumes some 22 000 GWh a year, half of this is consumed by the provincial capital.

Work at the project was on hold, pending an EIA, but according to an interview with the EDC, the project has very recently received positive feedback and the processes will again be set in motion. According to Hermann Oelsner, these turbines are expected to be operational by mid-2005.

3.2.3 Solar energy

There is considerable potential for the implementation of solar water heating (SWH) in the Western Cape and various initiatives with Public-Private Partnerships have been launched.

Existing initiatives include:

- SouthSouthNorth, which is overseeing the implementation of a SWH project that entails installing solar water heaters, ceilings and ceiling insulation, and compact fluorescent light bulbs (CFLs) in existing RDP houses through Project Kuyasa, in partnership with the City of Cape Town and Electricite de France (EDF)
- The unknown, but significant number of homes from Mandalay to Constantia that already have SWH systems installed.

- The more than 300 large SWH systems that were installed for communal showers in Lwandle by the former Helderberg Sub-structure.

- Project Ubushushu, developed by a consortium of non-governmental organizations (NGOs) working in the fields of local development and environmental justice, and which seek to pilot the large-scale uptake of solar water heaters across the greater Cape Town Metropolitan area.

New initiatives include:

- The City's ICLEI-funded SWH initiative for 25 SWH systems for NGOs and Bed and Breakfasts (B&Bs)

- The Driftsands housing initiative

- The N2 upgrade project

- An InWent-funded survey of the existing SWH systems in Cape Town

- The City has an opportunity to tap into the DME's national SWH programme, which is funded by the United Nations Development Programme (UNDP) and EDC, which seeks to install 9 000 SWH systems in South African households

- In addition, there are projects in Stellenbosch and elsewhere in the Western Cape Province that are under development.

One World Sustainable Investments in Cape Town is currently conducting an assessment of the SWH environment and requirements for the Western Cape. The projected requirement to meet the 2010 renewable energy target has been between 66 000 and 88 000 units According to the research, there is currently only one real player that has the capabilities of manufacturing and installing SWH within the Western Cape, Solardome SA, and their current maximum potential output is 1 000 units a month.

3.2.4 Biomass and Biofuels

Developments and initiatives for the production of Biofuels and biomass are as follows:

- Sasol, together with the EDC, is investigating the production of diesels that meet European emission standards.

  - The objective of the initiative is to test the potential of using soya beans to create a bio-diesel product.
  - This initiative is in accordance with the Petroleum Act Bill, which calls for cleaner fuel and less CO2 emissions through the exhausts.

- Another initiative includes a facility for producing biofuels planned by the Seed Oil Refinery of South Africa. This refinery is planning to produce 60 000 tons of bio-diesel per year, and PetroSA has produced an environmentally friendly product called 'eco-diesel'. This fuel is already available in some service stations around Cape Town.
- Oilkol (Pty) Ltd is the first used-oil collector in Africa to have ISO 14001 listing. It operates a road tanker fleet and collects used oil around the country.
  - Oilkol (Pty) Ltd has a depot in Brackenfell, Cape Town.
- Government has reduced the fuel levy on bio-diesel by 30%.
- Discussions have been taking place between the EDC, NCP Yeast Pty (Ltd) and Illovo to produce ethanol from sugar cane.
  - These two companies can produce a capacity of 100 million tons a year.
  - However, it was calculated that a capacity of 800 million would be necessary in order to fulfil the demand viably and so the ethanol may have to be imported from Brazil and India.

Wave energy

There have been some recent developments with regards to wave energy and technology, whereby an organisation with the backing of the UK is currently developing a wave plant within the Saldanha Bay area. There also is the intention of building 8 such plants from just south of Namibia up to Kwazulu-Natal. These projects are still within their infancy stages and greater details are at this stage unknown. This development was mentioned to highlight that there are constant developments within the energy sector and as a result this report should by no means be seen as exhaustive.

3.2.5 Other developments

- [7]The City of Cape Town, in partnership with the Southsouthnorth capacity-building programme on Clean Development Mechanisms (CDM), is investigating the possibility of capturing methane from existing landfill sites and selling it to Consol Glass.

- The Draft National Electricity Regulator, Energy Efficiency and Demand-Side Management Policy is likely to have implications for the 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 take environmental matters into consideration when they audit a company's financial statements. This has implications for energy use and efficiency.

- Forty-five per cent of 2.2 million tons of waste generated in the City of Cape Town comes from commercial activities and industries. The BECO Institute for Sustainable Business is engaged in a number of initiatives with industry aimed at waste minimization, which reduces not only waste, but also energy and water consumption.

3.3 TECHNOLOGY BASE OF THE ENERGY SECTOR

South Africa's industries do not generally use the latest in energy-efficient technologies, largely because there is little incentive to do so since energy costs are fairly low. However, South Africa has become an innovator to some extent. This section highlights some of the technologies that are necessary in the various sub-energy sectors, focusing on wind turbines, solar water heaters, biomass and biofuel technologies, as well as nuclear technologies.

3.3.1 Wind turbines

Wind technology requires a higher initial investment than fossil-fuelled generators, yet the life-cycle cost is significantly less, because it requires no fuel and has few operating expenses.

[7] http://www.sustainable.org.za/downloads/State%20of%20Energy%20Report%20PDF/SoE_Sec05_IndustryCommerce.pdf

The technology generally used to generate wind-driven energy, is a wind turbine. Termed 'green energy', the cost of wind energy is higher than current tariffs, but it should appeal to environment-conscious consumers and could be a viable alternative to coal and gas.

These wind turbines are currently being imported from Denmark and are powered by Nacelle technology.

The wind turbine blades used at the Klipheuwel Wind Farm were transported by Vanguard from the Vestas factory in Copenhagen, Denmark, to the port of Hamburg, Germany. They were 27m long and weighed 27 tons, making road transportation very difficult. Additional challenges faced during the importation process included prior border and route clearance, as well as organising a shipping line that could accommodate the lengthy and delicate packages.

[8].Vanguard was also responsible for offloading the equipment at Cape Town Harbour, as well as transportation to the Klipheuwel site, and the installation and the cold commissioning of the wind turbines.

During installation of these turbines, sourcing of mobile cranes and crawler cranes was necessary. The mobile cranes have extensions to the hydraulic beams in order to gain the extra height needed. Crawler cranes are able to perform the heavy lifting of the turbine blades and the other components of the technology.

3.3.2 Solar Water Heaters (SWH)

According to a solar base line study that was conducted on behalf of the DME (2002), all types of SWHs appropriate for relatively mild climates, but including freezing conditions, are manufactured in South Africa. These technologies include Integral Collector Storage systems, Close-Coupled and Split systems. The close-coupled and split systems can be subdivided into direct or indirect circulation systems. A brief description of the various types of technologies is provided below:

- ***Hand Fill SWHs***: These SWHs are designed specifically for easy filling by means of a bucket or hose, where mains water supply is available. They are often mobile (have wheels) and are of integral or close-coupled design.

[8] http://www.engineeringnews.co.za/eng/features/electricpower/?show=34476

- They do not have electric back-up heating and are not suited to permanent on-roof installation. This is one of their major advantages, as they can simply be delivered to the site, pre-assembled and ready for use.

- ***Integral SWHs***: Integral SWHs incorporate the storage tank and collector surface as one component – the top surface of the tank is painted black and also serves as the absorber. They cannot accommodate an electrical back-up element unless special precautions are taken to prevent excessive heat loss at night.

- ***Close-coupled SWHs***: The storage tank and collector abut one another, hence the term 'close-coupled'. These SWHs can be either direct or indirect (using a heat exchanger and heat transfer fluid). They generally incorporate an electric back-up heating element. This is currently the most common type of SWH for domestic use.

- ***Split Collector/storage SWHs***: When the storage tank is situated some distance from the solar collector (2 to 50 metres and more) the SWH is termed a 'separate collector storage system'.

    - Split systems generally used for aesthetics are of critical importance, as the tank can be located in the ceiling space. They are also the most common design for commercial, industrial and institutional SWH systems.

    - They can be either direct or indirect, pumped or working on thermosyphon circulation. They generally incorporate back-up heating of one form or another.

3.3.3 Biomass and Biofuel refineries

South Africa has a well-developed refining and downstream oil sector and is one of the major refining nations in Africa.

Multinational companies in South Africa include Shell, BP, Caltex and Total Elf Fina, so the potential and capacity to create biofuel refineries already exist.

3.3.4 Nuclear technology

The development of nuclear technology is still being heatedly debated, but there has been some development in this sphere in the form of the Koeberg Power station and the PBMR. The type of technology that is currently being developed is explained in this section.

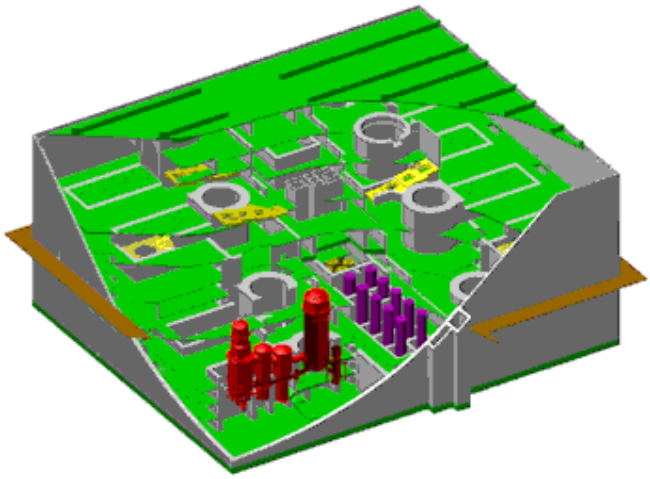
The Koeberg Power Station was initiated and built by the French, but South Africans were trained in all the skills and resources necessary to operate it. Over the past 20 years, the Koeberg power station has provided a greatly expanded skills base in nuclear technology in the Western Cape.

Eskom has been investigating the technology since 1993 for potential application as a power source in South Africa, as well as a viable South African export product. [9]Eskom currently has two partners in the project, namely the Industrial Development Corporation (IDC), and British Nuclear Fuels. The intention is to build a demonstration plant at Koeberg and an associated fuel plant at Pelindaba.

The first phase of the project, which comprised a detailed feasibility study and environmental impact assessment (EIA), has been finalized and the EIA reports have been submitted to the Department of Environmental Affairs and Tourism (DEAT)

The PBMR is a helium-cooled, graphite-moderated high temperature reactor (HTR). The concept is based on experience in the US and particularly Germany where prototype reactors were operated successfully between the late 1960s and 1980s. Although it is not the only high-temperature, gas-cooled nuclear reactor currently being developed in the world (China, for instance, started up a research reactor in December 2000), the South African project is internationally regarded as the frontrunner in the field.

Figure 7: Illustration of the PBMR



[9] http://www.scienceinafrica.co.za/2003/june/pbmr.htm

The diagram above shows an 8-pack configuration of the PBMR, with one module (bottom left) completed and the others in various stages of construction. The PBMR has been configured into 2, 4 and 8-pack layouts to maximise the sharing of support systems.

A significant challenge that is an obstacle to nuclear technology is the controversy surrounding nuclear contamination and its lethal effects on all forms of life. Another challenge that should be taken into consideration is the fact that pebble-bed power plant may result in job losses in the coal mining and power-generating industries, should it be built and prove successful.

These impacts would have to be weighed against the desirability of this type of technology.

3.3.5 Wave technology

Waves are generated on the surface of the oceans by wind systems, which result from the differential heating of the earth (Whittaker et al., 1997). Wave energy converters generate electricity by driving generators at high rotational speed and make use of air or hydraulic systems often coupled to gearboxes to achieve this (Duckers, 2000).

The two components of energy in waves are potential energy and kinetic energy. Potential energy refers to the form or elevation of the wave, while kinetic energy is associated with the velocity of the water particles within the wave. Ocean wave energy conversion technologies therefore make use of the kinetic energy trapped within the ocean's waves to produce electricity (Bregman, 1996).

In this context two broad categories of wave devices are available, i.e. shoreline devices and offshore devices:

- Surge devices: they utilize the forward horizontal force of the waves. ·
- Heaving floats: make use of the vertical motion of relatively small buoys.
- Heaving and pitching floats: absorb energy from heaving and pitching motions.
- Pitching devices: harness energy from the pitching movement of rotary pumps.
- Heave and surge devices: they make use of heave and surge to pump water.
- Oscillating water columns (OWC): involve the conversion of wave-induced fluctuations to energy.

3.3.6 Conclusions on the technological positioning of the energy sector

- The wind turbines used for wind energy are currently being imported from Denmark and powered by Nacelle technology.

- Wind technology requires a higher initial investment than fossil-fuelled generators, yet the life-cycle cost is significantly less, because it requires no fuel and few operating expenses.

- All types of SWHs appropriate for relatively mild climates, but including freezing conditions, are manufactured in South Africa so the country does have the potential and capabilities to develop and design the technologies locally.

- Multinational companies in South Africa include Shell, BP, Caltex and Total Elf Fina so the potential and capacity to create biofuel refineries already exist.

- The South African PBMR includes unique and patented technological innovations that make it particularly competitive. There are export potentials should this technology and project be completed.

    - Adoption of nuclear technology poses a significant challenge due to the controversy surrounding nuclear contamination and its lethal effects on all forms of life

3.4 LABOUR MARKET OVERVIEW

A study on the employment potential of renewable technologies was conducted by AGAMA Energy. The information from the study has been extrapolated and summarised below, although attention should be paid to the fact that accessing high-quality data on employment figures and trends within the Western Cape energy sector was extremely difficult and there could be inaccuracies in some instances.

The energy sub-sectors will be segmented with regard to employment, in order to highlight the trends within these various areas.

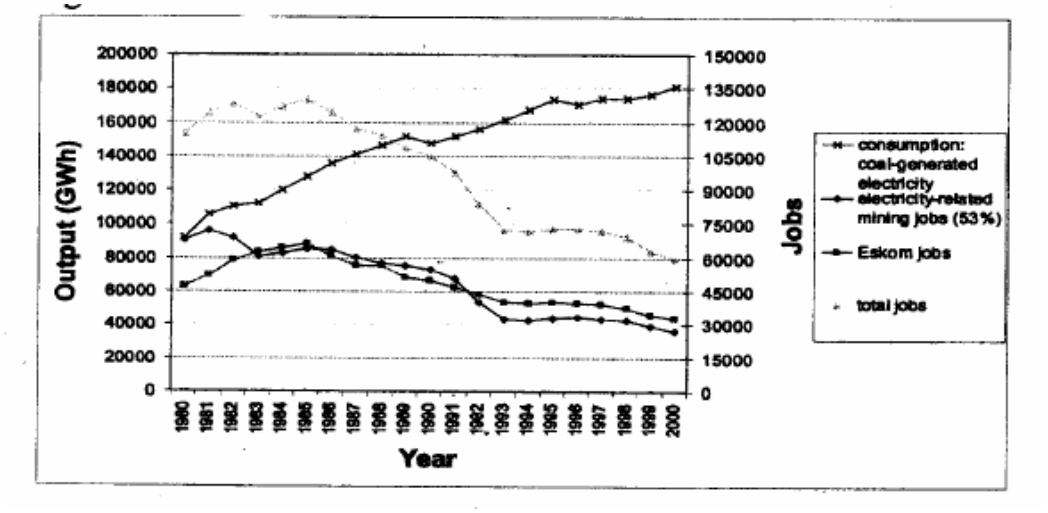
3.4.1 Employment

Coal

According to a [10]recent study on national energy employment trends, the coal-based electricity generation employment figures seem to be following international trends. In the coal mining sector employment decreased from 128 149 to 51 235 between 1980 and 2000 (DME, 2003). Similarly, Eskom's employment figures declined from 40 128 to 29 359 between 1993 and 2002 (Eskom, 2002).

Over the period 1985 to 2000 the total number of jobs declined by an average of 5.4% per annum, while the electricity generated increased by 2.4% per annum. This trend is shown in Figure 8: Employment in coal-based industry in South Africa.

Figure 8: Employment in coal-based industry in South Africa



Source: Analysis done by AGAMA Energy using data taken from Eskom (1989), Eskom (2002), Statistics SA (1995), Statistics SA (2002), NER (2000), DME (2003)

Over this period the total loss of jobs was 54% while electricity generation increased by 60%. Ultimately the number of jobs per GWh decreased from 1 job per GWh in 1985 to 0.3 jobs per GWh in 2000 (AGAMA Energy, 2003)

10 employment potential of renewable energy in SA, 2003, Agama energy Pty Ltd

Nuclear power

South Africa has a single nuclear power-generating station, Koeberg, which has a capacity of 1 840MW. According to Eskom (2003), approximately 1 000 people are employed in the nuclear power generation industry in South Africa. The employment potential of the proposed PBMR demonstration plant has been estimated at between 1 250 and 4 000 employees and includes construction, full-time as well as outsourced operations and maintenance (O&M) staff.

For conventional nuclear energy the technology is quite mature, and it is predicted that labour trends will remain the same. The PBMR is still at a developmental stage and the jobs in construction could decline quite significantly as compared with those presented for the pilot plant.

Natural gas

There are proposals and initiatives on the table to develop the natural gas market and industry in the Western Cape. These provide some insight into the potential for job creation.

According to a presentation by Hoffman B (2003), the potential exists for the development of an 800 to 1 400 MW IPP in 2006, 800 to 2 000 MW IPP in 2008 and 1 600 to 2 000 MW in 2012. Not all the gas brought in from the Kudu and Ibhubebesi gas fields will be utilized in electrical generation plants; there will also be some fuel switching and LP gas replacements. Three categories of jobs will be created:

- In drilling and testing a gas well it is estimated that hundreds of people are involved.
- In developing a gas delivery system, thousands of new jobs are created.
- Bringing the gas to market requires the development of a dedicated commercial industry and involves the creation of tens of thousands of jobs.

However, the available data is not specific enough to allow for detailed comparisons of the employment potential.

Renewable energies

The introduction of renewable energies into the South African energy market has a great potential for creating new jobs directly as well as indirectly. These possibilities are highlighted in brief. All of the projections come from a study that was commissioned by

Sustainable Energy and Climate Change Partnership (SECCP) and Earthlife Africa in 2003, called the *Employment Potential of Renewable Energy in South Africa*.

- Taken in isolation, the RE electricity-generating technologies will create 36 400 new direct jobs when providing 15% of the total electricity mix in 2020, without taking jobs away from the coal-based electricity generation sector.

- In the transport sector, the development of biodiesel and bioethanol programmes that would replace 15% of current ethanol (petrol) and diesel consumption would see the creation of 350 000 new direct jobs.

- In the thermal energy sector, the targeted deployment of SWHs should result in the creation of at least 118 000 new direct jobs.

- Each renewable energy sector will result in the creation of at least the same number of indirect jobs as direct jobs, with a total of around 700 000 indirect jobs across all the renewable energy (RE) sectors.

- Massive employment gains may be achieved quickly and easily in the SWH and biofuels sectors while showing good returns on a limited investment by government.

3.4.2 Skill requirements

The energy sector requires a combination of high and low-level labour. Table 7 below summarises the skill requirements within the energy sector, as identified by various sources and respondents in the Western Cape. These skills vary from the highly professional and technical skill requirements to artisan-type skill requirements.

Table 7: Skill requirements in the energy sector

MAIN OCCUPATIONAL CATEGORY	MINOR OCCUPATIONAL CATEGORY
Scientists and researchers	Experienced and qualified scientists and researchers across all fields but specifically working in scientific and technological fields
Managers	Entrepreneurship and business leadership Integration of engineering and marketing to commercialise various innovations Project management Logistics management Financial management
Professionals and experienced technicians	Macro-economic researcher Venture capitalist specialists Energy planning specialists

	Agricultural economist Geohydrological modeller Environmental geochemist Agricultural product technicians Quantity surveyors Architects Commercial/administration
Engineers	Electrical engineers Mechanical engineers Chemical engineers Electronic sensor systems engineers Environmental engineers
Artisan and related workers	Electricians Fitters and turners Millwrights Specialist steel welders Plumbers Trainees (graduates. apprentices) Craftsmen Semi-skilled workers

Source: Adapted from SETA Sector skill planning (SSP) various 2000, Bureau of Market Research, University of South Africa, Key skills shortages and the fast tracking of skills development 2001 and SDPU (2003), Survey of public sector skills needs and personal interviews with industry stakeholders.

The above table provides a list of skill requirements in the energy sector. In addition to the above, a specific skill needed for wind energy technology has been identified – that of mechatronic engineer, which is a conglomeration of various skills such as mechanics and electronics.

Initiatives have been developed to recognise and develop these requirements. An organization dealing with these initiatives is the Energy Sector Education and Training Authority (ESETA), a government programme focusing specifically on bridging skills gaps and requirements within the energy sector.

ESETA has launched a number of initiatives with regard to providing the skill requirements for the energy sector. Some of these achievements are highlighted below:

Table 8: Highlights of ESETA achievements

Education and training quality assurance	100 assessors have been trained and a further 400 are scheduled for training within the energy sector. A policy document to assess and evaluate individuals with knowledge and experience, but no formal qualifications, has been developed. Koeberg Nuclear Power Station, Pelindaba Skills Institute and Eskom Learning Institutions have been accredited as training providers.
Skills development and planning	66 facilitators have been registered and many have undergone an orientation programme. Employers are being encouraged to submit workplace skills plans to ensure eligibility for grants.
Funding and grants disbursements	Funding of the sector education and training authorities is made possible via a skills development levy, based on a percentage of the payroll, which is payable by all companies. Of this, a minimum of 70% is available for reimbursements to employers for the education and training of their employees, with the remainder split between a national skills fund (18%) and administration costs (12%). In 2001/02, ESETA received R33 million from the skills development levy and distributed grants of R10 million. Coupled with the excess from the previous year, in which the ESETA started operation, the total funds available for disbursement currently stand at R32 million.
Learnerships	A grant for learnership development was obtained from the European Union to enable employers and providers to start developing curricula and learner support materials. In conjunction with Alexandra Technical College, a pilot programme for NQF level 1 and 2 electrical learnerships is

	being developed. Workshops have been facilitated for the fuel gas and renewable energy sub-sectors for the development of nationally recognized, industry-specific unit standards and qualifications.
Human resources	The management team has undergone training in strategic thinking skills. The learnership department has undergone project management training. A researcher in the skills planning department has undergone energy policy management training.

Source: ESETA website, 2004

At the time of this study, no data was available on how many people are being trained, the number of skill gaps in relation to employment requirements, or the extent of training relative to the need. Hence it was not possible to make a thorough evaluation of the actual situation as compared with the needs of the sector.

Moreover, according to the ESETA website, a database on the economic, educational and employment profile of the sector has been developed, but further information on accessing this database and how it impacts the skill requirements of the energy sector was unobtainable.

3.4.3 Skills training

The three universities in the Western Cape have joined forces to train petroleum geologists and geophysicists for work on the oil and gas fields in South Africa. [11]The South African Petroleum Studies Programme has been established by the Universities of Cape Town, Stellenbosch and the Western Cape with the aim of producing graduates with a solid education in petroleum geology and geophysics, who are capable of entering the local upstream industry. The focus is on the phases prior to refining produced natural gas and/ or oil.

[11] http://www.erc.uct.ac.za/Energy%20Managment%20News/emn%20june%202000.htm#mark8

Various tertiary institutions also offer courses relating to the skill mix in the energy sector:

- The Cape Technikon, which has combined with the Peninsula Technikon (Cape Peninsula University of Technology), offers courses in Chemical Engineering, Electrical Engineering, Industrial Design, Industrial Engineering, Landscape Technology, Management, Maritime Studies, Mechanical Engineering and Quantity Surveying.
    - The Technikon also has an Energy Technology Unit, which is headed up by Prof. Uken.
    - This technology unit has implemented various successful projects such as producing solar sewing machines, and providing employment and electricity in areas that had none of these luxuries.
- The University of Cape Town (UCT) offers courses in the following disciplines: Quantity Surveying; Construction Management; Property Studies, Chemical Engineering; Civil Engineering; Electrical Engineering; Electrical & Computer Engineering; Mechanical Engineering; Mechatronics; Geomatics, Geomatics, Construction Studies; Property Studies, Architectural Studies, and a Certificate in Engineering Management.
    - UCT also has an extensive Faculty of Science and offers courses in Information Technology; Biology, Earth & Environmental Sciences; Chemical, Molecular & Cellular Sciences; Mathematical, Physical & Statistical Sciences, Applied Mathematics; Archaeology; Computer Science; Ecology; Environmental & Geographical Science; Geology; Mathematics; Microbiology; Ocean & Atmosphere Science; Physics; Physiology and Statistics.
    - The Energy Development and Research Council (EDRC) is also based in UCT under the leadership of Prof. Anton Eberhard, who has made a huge contribution to the energy sector in terms of consultation.
- The University of Stellenbosch also offers a number of courses that are necessary to complete the skills mix within the energy sector, ranging from engineering to economics and management, as well as sciences.
- The University of Western Cape does not have an engineering faculty but focuses on economic and management courses and has a successful faculty of sciences.

3.4.4 Conclusions on labour conditions in the sector

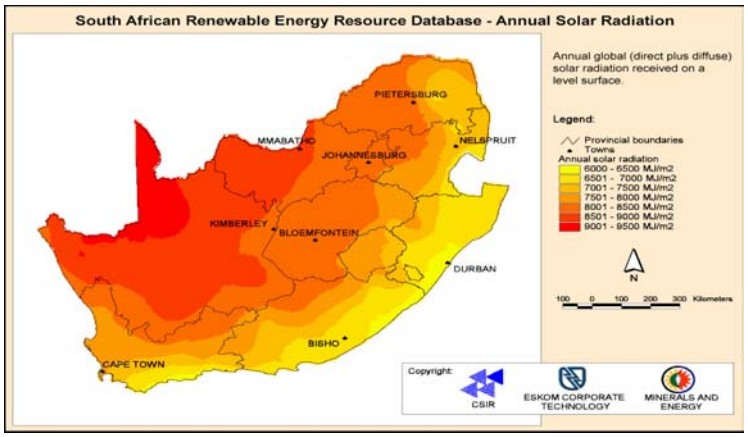
- Jobs in the coal sub-sector are showing a pattern of decline.
- Should the potential of natural gas be exploited, the possibility of creating employment opportunities is most likely in areas like drilling and testing, developing gas delivery systems and bringing the gas to the market.
- Massive employment gains could be achieved quickly and easily within the renewable energy sector, especially in SWH and biofuels, while showing good returns on a limited investment by government.
- There is a high rate of illiteracy but nevertheless a good deal of skills development in South Africa and there are a number of skills requirements which have been identified, particularly amongst scientists and researchers, managers, professionals and experienced technicians, engineers as well as artisans.
- There are a number of initiatives and institutions that provide the necessary skills in the energy sector, namely:
    - The University of Cape Town
    - The University of the Western Cape
    - The University of Stellenbosch
    - ESETA
    - The Cape Peninsula University of Technology
    - The South African Petroleum Studies Programme
- At the time of compiling this study, data was not available on how many people are being trained, the number of skills gaps in relation to employment requirements, as well as the extent of training relative to the need. Owing to this lack of data, a thorough evaluation of the actual situation against the needs of the sector could not be conducted.

3.5 COMPETITIVE ADVANTAGES IN THE ENERGY SECTOR

South Africa has many competitive advantages that could constitute an incentive for possible investment and growth within the sector. The most pertinent competitive advantages in the energy sector are discussed below:

- South Africa has a significant competitive advantage in the form of the harbours at Cape Town and Saldanha Bay, which are well situated to service the drilling rigs and floating production platforms operating off the West coast of Africa.
    - South Africa also has the engineering expertise and other resources such as capital infrastructure to provide a world-class service.
    - Industrial development and expansion in Saldanha Bay will cause a rise in the demand for energy and will necessitate the provision of bulk supply.
    - The city is already servicing oil rigs and service vessels and it was estimated in 2002 that the oil fields off West Africa were sustaining about 5 000 jobs in South Africa. The oil and natural gas industry consumes vast quantities of supplies and the most of this is being flown in to West Africa from Europe and the US at high cost.
    - Cape Town has sophisticated banking and communication systems in addition to other resources, so the city is well placed to become a service hub to the industry.
- The Western Cape has completed several major marine engineering projects and, as a result, the province is gaining the confidence of investors and oil companies.
- Another competitive advantage relates to South Africa having a highly developed synthetic fuels industry, as well as small deposits of oil and natural gas.
- South Africa experiences some of the highest levels of solar radiation in the world, which implies that there is considerable potential for SWH and even solar photovoltaic power generation.

Figure 9: Annual Solar Radiation in South Africa

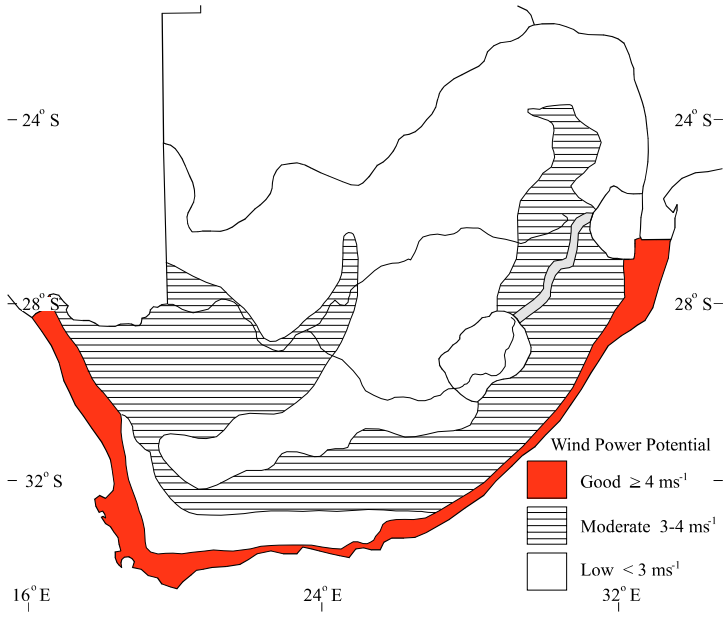


Source: DME, 2003

- Average daily solar radiation in South Africa ranges from 4.5 and 6.5 kWh/m²

- The Western Cape has prevailing winds coming from two directions and, usefully, they tend to blow during peak electricity consumption periods. These winds have the potential to generate 10 times the official national wind energy estimates and, coupled with vast tracts of open land and good infrastructure, the Western Cape has the potential to become a 'wind powerhouse'.

Figure 10: Wind map of South Africa



Source: Wind resource assessment as provided by Herman Oelsner, 2004

- The red represents the potential areas of good wind, which run right around the entire coastline, including the West coast.

- Replacing wood fuels and paraffin with affordable fuel sources (LPG, gel fuel) will open up avenues for job creation (distribution), local manufacture, health improvement and improved safety in informal settlements.

3.6 BARRIERS TO ENTRY FOR ALTERNATIVE SOURCES OF ENERGY

There are a number of barriers to entry into the South African market. According to the various industry experts and secondary sources of information, the greatest barrier to entry into the energy sector, especially renewable energies, is costs.

The utilization of alternative forms of energy other than coal is not at present cost-competitive compared to South Africa's fossil fuel-based energy supply industry.

South Africa has had excess capacity for a number of years and as a result, one of the country's competitive advantages is that South Africa presently has one of the cheapest electricity rates at +/-25c per kW.

- The high capital cost of renewable energies is a major barrier to expanding the market. The initial installed price of an electric water heater, for example, is approximately half that of its corresponding SWH.

- Prices of renewable energies are high due to low sales volumes, therefore economies of scale would greatly assist in reducing manufacturing costs and bringing down the need for high profit margins.

- As mentioned above, the domestic electricity price in South Africa is among the lowest in the world, which makes it very difficult for renewable energies to compete.

- The domestic tariff varies from one local authority to the next. It is hoped that the NER and the DME, in association with local authorities, will implement a single national domestic electricity tariff.

- The DME has suggested a poverty alleviation tariff of zero cents per kWh for the first 50kWh/month and it is also suggested that a stepped tariff should be introduced for the remaining domestic electricity consumption.

    - A second level should be set of approximately 30cents/kWh for consumption between 50 and 400 kWh/month and more than 50cents/kWh for usage over 400kWh/month.

Government is aware of these barriers and is therefore considering a number of measures to overcome the resultant problems. A decision has been taken to support renewable energy IPPs and the use of alternative forms of energy through policy papers like the White Paper on Renewable Energy (November 2003) and other government initiatives.

3.7 KEY GOVERNMENT INITIATIVES IN THE ENERGY SECTOR

The following section provides a summary of the support and major initiatives instituted by Government with regard to developing the energy sector and rendering possible a balance of supply and demand.

3.7.1 Initiatives by Government

- Last year there was an announcement in the President's State of the Nation Address that a new tender had been issued in December 2004 for the additional generation capacity to meet the growing energy demands. The deadline was

met and a number of ***Independent power producers*** locally, as well as internationally, managed to submit tenders.

- In a recently released draft ***White Paper on 'Renewable Energy and Clean Energy Development'***, Government recognizes the important role of renewable energy 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 as regards renewable energy. It also 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. To get started on a deliberate path towards this goal, the Government's medium-term (10-year) target is 10 000 GWh renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio- fuels. This is approximately 4% (1 667 MW) of the projected electricity demand for 2013 (41 539 MW), and is equivalent to replacing two (2x 660 MW) units of Eskom's combined coal fired power stations

- An ***additional requirement of 2 500MW peaking capacity*** between 2006 and 2010 was identified in the government's long-term planning. It was decided that Eskom would be responsible for addressing the supply requirement up to the end of 2007, while the DME would ensure that an additional 1 000MW of peaking power plant, in the form of Open Cycle Gas Turbines, would be introduced by the end of 2008.

- The DME will continue supporting BEE suppliers in accordance with the Liquid and Petroleum Charter. On 30 November 2004, the Department and individual members of SAPIA signed a memorandum of understanding aimed at the creation of a ***Supplier Development Agency***. The Agency is set to open its doors for trading as from 1 April 2005.

    - The primary objectives of the Agency are:

        - to source potential BEE suppliers to the industry,

        - accredit the suppliers to combat fronting,

- develop suppliers to meet the performance levels of the industry, and
- source opportunities for the BEE suppliers from industry.

- There is a plan to establish the first ***Regional Electricity Distributor (RED)*** in the Western Cape by June 2005. The objective of restructuring the electricity distribution industry is to improve quality of supply and increase the efficiency of the electricity industry as a whole. Considerable work has been done in this regard.

- The new ***National Energy Regulator (NER)*** of South Africa will hopefully be launched in the course of 2005. The new regulator seeks to consolidate the economic regulators within the energy sector, to derive maximum efficiency in regulation to the benefit of the end consumer.

- The implementation of the Kyoto Protocol came into effect on Wednesday, 16 February 2005. In preparation for participation in this, Government had established a ***Designated National Authority (DNA)*** office in the Department of Minerals and Energy to handle Clean Development Mechanism (CDM) transactions.

    - It officially opened on 1 December 2004. To date the DNA office has received a number of project proposals for review from the private sector. These projects, when implemented, will reduce South Africa's CO_2 emissions by 21 million tonnes by the year 2012 and generate revenue of R618 million by the year 2012 from sales of Certified Emission Reductions (CERs).

- The DME has developed a ***Gas Infrastructure Plan,*** which will form the basis of a strategy to develop the natural gas industry in South Africa, based on the 1998 White Paper on Energy. It is anticipated that there will be four main phases in the gas infrastructure development plan. These are outlined below.

    - The first phase will involve the construction of a pipeline between South Africa and Mozambique. The 865km pipeline - from Mozambique to Secunda - will cost $549-million to build. The Lilly 1 gas pipeline from Secunda to Durban may eventually have to be upgraded or replaced.

    - The second phase will be a pipeline in the Western Cape. Two options are being considered: either an onshore pipeline from Kudu or an offshore

pipeline from Ibhubezi to Saldanha, proceeding to Cape Town, and eventually to Mossel Bay and Port Elizabeth.

- Phase three will be a pipeline from the West Coast to Gauteng via Sishen in the Northern Cape.
- The fourth phase will involve building a pipeline from Port Elizabeth to Durban via East London.

3.7.2 [12]Local and Global Initiatives

There are also a number of global and local initiatives that have an impact on energy-related issues. The section below provides an overview of some of the more important initiatives that have potential implications for the formulation of micro-economic strategies and policies in the Western Cape.

Millennium Development Goals

Millennium Development Goals (MDGs) were agreed upon by world leaders in September 2000. The MDGs are a set of measurable goals with a designated time line.

- The MDGs have targets for combating hunger, illiteracy, poverty, disease, discrimination against women and environmental degradation.
- The target of halving the number of people living on one dollar a day or less by the year 2015 will not be achieved without increased access to modern energy services.
- The MDGs include a commitment to integrate the principles of sustainable development into the country's policies and programmes and to reverse the loss of environmental resources.
- Two indicators that are being used to measure this integration and commitment are energy-related, namely GDP per unit of energy use, and carbon dioxide emission per capita.

[12] Chown D and Jon Hankins Consulting, 2005, Towards the Development of an Integrated Energy Strategy for the Western Cape Initial Status Quo and Gap Analysis – Draft

The World Summit on Sustainable Development (WSSD)

The WSSD reaffirmed sustainable development as a global priority. Energy matters were high on the agenda at the WSSD, and the setting of concrete targets for energy constituted one of the key areas of disagreement in the negotiations. The most important WSSD commitments for energy include:

- Diversifying energy supply and substantially increasing the global share of renewable energy sources in order to increase their contribution to the total energy supply. (No timeframe or target was set for this.)

- Improving access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services and resources, sufficient to achieve the Millennium Development Goals, including the goal of halving the number of people living in poverty by 2015.

- Eradicating energy market distortions, including restructuring of taxes, phasing out harmful subsidies and supporting efforts to improve functioning, transparency and information about energy markets in respect of both supply and demand, with the aim of achieving greater stability and ensuring consumer access to energy services.

- Establishing domestic programmes for energy efficiency with the support of the international community, and accelerating the development and dissemination of energy efficiency and energy conservation technologies, including the promotion of research and development.

The following are some of the more significant 'Type II' voluntary partnerships launched at the Summit:

- The nine major electricity companies of the E7 signed a range of agreements with the UN to facilitate technical cooperation for sustainable energy projects in developing countries.

- The EU announced a $700 million partnership initiative on energy and the US announced that it would invest up to $43 million in 2003.

- The UN Department of Social and Economic Affairs, UN Environment Programme and US Environmental Protection Agency announced a partnership on Cleaner Fuels and Vehicles.

- Eskom announced a partnership to extend modern energy services to neighbouring countries.

- UNEP launched the Global Network on Energy for Sustainable Development to promote the research, transfer and deployment of green and cleaner energy technologies to the developing world.

The WSSD and its Plan of Implementation also called for the rapid, global phasing out of lead in petrol and the reduction of sulphur in diesel. The work is also being guided by the Dakar Declaration of March 2002 in which countries backed the phasing out of lead in petrol by 2005.

- A further 22 countries, including Eritrea, Ghana, Kenya, Nigeria, South Africa, Togo and Uganda, have drawn up, or are in the process of drawing up, action plans to phase out leaded fuel by 2005-2006.

Johannesburg Plan of Implementation

Two follow-up conferences have been held to follow up and deal with two shortcomings of the Johannesburg Plan of Implementation. These include setting targets for Renewables through the ***Bonn Renewables 2004 Conference*** held in June last year in Germany and the ***Energy for Development (E4D)*** Conference held in the Netherlands in December 2004.

The Bonn Renewables 2004 Conference

- On 4 June 2004, government delegates from 154 countries adopted the Political Declaration on Renewables. The declaration contains definitions of common political objectives for promoting the role of renewable energies.

- In the International Action Programme (IAP), governments, international organisations and stakeholders have committed themselves to a range of activities that are geared towards the increased use of renewable energies.

- Almost 200 proposed voluntary actions and commitments from all over the globe have been accepted for incorporation into the IAP. All submitting parties have expressed a strong willingness to promote renewable energies.

- South African institutions such as Eskom, the City of Cape Town and the DME have committed themselves to taking action.

The Energy for Development (E4D) Conference

- The E4D event was held with the objective of accelerating the implementation of energy-related issues in the WSSD action plan. Key policy outcomes included widening access to energy services for the poor, enhancing environment and health performance and increasing investments in the energy sector in developing countries.

- At the conference, the International Energy Agency (IEA) announced that more vigorous action to introduce environmental and energy security policies as well as energy-efficient technologies is required to cope with the future increase in sustainable energy demand.

4 WC DEDT CONCLUSIONS AND RECOMMENDATIONS FOR THE SECTOR

- There is a lack of detailed market share and demand-side data at a provincial level. Data on electricity is more readily obtainable than data on other fuels, but is not adequate.
    - It is likely that adequate data collection will need to precede proper energy planning and micro-economic strategy development. The data presented in this report should be viewed in this light, and is interpreted so as to highlight areas of known inaccuracy.
    - A complete province-wide energy audit is recommended for the Western Cape. This quantitative data would be important to help develop future scenarios and options that will inform the strategy and define the key initiatives.
    - The process of the audit would be similar to the methodology used in formulating the integrated sustainable strategy for Cape Town that was done in 2003. It should entail a process of contacting the various municipalities and energy-related organisations in the Western Cape to assess the energy requirements, demand and sources of supply.
- Demand-side management initiatives are being undertaken at a number of municipalities. Strengthening these and developing relationships with Eskom, as well as all the other organizations involved in energy conservation initiatives, should be a priority.
    - This includes providing the people with sound education concerning the implications of energy efficiency and demand-side management.
- The Government will need to play an active role in promoting energy efficiency amongst the population. For example, it would help if the approval of EIAs, which is normally a prolonged process, were to be speeded up, since delays retard the progress of potential projects like the Darling wind farm.
- The Government departments, institutions and organizations that are active in the energy sector need to ensure that they are in alignment and should consider forming a partnership, in order to develop and roll out a sound, integrated energy strategy across the province.

- A fully integrated approach to provincial energy security and energy strategy should be developed and implemented.

- The Western Cape has considerable advantages in the energy sector that are currently under-utilized. With the correct planning and support from Government as well as private parties, these alternative energies have the potential to generate additional employment, particularly in the sphere of renewable energy such as wind, solar and biofuels.

  - The Western Cape has some of the highest levels of solar radiation in the world, which means that there is considerable potential for SWH and even solar photovoltaic power generation.

  - Volume production would be achieved if the use of SWH was mandatory, as is the case in many other parts of the world. For example, in Israel, use of SWH as the main source of energy for heating domestic hot water is mandatory, and today, more than 60% of domestic water heating is provided by the sun.

  - A start could be made by legislating for all houses funded by the Reconstruction and Development Program (RDP) to use solar energy as the prime source of energy for domestic water heating. This action would provide the industry with a 'base-load'.

  - The Western Cape has prevailing winds coming from two directions, namely from the south-east as well as the west and, usefully, they tend to blow during peak electricity consumption periods. These winds have the potential to generate 10 times the official national wind energy estimates and, coupled with vast tracts of open land and good infrastructure, the Western Cape has the potential to become a 'wind powerhouse'.

  - The Western Cape has access to energy crops such as sunflowers, soya beans, canola seeds and Jathropha tree seeds, which are used to manufacture bio-diesel. Several opportunities have been identified to catalyse this existing sector with co-investment in commercial products that will also support job creation in rural areas.

- South Africa has a significant competitive advantage in the form of the Cape Town and Saldanha harbours, which are well situated to service the drilling rigs and floating production platforms operating off the West coast of Africa.

- South Africa also has the engineering expertise and other resources like capital infrastructure to provide a world-class service.
- Industrial development and expansion in Saldanha Bay will see a rise in the demand for energy and will necessitate provision of bulk supply.
- The city is already servicing oil rigs and service vessels, and it was estimated in 2002 that the oil fields off West Africa were sustaining about 5 000 jobs in South Africa.
- Cape Town has sophisticated banking and communication systems in addition to other resources, so the city is well placed to become a service hub to the industry.

- The Western Cape Government's stated objectives of developing public-private partnerships, broad-based BEE, and investing in infrastructure can be met through facilitating investment in new energy projects through innovative partnerships.

REFERENCES

Documents and articles:

Article: Saldanha lure oil firms, South African.info reporter, 2003

Article: Coega ready to plug and play, SouthAfrica.info reporter, 3 December 2004

Afrane-Okese, Y 2003. Operational Challenges of Large Scale Off-Grid Programme in South Africa. NER Quarterly Journal (4).

African Energy 2001. Online at Africanenergy.co.za.

Agama energy Pty Ltd, 2003, Employment potential of renewable energy in SA, (8).

Auf der Heyde, T & Thomas, S 2002. The PBMR project: an assessment of its economic viability. South African Journal of Science 98 (Jan / Feb): 36-42.

Berger, D 2002. South Africa Yearbook 2002/2003. Pretoria, Government Communication and Information System.

Biggs, R & Greyling, A 2001. Project energy. Report for the Paraffin Safety Association of Southern Africa. Cape Town, Markinor.

Borchers, M 2000. Review of international and local experience with Integrated Energy Planning (IEP) and Integrated Resource Planning (IRP). Pretoria, Department of Minerals and Energy.

Borchers, M, Qase, N, Gaunt, T, Mavhungu, J, Winkler, H, Afrane-Okese, Y & Thom, C 2001. National Electrification Programme evaluation: Summary report. Evaluation commissioned by the Department of Minerals & Energy and the Development Bank of Southern Africa. Cape Town, Energy & Development Research Centre, University of Cape Town.

Case study: Coal-bed methane potential of South African coal mines, EDRC, University of Cape Town.

Chown D and Jon Hankins Consulting, 2005, Towards the Development of an Integrated Energy Strategy for the Western Cape Initial Status Quo and Gap Analysis.

City of Cape Town and Sustainable Energy Africa. State of Energy Report for Cape Town. Sustainable Energy for Environment and Development (SEED) Programme. June 2003.

City of Cape Town. Cape Town Energy Strategy – Draft. In collaboration with Sustainable Energy Africa and the International Council for Local Environmental Initiatives (ICLEI). October 2003.

City of Cape Town. Integrated Metropolitan Environmental Policy - The Environmental Policy of the City of Cape Town. October 2001.

City of Cape Town. State of Energy – Report for Cape Town. Compiled by Sustainable Energy Africa. June 2003.

Clark, A & Mavhungu, J 2000. Promoting public benefit energy-efficiency investment in new power contexts in South Africa. Cape Town, Energy & Development Research Centre, University of Cape Town.

Creamer, T 2003. Mlambo-Ngcuka's natural gas prayer. Creamer Media's Engineering News October 24-30 2003. 23 (41): pp. 9.

Darroll, L 2001. Can solar energy serve South Africa's electricity needs? African Energy Journal 3 (4): pp. 14-16.

Davidson, O 2002. Sustainable energy and climate change: African perspectives. O Davidson and D Sparks (Eds).

Developing energy solutions for climate change: South African research at EDRC, Energy & Development Research Centre, University of Cape Town : 145-152.

De Villiers, M, Howells, M & Kenny, A 1999. Sustainable energy for South Africa: Energy scenarios from 1995 to 2025. Report for Eskom and National Research Foundation. Energy Research Institute, University of Cape Town.

DME (Department of Minerals and Energy) 1998. White Paper on Energy Policy for South Africa. Pretoria, DME.

DME (Department of Minerals and Energy) 2000. Energy Balances for South Africa 1993-98. Pretoria, DME.

DME (Department of Minerals and Energy) 2001a. Annual Report 2000 – 2001. Pretoria.

DME (Department of Minerals and Energy) 2001b. South Africa National Energy Balance 1999. Microsoft Excel Spreadsheet. Pretoria

DME (Department of Minerals and Energy) 2002a. Draft white paper on the promotion of renewable energy and clean energy development – Part 1. 23 August. Pretoria.

DME (Department of Minerals and Energy) 2002b. South Africa National Energy Balance 2000. Pretoria, DME.

DME (Department of Minerals and Energy), 2002, Eskom and Energy Research Institute. Energy Outlook for South Africa, University of Cape Town.

DME (Department of Minerals and Energy), 2004, Draft Energy Efficiency Strategy of the Republic of South Africa, DME.

Dubash, N 2001. The public benefits agenda in power sector reform. Energy for Sustainable Development V (2): 5- 14.

Dubash, N (Ed) 2002. Power politics: Equity and environment in electricity reform. Washington DC, World Resources Institute.

Eberhard, A & Van Horen, C 1995. Poverty and Power: Energy and the South African state. London, Pluto Press and UCT Press.

Eberhard A & Marquard A, Towards Energy Equity, Efficiency and Environmental Sustainability in South Africa: Policy Challenges. Energy for Sustainable Development. Vol. 4:4.

EC, DBSA & ISES (European Commission DG XVII, Development Bank of Southern Africa, International Solar Energy Society) 2000.

Energy Research Centre. Energy for Sustainable Development – South African Profile. Phase 1- Final Report. University of Cape Town. 2003.

Renewable energy technologies in SADC – a guide for investors. Midrand, Development Bank of Southern Africa. January.

ECON 2000. Electricity market scenarios: Phase 1. Commissioned by the National Electricity Regulator. Oslo, ECON Centre for Economic Analysis.

EDRC (Energy & Development Research Centre) 2003. Policies and measures for renewable energy and energy efficiency in South Africa. Prepared for the Sustainable Energy & Climate Change Partnership. Cape Town, EDRC, University of Cape Town.

ERI (Energy Research Institute) 2001. Preliminary energy outlook for South Africa. 10 October. University of Cape Town. www.dme.gov.za.

Howells, M I 2000. Baseline and greenhouse gas mitigation options for bulk energy supply. Energy Research Institute, University of Cape Town.

Hunt M, 2003, Diaphragm pump harnesses wave power, www.engineeringnews.co.za

IEA (International Energy Agency) 2002a. Key World Energy Statistics from the IEA. Paris, IEA.

IEA (International Energy Agency) 2002b. World Energy Outlook: Energy & Poverty. Paris, IEA.

IEA (International Energy Agency) 2003. Online at www.eia.doe.gov/emeu/cabs/safrica.html.

Kenny, A & Howells, M 2001. Energy futures: trends and options for the world and for South Africa, with emphasis on the generation of electricity. Energy Management News June. 7 (2): pp. 10-17.

http://www.eri.uct.ac.za/Energy%20Managment%20News/June2001/01.pdf.

Le Roux H, 2005, Construction of Western Cape commercial farm is nearer, www.engineeringnews.co.za

Lloyd, P J D 2003. Supporting economic development through sustainable energy investment

Lourens C, 2005, Ispat Iscor is looking stronger than ever: 14.

Lombard, E 2001. Eskom to harness wind: multi-million rand project in Western Cape will investigate environmentally friendly, alternative energy source. Sunday Times. 25 February Johannesburg.

Lukamba-Muhiya, J M & Davidson, O R 2003. Dissemination of solar water heaters in South Africa: Policy Perspectives. Journal of Energy in Southern Africa 14 (3): 99-105. August 2003.

Marrs D, 2000a, Cape power station likely after gas find, Business Day, www.businessday.com.

Marrs, D 2000b. Sasol takes over stakes in Temane gas field. Business Day, www.businessday.com

Martens, J-W, De Lange, T J, Cloin, J, Szewczuk, S, Morris, R & Zak, J 2001. Accelerating the market penetration of renewable energy technologies in South Africa. Brussels, ECN, CSIR, UCCEE and RMA for the European Commission Synergy Programme. www.ecn.nl/unit_bs/resa/main.html.

Mlambo-Ngcuka, P 2002. Budget vote speech by Minister of Minerals and Energy, Ms. Phumzile Mlambo-Ngcuka. Cape Town. 7 May 2002.

Mlambo-Ngcuka, P 2003. Budget vote speech by Minister of Minerals and Energy, Ms. Phumzile Mlambo-Ngcuka.

Minerals and energy: a catalyst in pushing back frontiers of poverty. Cape Town, Parliament. 15 May 2003.

NER (National Electricity Regulator) 1999. Electricity supply statistics for South Africa 1999. Sandton, NER.

NER (National Electricity Regulator) 2000a. Annual Report 2000-2001. Sandton, NER.

NER (National Electricity Regulator) 2000b. Electricity supply statistics for South Africa 2000. Pretoria, NER.

NER (National Electricity Regulator) 2001a. Electricity supply statistics for South Africa 2001. Pretoria, NER.

NER (National Electricity Regulator) 2001b. Lighting up South Africa 2001. Pretoria.

NER 2001c. Non-grid electrification. Electricity Regulatory Journal February. pp. 4-5.

NER (National Electricity Regulator) 2001/2. National Integrated Resource Plan. Pretoria.

NER (National Electricity Regulator) 2002. An integrated electricity outlook for South Africa. Pretoria, NER. March.

Oelsner, H F W 2001. Harvesting the wind in Southern Africa. Darling, South African Wind Energy Association.

PBMR Ltd (Pebble Bed Modular Reactor (Proprietary) Limited) 2002. PBMR: Report on the proposed demonstration module and potential commercialization of the pebble bed modular reactor.

Pearce, D, Markanda, A & Barier, E 1989. Blueprint for a green economy. London, Earthscan.

PEER Africa 1997. Housing as if people mattered. The story of Kutlawanong, South Africa. A no regrets case study.

United Nations Framework Convention on Climate Change Third Conference of the Parties, Kyoto, November.

Participants of the City Energy Strategies Conference. The Cape Town Declaration on Energy for Cities. 21 November 2003.

Province of the Western Cape. Department of Transport and Public Works. White Paper on Western Cape Provincial Transport Policy. June 1997.

Province of the Western Cape. Framework for the Development of the Western Cape Province – 2004-2007.

Provincial Administration: Western Cape (PAWC). Chief Directorate of Policy and Strategic Management. Policy and Strategic Management. Framework for the Development of the Western Cape Province.

PWC (Price Waterhouse Coopers) 2000. Consolidated emerging views. Electricity distribution industry restructuring project: Working paper 7. Johannesburg.

Qase, N, Lloyd, P J D & Van Zyl, H 2000. Intervention potential for low smoke fuels in the coal distribution chain, final report. Cape Town, Energy & Development Research Centre.

Republic of South Africa. Department of Minerals and Energy. White Paper on Renewable Energy. November 2003.

Republic of South Africa. Government Gazette. Energy Regulator Bill. No. 25994. 2004.

Republic of South Africa. Government Gazette. No. 209 of 1993. Local Government Transition Act.

Republic of South Africa. Government Gazette. No. 3007 of 1998. Department of Minerals and Energy.

Republic of South Africa. Government Gazette. No. 41 of 1987. Electricity Act.

SADC (Southern African Development Community) 1996. SADC energy co-operation policy and strategy. Luanda, Angola, SADC Energy Sector Technical and Adminis trative Unit.

SADC 2001a. Key Priorities for SADC. SADC Sub Regional consultations in preparation for the WSSD, Mauritius.

SADC 2001b. SADC Progress report on the implementation of agenda 21 and sustainable development. A report submitted to the 2002 world Summit on sustainable development. Maseru.

SANEA 2003. South African Energy Profile 2003. Melville, South Africa.

SAPIA (South African Petroleum Industry Association) 2001. Annual Report. Cape Town, SAPIA.

Sasol 2002. Online at www.sasol.com/sasol_internet.

Schäffler, J L 2000. Distributed generation in South Africa: Economically sound or environmentally benign? Journal of Energy in Southern Africa 11 (2): 208-213.

SEA, 2003, City of Cape Town State of Energy Report

Shell (Shell International) 2001. Energy needs, choices and possibilities: Scenarios to 2050. London.

Smetherham, J-A 2002. Eskom's latest study is blowing in the wind. Cape Times. 22 August: 4.

Soontornrangson, W, Evans, D G, Fuller, R J & Stewart, D F 2003. Scenario planning for electricity supply. Energy Policy 31: 1647 –1659.

Spalding-Fecher, R 2002a. Energy and energy policies in South Africa: an overview. NER Quarterly Journal 1 (1): 1-18. October.

Spalding-Fecher, R 2002b. Energy sustainability indicators for South Africa. Cape Town, Energy & Development Research Centre, University of Cape Town.

Spalding-Fecher, R, Clark, A & James, B 2002. Economic assessment and development evaluation of climate change mitigation projects in South Africa.

Davidson and D Sparks (Eds). Developing energy solutions for climate change: South African research at EDRC. Cape Town, Energy & Development Research Centre, University of Cape Town : 20-43.

Spalding-Fecher, R & Matibe, D K 2003. Electricity and externalities in South Africa. Energy Policy 31 (8): 721-734.

Spalding-Fecher, R, Williams, A & Van Horen, C 2000. Energy and environment in South Africa: charting a course to sustainability. Energy for Sustainable Development 4 (4): 8-17. December.

Spicer, D 2003. Keeping the lights burning. Creamer Media's Engineering News October 24-30 2003. 23 (41): pp. 16-17.

Statistics South Africa, 2002. Statistical release P0302. Pretoria, Statistics South Africa.

Statistics South Africa, 2004, Stats in Brief – Ten Years of Democratic Governance.

Thorne, S, Spalding-Fecher, R & Wamukonya, N 2000. Residential solar water heating as a potential CDM project:

A South African case study. Paper presented at workshop on Forging New Links and Reinforcing National Capacities on Climate Change: Challenges and Opportunities for CDM in Africa, 8-10 May 2000, Cape Town.

Trollip, H 1996. Overview of the South African energy sector. Report No. EG9404. Pretoria, Department of Minerals & Energy.

UCT (University of Cape Town) 2002. Options for a basic electricity support tariff: Analysis, issues and recommendations for the Department of Minerals & Energy and Eskom. Cape Town.

Venter, I 2001. Africa's big gas adventure begins. Engineering News October 5-11 pp. 16-17.

Visser, M, Spalding-Fecher, R & Leiman, A 1999. Manufacturing and economic growth. Paper No. 10: World Wildlife Fund Macroeconomic Reforms and Sustainable Development in Southern Africa Project. Cape Town, Energy & Development Research Centre, University of Cape Town.

White Paper on the Energy Policy of the Republic of South Africa. Vol. 402, No. 19606. 17 December 1998.

White Paper on the Western Cape Provincial Transport Policy, Department of transport and public works, Western Cape, June 1997.

The Western Cape Policy Framework. Fact Sheet. No date.

United Nations Environment Programme. Division of Technology, Industry and Economics.

WESGRO. Annual Report-2004. 2004.

WESGRO. Biotechnology. Sector Fact Sheet. 2002.

WESGRO. Environment. Sector Fact Sheet. 2002.

WESGRO. South Africa's Western Cape. Business Facts and Opportunities. Fact Sheet. August 2002.

WESGRO. Study Report for WESGRO. Offshore Oil and Gas. 2002.

WESGRO. WESGRO Background Report - The Renewable Energy Industry in Western Cape of South Africa. 2000.

WESGRO. Western Cape Petrochemical Industry. Sector Fact Sheet. 2000.

WESGRO. Western Cape Renewable Energy Industry. Sector Fact Sheet. 2000.

Western Cape. Department of Economic Development and Tourism. Annual Report 2002 - 2003.

Western Cape. Department of Environmental Affairs and Development Planning. Annual Report – 2004.

Western Cape. Department of Transport and Public Works. Mobility Strategy – A Shared Vision . In collaboration with the City of Cape Town.

Winkler, H & Mavhungu, J 2001. Green power, public benefits and electricity industry restructuring. Cape Town, Energy & Development Research Centre, University of Cape Town.

Web-sites:

www.dme.gov.za

www.info.gov.za

www.ner.org.za

www.engineeringnews.co.za

www.scienceinafrica.co.za

www.capegateway.gov.za

www.wesgro.org.za

www.dti.gov.za

www.eskom.co.za