DEPARTMENT OF MINERALS AND ENERGY

REPUBLIC OF SOUTH AFRICA

WHITE PAPER

ON RENEWABLE ENERGY

November 2003

DEPUTY MINISTER'S FOREWORD

I am confident that in this dynamic new era of the African Renaissance and in the spirit of the World Summit on Sustainable Development, hosted by South Africa (2002), we shall see Renewable Energy taking its rightful place in the South African Energy Sector and playing a significant role in contributing towards sustainable development. The repercussions of a growing local renewable energy industry will be felt throughout the African Continent and the SADC region with the breakdown of trade barriers and the move towards a common policy, a move that will encourage competition and lower costs.

The world is facing the challenge of harnessing the earth's resources effectively and efficiently. There is still a vast dependence on fossil fuels, and the use of this energy source is common to both developing and developed countries. It is well known that the excessive burning of fossil fuels does not go without a price as they release large amounts of carbon dioxide into the atmosphere.

Air pollution from using fuelwood unsustainably is still a familiar sight in developing countries, where women and children are the most affected. Research has indicated that one of the highest causes of infant mortality is from acute respiratory illness associated with the inhalation of wood smoke. Women still have to bear the problem of obtaining water and fuelwood. This indicates that there is a need to develop efficient and safe technologies to relieve women from such a burden. Such improvements are generally part of integrated measures aimed at income generation via the pursuit of economic and agricultural development that afford women a more qualitative and productive time. However, the easier entry points for renewable energy are generally not in the remote rural areas, but in the urban household and industrial sectors. It is here that the possibilities for solar water heating, and the use of waste for power generation lie.

The African Continent is endowed with an abundance of renewable energy resources: hence this White Paper is being published to ensure that the renewable energy resources are used optimally. The present worldwide trend towards environmentally sustainable energy utilisation is a response to global climate change. This, coupled with market incentives to promote renewable energy technologies, can make this trend a reality in South Africa. Notwithstanding the legitimate needs in rural areas, commercial realities and the pressing demands made of our limited Fiscus, dictate that our initial ventures into renewable energy will be among the larger and more economically viable projects such as electricity from sugar mill bagasse and paper mill waste. It is sincerely hoped that this policy will provide certainty about our future direction and commitment.

It is in this context that the Ministry is committed to this policy document which is intended to give much needed thrust to renewable energy; a policy that envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy. To achieve this aim Government is setting as its target 10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. *This is approximately 4% (1667 MW) of the projected electricity demand for 2013 (41539 MW).*

This is in addition to the estimated existing (in 2000) renewable energy contribution of 115 278 GWh/annum (mainly from fuelwood and waste).

This policy is launched against the background of a massive campaign of electrification in South Africa and now the start of a process of managed liberalisation of the energy sector including the transformation of the electricity distribution sector into regional electricity distributors.

Some of the main benefits of the White Paper will be renewable energy for rural communities, far from the national electricity grid, remote schools and clinics, energy for rural water supply and desalination, and solar passive designed housing and solar water heating for households in urban and rural settings and commercial applications. Large-scale utilisation of renewable energy will also reduce the emissions of carbon dioxide, thus contributing to an improved environment both locally and worldwide.

As part of the Presidential lead programmes promoting integrated sustainable rural development, renewable energy needs to assume a significant role in supporting economic development. The Government has brought electricity to both urban and rural areas and this has resulted in an improvement in the quality of lives of our people. It is for this reason that Government is also introducing decentralized mini-grids and hybrid systems in rural areas that will also promote the development of small medium and micro enterprises (SMMEs).

Government is committed to the introduction of greater levels of competition in electricity markets. Promoting renewable energy will contribute towards the diversification of electricity supply and energy security. In doing so, Government will create an enabling environment to facilitate the introduction of independent power producers that generate electricity from renewable energy sources. To complement these reforms, I would like to see a greater investment by the private sector in renewable energy power producers, and in the commercialisation and local manufacturing of renewable energy technologies.

Within the renewable energy sector I would like to see human capacity building programmes being strengthened both at formal and informal levels. This policy document is intended to support the development of training centres with the objective of enhancing human resource development and thus promoting socio-economic development. Government is also in the process of launching integrated energy centres that will bring technologies and energy services closer to disadvantaged communities, as well as disseminate information and create awareness about renewable energy.

Finally, it cannot be over-emphasised that South Africa is faced with pressing social problems such as poverty and the HIV/Aids epidemic. The utilisation of renewable technologies, particularly in remote rural areas, where clinics and households will depend upon solar electricity for their power, have a potentially important role to play in tackling these important social issues.

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DEPUTY MINISTER OF MINERALS AND ENERGY

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GLOSSARY OF TERMS

Anthropogenic - generated by human activity.

Applications – the renewable energy electricity supply options employed can be;

- Connected to the main grid,
- Connected to a mini-grid, or
- Used for stand-alone systems (non-grid). Some stand-alone configurations provide services on the same level as grid services,
- Configurations substituting electricity are especially relevant for heat purposes in industry and households.

Clean Development Mechanism (CDM) - The CDM is specifically defined to support sustainable development with respect to greenhouse gas emissions in developing countries while helping Annex 1 countries to comply with their commitments under the Kyoto Protocol.

Environmental sustainability **-** the ability of an activity to continue indefinitely at current and projected levels, without depleting the social, cultural and natural resources required to meet present and future needs.

Externalities - impact on the environment, carrying costs that are not included in the market price for the service or goods produced. In practice it is difficult to measure economic prices/costs and often not all impacts are included.

Financial costs/prices - costs and prices evident in the market.

Greenhouse Gases (GHGs) - Gases primarily carbon dioxide, methane, and nitrous oxide in the earth's lower atmosphere that trap heat, thus causing an increase in the earth's temperature and leading towards the phenomenon of global warming.

Grid **–** the generic term used to describe both the National Electricity Grid; being all electricity networks of licensed electricity distributors and transmitters within South Africa, and the Eskom transmission system.

GWh (Gigawatt hour) An energy unit in which electricity consumption is measured. (1 GWh = 3600 GJ (Gigajoule) (Joule, unit of energy)

Independent power producers *(IPPs)* – producers of power (electricity), who sell their power to electricity distributors for supplying to the national electricity grid.

Mtoe (Million tons of oil equivalent) A universal unit of comparison in which all energy can be measured. (1 Toe = 42 GJ = 0.042 TJ = 0.012 GWh)

Renewable energy sources - sun, wind, biomass, water (hydro), waves, tides, ocean current, geothermal, and any other natural phenomena which are cyclical and non-depletable.

Renewable technology - the technology that converts a primary renewable source of energy or energy resource to the desired form of energy service.

Watt (W) = 1 Joule **per second** of **energy** consumption or dissipation (MW = 1000 000 W)

tcf (Trillion cubic feet) - standard term to measure natural gas volume

Energy Units Conversion Table

To / From	Joule	Gigajoule	Tetrajoule	Toe	kWh	GWh
Joule	1	10^{-9}	10^{-12}	2.4×10^{-12}	2.8×10^{-7}	2.8×10^{-13}
Gigajoule	10^{9}	1	10^{-3}	2.4×10^{-2}	278	278×10^{-6}
Tetrajoule	10^{12}	10^{3}	1	24	2.8×10^{5}	2.8×10^{-1}
Toe	42×10^{9}	42	42×10^{-3}	1	12×10^{4}	12×10^{-3}
kWh	36×10^{5}	36×10^{-4}	36×10^{-7}	8.3×10^{-6}	1	10^{-6}
GWh	36×10^{11}	36×10^{2}	36×10^{-1}	83	10^{6}	1

EXECUTIVE SUMMARY

The Constitution (Act No. 108 of 1996) requires that Government establish a national energy policy to ensure that national energy resources are adequately tapped and delivered to cater for the needs of the nation; further, the production and distribution of energy should be sustainable and lead to an improvement in the standard of living of citizens. The Government's overarching energy policy has been set out in its *White Paper on Energy Policy of the Republic of South Africa* (DME, 1998).

This White Paper on Renewable Energy (herein referred to as the White Paper) supplements the *White Paper on Energy Policy*, which recognises that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. It also informs the public and the international community of the Government's vision, and how the Government intends to achieve these objectives; and informs Government agencies and organs of their roles in achieving the objectives.

The *White Paper on Energy Policy*'s position with respect to renewable energy is based on the integrated resource planning criterion of:

> *Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options.*

Purpose of the Policy

Statement of the Problem

South Africa relies heavily on coal to meet its energy needs because it is well-endowed with coal resources***;*** in particular, South Africa has developed an efficient, large-scale, coal-based power generation system that provides low-cost electricity, through a grid system that is being extended to rural areas, to millions of residential, commercial and institutional consumers. As a result, coal is and is likely to remain, from a financial viewpoint, an attractive source of energy for South Africa.

However, at the same time South Africa recognises that the emissions of greenhouse gases, such as carbon dioxide, from the use of fossil fuels such as coal and petroleum products has led to increasing concerns worldwide, about global climate change. While South Africa is well endowed with renewable energy resources that can be sustainable alternatives to fossil fuels, so far these have remained largely untapped.

The above-mentioned concerns about global climate change were articulated at the Johannesburg World Summit on Sustainable Development in 2002 and a corresponding commitment to promote renewable energy in all the participating nations was made in the Johannesburg Declaration. Correspondingly, it is the intention of the Government to make South Africa's due contribution to the global effort to mitigate greenhouse gas emissions. For

this purpose, the Government will develop the framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy and to the global environment.

Energy Security

The driving force for energy security through diversification of supply in South Africa has remained one of the White Paper On Energy Policy's key goals, since a major portion of the nation's energy expenditure is via dollar-denominated imported fuels that impose a heavy burden on the economy. Further, the South Africa economy, which is highly dependent on income generated from the production, processing, export and consumption of coal, is vulnerable to the possible climate change response measures implemented or to be implemented by developed countries. At the same time there are now increased opportunities for energy trade.

> *Given increased opportunities for energy trade, particularly within the Southern African region, Government will pursue energy security by encouraging diversity of both supply sources and primary energy carriers (DME, 1998)*

Some activities in this regard have already been initiated; for example, the Government has, as a part of its Integrated Electrification Plan, developed a scheme for providing solar photovoltaic systems to households in remote, rural areas, that are expected to replace candles, illuminating paraffin and diesel for lighting or battery charging.

What is being proposed now is a strategic programme of action to develop South Africa's renewable energy resources, particularly for power generation or reducing the need for coal-based power generation. Renewable energy has been recognised in the Integrated Energy Plan (IEP) (DME, 2003) developed by the DME. The purpose of the IEP is to balance energy demand with supply resources in concert with safety, health and environmental considerations. The IEP provides a framework within which specific energy development decisions can be made.

One key element of this programme will be the entrepreneurship and innovativeness of South Africa's industrial and financial sectors, and another element will be the development by the Government of appropriate policies and frameworks that would encourage and guide the private sector. However, at present, these will not be enough, as renewable energy resource development in South Africa is in a nascent stage, while competing fossil fuels are well established and have relatively low costs.

It is clear that renewable energy development will require financial incentives. While the Government intends to provide the necessary incentives, South Africa's fiscal resources are limited, and there are competing high priority social and economic programs, particularly in providing services to historically disadvantaged communities. Hence, the financial resources for these incentives will have to come from a combination of South African and international sources. South Africa has already ratified the United Nations Framework Convention on Climate Change (1997) and the Kyoto Protocol (2002), which creates the framework for tapping international funds *via* the Global Environment Facility and the Clean Development Mechanism to reduce greenhouse gas emissions.

Government's long-term goal is the establishment of a renewable energy industry producing

modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels. The proportion of final energy consumption currently provided by renewable energy has come about largely as a result of poverty (e.g. fuelwood and animal waste used for cooking and heating). To get started on a deliberate path towards this goal, the Government's medium-term (10-year) target is:

> *10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1667 MW) of the projected electricity demand for 2013 (41539 MW).*

This is equivalent to replacing two (2x 660 MW) units of Eskom's combined coal fired power stations.

This is in addition to the estimated existing (in 2000) renewable energy contribution of 115 278 GWh/annum (mainly from fuelwood and waste).

Achieving this target will require a phased, flexible strategy. The starting point will be a number of "early win" investments spread across both relatively low cost technologies, such as biomass-based cogeneration, as well as technologies with larger-scale application such as solar water heating, wind and small-scale hydro, along with a focus on building and fine-tuning the required institutional framework. This will keep the subsidy requirements manageable at a time when the short-term costs of the competing coal-based power generation are low because of the current surplus in installed power generation capacity. South African funds available for this purpose are constrained by the need to provide funds for high-priority national activities, and the magnitude of the funds available from international sources such as the Clean Development Mechanism has not yet been established. However, there is a large potential for finance, available from international sources such as the Prototype Carbon Fund (PCF), bi-lateral assistance and private sector investment.

Over time, as the need for new power generation capacity arises, the costs of coal-based generation will increase, which would improve the financial viability of renewable energy technologies, thus reducing the subsidy needed per unit of power generated. Similarly, if the Rand continues to weaken against the US dollar, the opportunities for locally produced fuels to compete with US dollar-denominated fuels such as petrol, diesel and natural gas, will increase. By this time, the magnitude of available international funds would be clearer, and the availability of South African funds would also be expected to increase, as it is expected that many pressing social activities would have been completed by then. These changes are expected to make it feasible to make rapid progress towards the target in the second phase (2009 –2014).

Apart from the normal monitoring and evaluation associated with any policy, there would be a mid-term assessment after five years (end of 2008), which would consider any changes required in policies, targets or implementation strategies, taking account of changes in costs of coal-based as well as renewable energy power generation, availability of international funds as well as any international obligations agreed-to by South Africa, and the South African budgetary situation. This White Paper may be revised in the light of progress made.

Essential Elements for Renewable Energy Implementation

Sustainable Development

Renewable energy that is produced from sustainable natural sources will contribute to sustainable development. As most of the sources are indigenous and naturally available, energy supply is afforded security and is not subject to disruption by international crises or limited supplies. Mitigating the use of fossil fuels through the implementation of renewable energy will contribute to emission reductions while providing incremental financial resources to stimulate sustainable development.

Enabling Environment

South Africa is well endowed with abundant renewable energy resources that can be converted to productive energy uses. At present, however, the utilisation of these resources is not cost competitive in many locations when compared to South Africa's fossil-based energy supply industry. There are many reasons for this discrepancy in cost, including the fact that the lower cost associated with fossil fuel use does not fully account for its adverse impact on the environment. There is therefore a need for Government to create an enabling environment through the introduction of fiscal and financial support mechanisms within an appropriate legal and regulatory framework to allow renewable energy technologies to compete with fossil-based technologies.

Market conditions for renewable energy generation can be optimised by reducing the barriers to the increased production of electricity from this source through the development and implementation of an appropriate financial and legislative framework. There is a need for Government support for renewable energy to help establish initial market share and demonstrate the viability of renewable sources, after which economies of scale and technological development take over. Mechanisms need to be developed to overcome the barrier of non-discriminatory third party access to the Grid (defined here as the national electricity network – see Glossary) and procedures and wheeling charges defined and regulated to remove the barrier of cost effective transmission of power.

Institutional Arrangements

Electricity Sector: While one power producer, Eskom, currently dominates electricity generation and transmission in South Africa, the electricity distribution industry is currently undergoing restructuring, including the corporatisation of Eskom and the formation of six new regional electricity distributors. The *White Paper on Energy Policy* encourages the entry of multiple players into the generation market. However, the appropriate regulatory and legal framework will be needed to support the entry of renewable energy generators. The National Electricity Regulator has jurisdiction over the entire industry and regulates market access through licensing of all producers (greater than 5 giga watt hours/annum), transmitters, distributors and sellers of electricity, and should regulate the phased introduction of renewable energy generators. The Central Energy Fund should assist the implementation of renewable energy through the extension of its operational support.

Liquid Fuels and Gas Sector: *The Central Energy Fund Act* (Act 38 of 1977) is enabling legislation in terms of which levies can be imposed on liquid fuels products for collection into the Central Energy Fund and/or the Equalisation Fund. These funds can be employed for dedicated energy purposes in a manner prescribed by the Act. In terms of proposed amendments to the *Petroleum Products Act* (Act 120 of 1977), the Minister of Minerals and

Energy will remain the liquid fuels industry regulator and may prescribe; the price at which any petroleum product may be sold or bought, the method of trading, the publishing of prices and quantities of crude oil or petroleum products to be maintained by any person as well as the technical characteristics of any fuel.

Government has accepted a process of managed liberalisation of the regulatory dispensation of the liquid fuels industry. A ten-year timeframe is envisaged for the liberalisation of the industry, allowing time for the black empowerment companies to consolidate their positions within the industry.

The Gas Act (Act 48 of 2001) and amended *Petroleum Products Act* provide a basis for the integration of renewable energy derived liquid fuels such as bio-diesel and ethanol and landfill gas into the gas and petroleum industry regulatory framework. The Minister of Finance has announced a 30% tax reduction for bio-diesel.

***Renewable Energy Technologies*:** It is necessary to consider which technologies can be promoted by measures to stimulate the market. In the short-term it is important that technologies that are currently available in South Africa are implemented. The local content of equipment needs to be maximised in order to minimise the costs associated with implementation and operation, as well as the promotion of employment opportunities. The establishment of technology support centres within existing research and development institutions will facilitate the promotion and ongoing development of technologies and will assist Government in the certification of systems.

Strategic Goals and Objectives

Strategic goals and supporting objectives will be instrumental in facilitating the development of an enabling framework in order for Government to meet its commitment to promoting renewable energy. Four key strategic areas have been addressed, i.e. financial instruments, legal instruments, technology development, and awareness raising, capacity building and education.

Financial Instruments: The goal is to promote the implementation of sustainable renewable energy through the establishment of appropriate financial instruments with the following objectives:

- To ensure that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options.
- To set targets for the directing of public resources for the implementation of renewable energy technologies in combination with international sources of funding for this purpose.
- To introduce appropriate fiscal incentives for renewable energy.
- To extend existing state financial support systems and institutions and introduce innovative approaches to the establishment of sustainable structures and financing mechanisms for delivering renewable energy systems.
- To facilitate the creation of an investment climate for the development of the renewable energy sector, which will attract foreign and local investors.

Legal Instruments: The goal is to develop, implement, maintain and continuously improve an effective legislative system to promote the implementation of renewable energy with the following objectives:

- To develop an appropriate legal and regulatory framework for pricing and tariff structures to support the integration of renewable energy into the energy economy and to attract investment.
- To develop an enabling legislative and regulatory framework to integrate Independent Power Producers into the existing electricity system.
- To develop an enabling legislative framework to integrate local producers of liquid fuels and gas from renewable resources into their respective systems.

Technology Development: The goal is to promote, enhance and develop technologies for the implementation of sustainable renewable energy with the following objectives:

- To promote the development and implementation of appropriate standards and guidelines and codes of practice for the appropriate use of renewable energy technologies.
- To promote appropriate research and development and local manufacturing to strengthen renewable energy technology and optimise its implementation.

Awareness Raising, Capacity Building and Education: The goal is to develop mechanisms to raise public awareness of the benefits and opportunities of renewable energy with the following objectives:

- To promote knowledge of renewable energy and energy efficiency and thereby to increase their use.
- To promote and stimulate the renewable energy market through the dissemination of information regarding the economic, environmental, social and trade benefits of renewable energy technologies and their applications.
- To persuade the appropriate Government and Government funded institutions to implement training and education programmes with regard to renewable energy.
- To actively involve women in decision-making and planning and promote empowerment in renewable energy programmes or activities.
- To improve communication and interaction between national, provincial and local Government institutions on renewable energy policies.

Governance

The Constitution requires that the legislative and executive authority of different spheres of Government operate within a framework of cooperative governance. The Department of Minerals and Energy will take overall responsibility for renewable energy policy in South Africa. The Department will establish the appropriate enabling environment to ensure that activities undertaken by other stakeholders are co-ordinated, uniform and effective.

The future Energy Regulator will regulate market access through licensing of all producers transmitters, distributors and sellers of energy. The Energy Regulator will also regulate the prices at which power is purchased from all generators, including Eskom and the Independent Power Producers, and approve electricity tariffs.

In applying the *Petroleum Products Act* the Minister of Minerals and Energy may introduce measures to facilitate the entry of liquid fuels produced from renewable resources.
The key focus area of the Central Energy Fund (CEF) is aimed at contributing to the development of South Africa's energy sector by facilitating the universal access to energy, including the increased use of renewable energy. The CEF renders operational support to the energy sector in the form of treasury services, including the raising of funds both locally and internationally. Mechanisms will be investigated to extend the operational support available from the Central Energy Fund to renewable energy programmes.

The Department of Minerals and Energy will develop a partnership approach to ensure an integrated focus for national renewable energy initiatives.

The Way Forward

A Strategy on Renewable Energy will be developed, which will translate the goals, objectives and deliverables set out herein into a practical implementation plan. Underpinning the Renewable Energy Strategy is a Macro-economic analysis to guide cost efficient Government financial assistance based on a least-cost and employment maximising supply model in reaching the target. A number of important investigations will be undertaken during the Strategy development, including, *inter alia*, how the renewable energy target will be periodically reviewed with respect to the different primary energy carriers, the mechanism that is selected for the feed-in of electricity generated from renewable resources into the national electricity network, and the modalities of the various financial, legal and regulatory instruments to be employed as part of the enabling framework of mechanisms to support the promotion of renewable energy.

The main aim of the policy is to create the conditions for the development and commercial implementation of renewable technologies. Government will use a phased, managed and partnership approach to renewable energy projects that are well conceived and show the potential to provide acceptable social, environmental and financial returns for all investors and stakeholders. This will lessen the strain on fiscal resources and hold greater potential for successful implementation. The focus will be on delivery and not to re-invent the wheel with respect to technologies that are readily available. An appropriate enabling environment towards full commerciality will nurture the technologies that are proven to best meet Government's policy objectives.

The policy will be evaluated mid-term, after five years, to see if the targets, objectives and deliverables are being achieved. It will be updated in the light of progress to assess whether any amendments in policy are required. Sustainable development criteria – economy, environment and social priorities - will be used to guide strategy in a balanced way for the longer-term. At the same time, Government will monitor worldwide technical developments in renewable energy with a view to identifying technologies that may be particularly appropriate to the South African situation in the long-term, making the best use of partnerships where possible, both locally and internationally.

1. INTRODUCTION

This White Paper on Renewable Energy (herein referred to as The White Paper) supplements the Government's overarching policy on energy as set out in its *White Paper on the Energy Policy of the Republic of South Africa* (DME, 1998), which pledges 'Government support for the development, demonstration and implementation of renewable energy sources for both small and large-scale applications'.

The need and urgency for a White Paper on Renewable Energy has its basis in the World Summit on Sustainable Development (WSSD): Johannesburg Plan of Action (CSD-11, 2002):

"Diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies,...
With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply, recognizing the role of national and voluntary regional targets"

The White Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. Additionally, it has the following two goals:

- to inform the public and the international community of the Government's goals, and how the Government intends to achieve them, and;
- to inform Government agencies and Organs of State of these goals, and their roles in achieving them.

1.1 VISION

Government's overall vision for the role of renewable energy in its energy economy is:

> *An energy economy in which modern renewable energy increases its share of energy consumed and provides affordable access to energy throughout South Africa, thus contributing to sustainable development and environmental conservation.*

1.2 DEFINITION OF RENEWABLE ENERGY

Renewable energy harnesses naturally occurring non-depletable sources of energy, such as solar, wind, biomass, hydro, tidal, wave, ocean current and geothermal, to produce electricity, gaseous and liquid fuels, heat or a combination of these energy types.

Solar energy can be used to generate electricity; heat water; and to heat, cool and light buildings. For example, photovoltaic systems capture the energy in sunlight and convert it directly into electricity. Alternatively, sunlight can be collected and focused with mirrors to create a high intensity heat source that can be used to generate electricity by means of a steam turbine or heat engine.

Wind energy uses the naturally occurring energy of the wind either directly as in windmills or to generate electricity, and can be used, for example, to charge batteries or pump water.

Large modern wind turbines operate together in 'wind farms' to produce electricity for utilities. Small turbines are used to meet localised energy needs.

Biomass energy (from organic matter) can be used to provide heat, make liquid fuels, gas and to generate electricity. Fuelwood is the largest source of biomass energy, generally derived from trees. However, fuelwood is used unsustainably when new trees are not planted to replace ones that are used. Fuelwood derived in this way cannot be properly defined as renewable**.** Other types of biomass include plants, residues from agriculture or forestry, and organic components in municipal and industrial wastes. Landfill gas is considered to be a biomass source.

Bio-fuels in liquid form can be produced from the conversion of biomass and used, for example, for transportation. The two most common bio-fuels are ethanol and bio-diesel. Fermenting any biomass that is rich in carbohydrate, such as maize, makes ethanol. Bio-diesel is made using vegetable oils, animal fats and algae.

Hydropower uses the movement of water under gravitational force to drive turbines to generate electricity.

Wave power, tidal power and ocean currents can be used to drive turbines to generate electricity. Technologies to harness these forms of power are presently being developed to the stage of commercialisation.

Geothermal *activity* in the earth's crust derives from the hot core of the earth. Examples are the natural geysers and hot water sources employed for power generation and space heating or using deep hot dry rock as heat exchangers by pumping water through the natural rock fissures to produce steam for power generation.

1.3 PURPOSE OF THE POLICY

The purpose of this White Paper is to set out Government's principles, goals and objectives for renewable energy. It furthermore commits Government to a number of enabling actions to ensure that renewable energy becomes a significant part of its energy portfolio over the next ten years.

Government intends to strategically develop the renewable energy resources in the future in a systematic way. The challenge for the Government will be to provide sufficient incentive for the renewable energy-based industries to develop, grow and to be sustainable in the long-term. South Africa's fiscal resources are however limited. The limited financial resources available for the renewable energy programme will be optimally used with a specific emphasis on ensuring that the global climate change resources and other financial resource are accessed to facilitate its implementation.

South Africa will continue to benefit from the innovativeness of its people in industry and academia to meet the challenge of providing renewable energy alternatives that can initiate the renewable energy programme without the requirement of exorbitant subsidy demands. It is the aim of the Government to set proper boundaries within which the renewable energy

industry can operate and grow, thus contributing positively to the South African economy and to the global environment. This will include changing the basic framework of how energy is produced, sold, traded, transferred and bought. The long-term goal is the establishment of a sustainable renewable energy industry with an equitable BEE share and job market that will offer in future years a fully sustainable, non-subsidised alternative to fossil fuel dependence.

1.4 DEVELOPMENT PROCESS

With an increasing demand in energy predicted and growing environmental concerns about fossil fuel based energy systems, the development of large-scale renewable energy supply schemes is strategically important for increasing the diversity of domestic energy supplies and avoiding energy imports while minimising the environmental impacts. Consequently, the Department of Minerals and Energy has been engaged for a number of years in a process for the development of a renewable energy policy, whose need and urgency has been underlined by the WSSD. Various studies have been undertaken and discussions, meetings and workshops have been held with a wide range of stakeholders to discuss the development of a renewable energy policy.

2. STATEMENT OF THE PROBLEM

Coal based economy
South Africa currently relies almost completely on fossil fuels as a primary energy source (approximately 90%), with coal providing 75% of the fossil fuel based energy supply (DME, 1999). Furthermore, of the total amount of electricity generated in 1999, 91% was derived from coal (NER, 2000). Coal combustion in South Africa is the main contributor to carbon dioxide emissions, which is the main greenhouse gas that has been linked to climate change. Indeed, South Africa has one of the highest levels of carbon dioxide emissions per capita in the World (see Figure 2). This reliance on fossil fuels to meet energy requirements is recognised, but as concerns about global climate change grow, South Africa also needs to be a responsible global neighbour. South Africa is a major exporter of coal. Therefore emission constraints could have a significant impact on the South African economy and trade. Thus, alternative means of producing energy such as renewable energy sources, which have less impact on the environment compared to fossil fuels have to be considered.

Fuelwood
Secondly, although presently 9% of SA's energy mix is renewable energy, largely in the form of fuelwood, this is harvested in an unsustainable manner. In time the rural poor will run out of fuelwood unless something is done. Since many of the communities reliant on fuelwood are remote from the electricity grid, a package of energy services (e.g. paraffin, LPG and renewable energy alternatives such as hybrid mini-grid systems, gel fuel, solar cookers and solar water heaters) have to be employed. Such modern energy systems will not only provide better, cleaner and healthier energy services, they will also help to save the remaining woodlands.
The advantage of this approach is that not only are the basic services (e.g. lighting, cooking) provided but also sufficient power (e.g. hybrid mini-grid) to activate and enhance the economic and job creation potential of the community.

New Electricity Generation Capacity (DME, 2003)

Current peak electricity demand is approximately 31 500 MWe (July 2002), and national installed capacity is approximately 37 000 MWe. Assuming a 10% reserve margin, South Africa will be short of capacity by 2005-2007, unless demand side management occurs or new plant is built (see Figure 2). Assuming the 10% reserve margin on a gross capacity of 37 000 MWe, the current net capacity is 33 300 MWe, which is only 1 800 MWe (that is the size of Koeberg) above the peak demand. Given the time to commission a new plant, the current electricity generation system could soon be viewed as vulnerable. A renewable energy power plant has a lead time of approximately 3 years as compared to conventional coal fired plant that has a lead time of approximately 5 years (EIA, 2001). Distributed generation, (many small units) would have the shortest lead time.

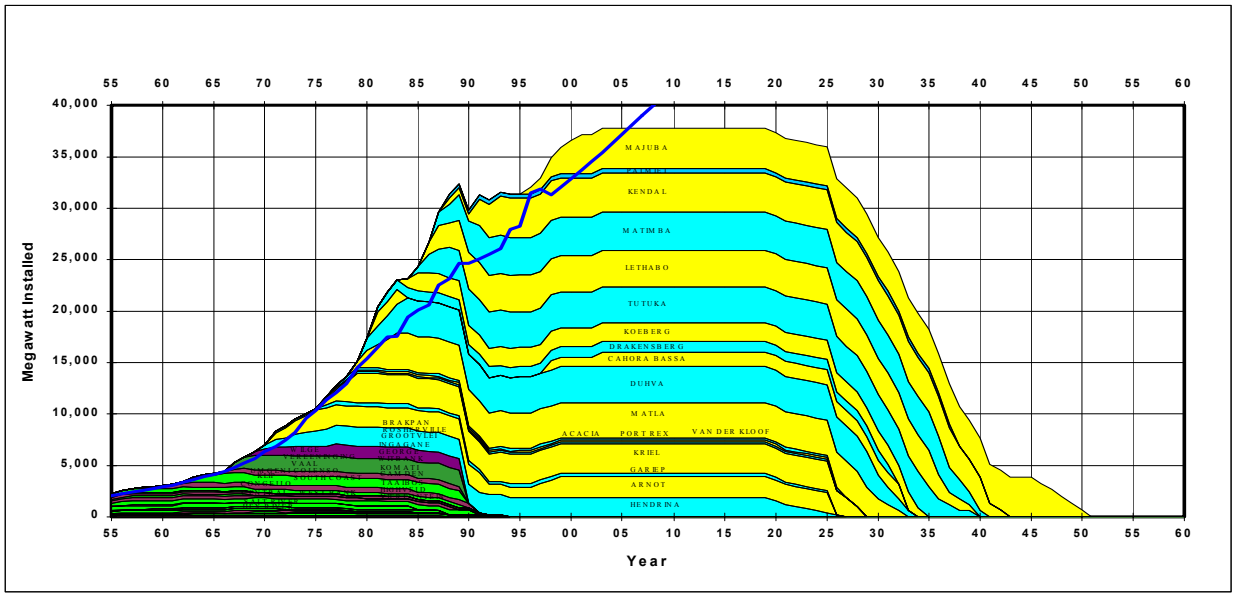


Figure 1: Eskom electricity generation capacity as a function of time - the solid line indicates actual and projected demand (DME, 2003)

New electricity generation capacity will have to include "cleaner" technologies as power plants last 40 years or more - long after South Africa may be required to take on commitments related to GHG emissions. Hence, it is the intention of the Government to strategically develop its energy resources in order to address the issue of diminishing resources, energy security and mounting environmental concern. This issue can be resolved by diversifying South Africa's energy sources.

Natural gas

Natural gas is generally considered to be a "cleaner fuel" as it produces lower GHGs in comparison with coal and oil.

The current euphoria (primarily on an environmental basis) regarding a potential shift to natural gas as a significant contributor to energy supply needs to be placed in the context of available local and regional gas reserves. The Integrated Energy Plan (DME, 2003) indicates that the energy content of the known gas reserves, (including those of Namibia and Mozambique), are 0.5% of the known coal reserves. Even if the gas reserves were 20 tcf (and

compared with coal reserves of 55 billion tonnes), then the gas reserves would amount to only 1.9% of coal reserves. .

Hence, it is manifest that under these circumstances gas is unlikely to form any major component of primary energy supply over any extended period when compared with coal. Other energy resources such as renewable energy, which South Africa has an abundance of, see (4.2), need to be promoted.

Renewable energy

Renewable energy will contribute to the diversification of energy resources through the implementation of a properly managed programme of action that will provide sufficient incentive for the sustainable development of the renewable energy-based industries.

Although renewable energy technologies often have higher investment costs, their operation and maintenance costs are generally lower than conventional fossil-based energy technologies. The result is that many renewable energy technologies are not cost-competitive compared with South Africa's fossil-based energy technologies. Recent years have seen some significant cost reductions (see Table 1) with some renewable energy technologies already competing with fossil based energy technologies in certain niche markets.

Table 1: International cost data for Renewable Energy Technologies (UNDP, 2000)

Technology for electricity generation	*Operating capacity, end 1998*	*Capacity factor*		*Turnkey investment costs*		*energy cost of new systems (2000)*		*Potential future energy cost*	
	GWe	*%*		*(US$ per kW)*		*US c/kWh*		*US c/kWh*	
		Low	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Biomass	40	25	80	900	3 000	5	15	4	10
Wind	10	20	30	1 100	1 700	5	13	3	10
Solar PV	0.5	8	20	5 000	10 000	25	125	5	25
Solar thermal	0.4	20	35	3 000	4 000	12	18	4	10
Small hydro	23	20	70	1 200	3 000	4	10	3	10
Geothermal	8	45	90	800	3 000	2	10	1	8
Tidal	0.3	20	30	1 700	2 500	8	15	8	15

There are many reasons for this discrepancy in cost, including, the fact that the lower costs associated with fossil fuel use does not fully account for its adverse impact on the environment and society. Blignaut & King, 2002, stated that the environment and society are subsidising the coal combusting industries by, on average, an amount more than the private cost of coal. Thus, if the use of renewable energy is to be successfully implemented Government should create an enabling environment through the introduction of fiscal and financial support mechanisms within an appropriate legal and regulatory framework, to allow renewable energy technologies to compete with fossil-based technologies.

3. SETTING THE CONTEXT

The White Paper was developed in the context of both international and national driving forces. International developments around the United Nations Framework Convention on Climate Change, the world markets for renewables, South Africa's reintegration into the global economy and hosting of the WSSD, necessitated the development of a definitive policy on renewable energy. Government's overarching energy policy (DME, 1998) touched on renewable energy, which needed to be fully developed and articulated.

3.1 THE NATIONAL CONTEXT

3.1.1 The Constitution

The *Constitution* (Act No. 108 of 1996) provides the legal basis for allocating powers to different spheres of Government and contains a number of rights specifically relevant to the national energy policy. The *Constitution* states that Government must establish a national energy policy to ensure that national energy resources are adequately tapped and delivered to cater for the needs of the nation. Energy should be made available and affordable to all citizens, irrespective of geographic location. The production and distribution of energy should be sustainable and lead to an improvement in the standard of living of citizens.

The *Bill of Rights* provides that:

> "*Everyone has the right*
> *(a) to an environment that is not harmful to their health or well-being; and*
> *(b) to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that -*
> *(i) prevent pollution and ecological degradation;*
> *(ii) promote conservation; and*
> *(iii) secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development."*

Chapter 2, Bill of Rights of the Constitution further states: "*The State must respect, protect, promote and fulfil the rights in the Bill of Rights".*

In order to meet the Government's obligations in this regard, the *White Paper on Energy Policy* states that:

> *Government will work towards the establishment and acceptance of broad targets for the reduction of energy related emissions that are harmful to the environment and to human health.*

3.1.2 White Paper on the Energy Policy of the Republic of South Africa

The *White Paper on Energy Policy* (DME, 1998) sets out Government's policy with regard to the supply and consumption of energy for the next decade. The policy strengthens existing energy systems in certain areas, calls for the development of underdeveloped systems and demonstrates a resolve to bring about extensive change in a number of areas. The policy addresses all elements of the energy sector.

Given increased opportunities for energy trade, particularly within the Southern African region, Government will pursue energy security by encouraging diversity of both supply sources and primary energy carriers (DME, 1998)

The *White Paper on Energy Policy* states that the electricity sector reform will be based on introducing competition into the industry by restructuring Eskom generation into separate generation and transmission companies.

The policy recognises that South Africa has neglected the development and implementation of renewable energy applications. However, the significant medium and long-term potential of renewable energy is recognised. Government policy on renewable energy is concerned with meeting the following challenges:

- Ensuring that economically feasible technologies and applications are implemented through the development and implementation of an appropriate programme of action.
- Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options.
- Addressing constraints on the development of the renewable energy industry.

3.1.3 Reconstruction and Development Programme

Since 1994, social and economic policies have largely been informed by two strategies: the *White Paper on Reconstruction and Development* (1994), and its programme "for integrated and coherent socio-economic progress" (*White Paper on Reconstruction and Development* p71), and the macro-economic strategy - *Growth, Employment and Redistribution* (GEAR). The main energy emphasis in the *White Paper on Reconstruction and Development* was the electrification of 2.5 million households by 2000.

The five programmes of the Reconstruction and Development Programme (RDP) - meeting basic needs, developing human resources, building the economy, democratising the state and society, and implementing the RDP, are to a large extent echoed in the five overarching policy goals set out in the *White Paper on the Energy Policy*.

Other policy documents, such as the *Rural Development Strategy of the Government of National Unity* (1995) detailed the challenges facing rural people with regard to access to energy supply and the need for co-ordination of rural development.

3.1.4 Growth, Employment and Redistribution Macroeconomic Strategy

The Growth, Employment and Redistribution Strategy of 1996 placed its emphasis on two core strategies:

- Promoting growth through exports and investment; and
- Promoting redistribution by creating jobs and reallocating resources through the budget.

The energy sector contributes towards economic growth, trade, investment and employment creation, as well as providing infrastructure for households.

In addition, there has been an increased emphasis in recent years towards a liberalisation of the energy sector. This includes a programme of restructuring and rationalisation of state-owned enterprises. This has implications in a number of energy markets, in particular for the electricity sector.

3.1.5 The Integrated Sustainable Rural Development Strategy (ISRDS)

The Integrated Sustainable Rural Development Strategy (ISRDS 2000) was "designed to realise a vision that will attain socially cohesive and stable rural communities with viable institutions, sustainable economies and universal access to amenities, able to attract and retain skilled and knowledgeable people, who are equipped to contribute to growth and development".

A strategic objective of the ISRDS is "to ensure that by the year 2010 the rural areas would attain the internal capacity to integrated and sustainable development" (ISRDS, 2000). Key aspects facilitating this objective are decentralised Government, capacity building at the local level and significant transfers from central Government to provide incentives for efficient local Government.

While the contribution of the energy sector is to provide basic energy services to rural areas, in particular extending access to electricity including non-grid electrification and mini-grids, as well as improving access to other fuels and appliances, the effort should also be viewed as an opportunity to create an economic base via agricultural and home-based industries and SMMEs in order to grow the income-generating potential of communities. Such energy activities should be co-ordinated with the Integrated Development Plans of Municipalities.

3.1.6 Legal Context

At present legislation covers the areas of electricity and liquid fuels. The *White Paper on Energy Policy* encourages the entry of multiple players into the power generation market.

Through the *Electricity Act* (Act no 41 of 1987) the National Electricity Regulator (NER) has jurisdiction over the entire industry and regulates market access through licensing of all producers (greater than 5 giga watt hours per annum), transmitters, distributors and sellers of electricity. All electricity tariffs have to be approved by the NER that also regulates quality of supply and mediates disputes and customer complaints. A regulatory framework is being prepared to govern the approach to renewable energy implementation.

The liquid fuels industry is governed by generally applicable legislation such as the *Competition Act* (Act no 89 of 1998). Price control is affected by the Minister of Minerals and Energy in terms of the *Petroleum Products Act* (Act 120 of 1977). In terms of the *Petroleum Products Act Amendment Bill (of 2002)*, certain transitional measures are introduced to ensure an orderly process of managed liberalization. The Minister of Minerals and Energy will remain the liquid fuels industry regulator and may prescribe the price at which any petroleum product may be sold or bought, method of trading, publishing of prices and quantities of crude oil or petroleum products to be maintained by any person. The Minister shall furthermore appoint a person in the public service as Controller of Petroleum Products who shall issue licenses in terms of the Act and in issuing such licenses.

The *Central Energy Fund Act* (Act 38 of 1977) is enabling legislation in terms of which, *inter alia*, levies may be imposed on liquid fuels products for collection into of the Central Energy Fund and or the Equalisation Fund. These funds can be employed for dedicated energy purposes in a manner prescribed by the Act.

In order to develop the piped gas industry and regulatory framework for the development of a competitive gas industry through granting of licenses for the transmission, storage, distribution and trading of piped gas and matters connected therewith the *Gas Act* (Act 48 of 2001) was promulgated.

The high initial costs for renewable energy necessitates the establishment of funding mechanisms to promote their implementation. The Central Energy Fund has historically been focussed on the management of crude oil and locally produced hydrocarbons. However, increasing the use of renewable energy, biomass derived liquid fuels and energy sources such as bio-diesel, ethanol and landfill gas have been identified as one of its key focus areas in future. Mechanisms, such as the Central Energy Fund and Equalisation Fund, could be harnessed to extend the operational support available to renewable energy programmes. The *Gas Act* and the proposed amendment to the *Petroleum Products Act* will provide a basis for the integration of renewable energy derived liquid fuels and landfill gas into the petroleum and gas industry regulatory framework. Government has already stated that it will incentivise the production of bio-fuels produced from biomass in the form of a 30% reduction in the Fuel Levy (tax) on such fuels (Budget Speech Minister of Finance, February 2002). Government could take the lead by setting supply and demand targets e.g. a percentage of Government (national and provincial) and Government related financial institutions, agencies projects budget invested in renewable energy programmes and a target set for a percentage of renewable energy demand by Government (national and provincial) and related institutions and agencies.

A proposed Energy Bill (Energy Bill, 2003) will allow the Minister to make renewable energy regulations regarding:
”minimum contributions to the national energy supply from renewable energy resources, and may in regard thereto specify renewable energy technologies". This may create a market demand for renewable energy which will speed up the commercialisation of renewable energy technologies with less government assistance.

3.1.7 Barriers to Renewable Energy Implementation

There are significant barriers to the further implementation of renewable energy that need to be addressed. The key issues include the following:

- Many renewable energy technologies remain expensive, on account of higher capital costs, compared to conventional energy supplies for bulk energy supply to urban areas or major industries.
- Implementation of renewable energy technologies needs significant initial investment and may need support for relatively long periods before reaching profitability.
- There is a lack of consumer awareness on benefits and opportunities of renewable energy.
- The economic and social system of energy services is based on centralised development around conventional sources of energy, specifically electricity generation, gas supplies and, to some extent, liquid fuel provision.
- Financial, legal, regulatory and organisational barriers need to be overcome in order to implement renewable energy technologies and develop markets.
- There is a lack of non-discriminatory open access to key energy infrastructure such as the national electricity grid, certain liquid fuels and gas infrastructure.

- Market power of utilities

3.2 THE INTERNATIONAL CONTEXT

3.2.1 Climate Change

The Intergovernmental Negotiating Committee for a Framework Convention on Climate Change was established in 1990. This Committee drafted the United Nations Framework Convention on Climate Change (UNFCCC), which was opened for signature in June 1992 at the Rio de Janeiro Earth Summit. The fundamental objective of the UNFCCC is to achieve stabilisation of the concentrations of GHG in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. South Africa ratified the UNFCCC in 1997, which enables South Africa to apply for financial assistance for climate change related activities from the Global Environmental Facility (GEF).

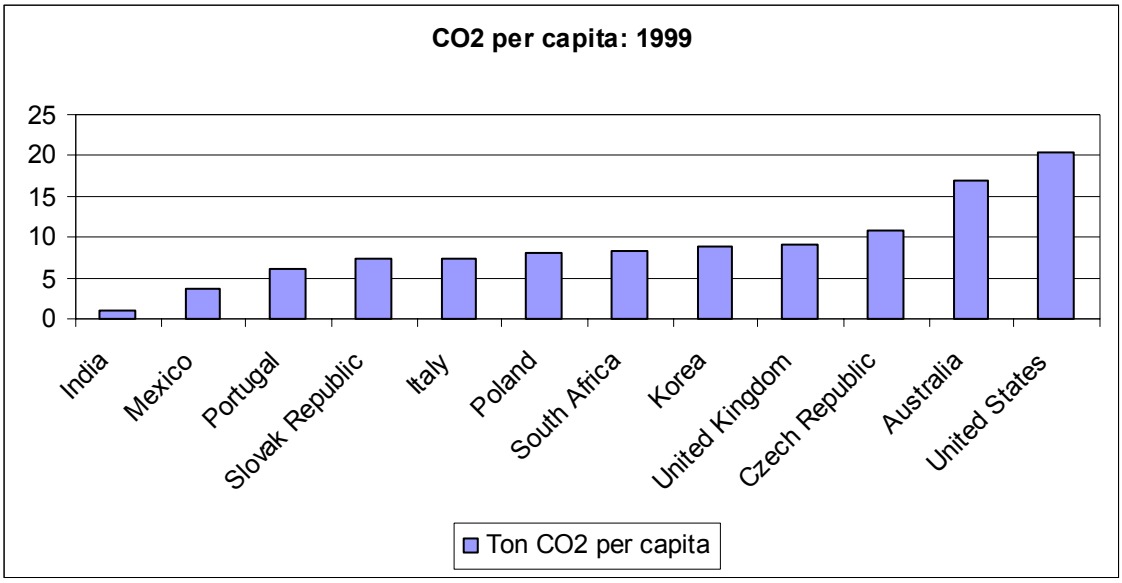
The Kyoto Protocol was introduced in 1997 at the third Conference of Parties. The conference resulted in a consensus decision to adopt a Protocol under which industrialised countries (Annex 1 countries) will reduce their combined greenhouse gas emissions by at least 5% compared to 1990 levels by the period 2008 to 2012.

The Protocol will come into force after it has been ratified by least 55 parties to the UNFCCC, including Annex 1 parties accounting for at least 55% of the total 1990 carbon dioxide emissions in this industrialised group.

South Africa acceded to the Kyoto Protocol in March 2002. The Kyoto Protocol does not commit the non-Annex 1 (developing) countries, like South Africa, to any quantified emission targets in the first commitment period (2008 to 2012). However, there is potential for low cost emission reduction options in these countries. The Clean Development Mechanism provides for the certified emission reductions between non-Annex 1 countries and Annex 1 countries. The mechanism is specifically defined to support sustainable development with respect to greenhouse gas emissions in developing countries while helping Annex 1 countries to comply with their commitments under the Kyoto Protocol. The Annex 1 countries may use the certified emission reductions accruing from such project activities to contribute to compliance with part of their emission reduction commitments.

South Africa is by far the largest emitter of GHGs in Africa and one of the most carbon emission-intensive countries in the world as shown in figure 2, due to the energy intensive economy and high dependence on coal for primary energy.

Figure 2: Carbon Dioxide Emissions per capita (IEA, 2001)



3.2.2 World Markets for Renewables

Renewable sources of energy are estimated to meet between 15 and 20% of current final world energy consumption, predominantly from hydro-electricity, fuelwood, biomass and geothermal (UK DTI, 1999). Scenario analyses by Shell, which assume pressure towards sustainability, show renewables meeting around 40% of world energy needs by the middle of the century (Shell, 2001). This prognosis is based on the reducing role for fossil fuels as they become scarcer, the need to contain fossil fuels use because of their emissions and the need to reduce their impact on climate change.

3.2.3 South Africa in the International Arena

South Africa faces the challenge of ensuring the availability of abundant easily sourced and competitively priced energy supplies. Energy security is now being achieved through the greater diversification and flexibility of supply and competition between energy carriers. The challenge facing Government is to create a policy framework with appropriate legal, fiscal and regulatory instruments that attract domestic and international investment, while ensuring that national policy objectives are achieved and at the same time resulting in an appropriate energy mix.

There is an international trend towards the generation of "clean" energy in response to the threat of climate change and to meet the commitments of the Kyoto Protocol. South African industry depends on modern energy carriers produced from coal, oil and gas. Although South Africa is not committed to a specific timeframe to reduce greenhouse gas emissions, it has a window of opportunity to utilise international funding for the penetration of renewable energy into South Africa's energy mix.

4. RENEWABLE ENERGY RESOURCES AND APPLICATIONS

4.1 RENEWABLE ENERGY POTENTIAL

Globally, the renewable energy industry is projected to grow rapidly over the next decade. The International Energy Agency estimates a 15-20% of total energy supply contribution from renewable energy by 2010 (UK, DTI, 1999), up from 10% in 1999 (IEA, 1999). This is due to renewable sources of energy having considerable potential for increasing security of supply by diversifying the energy supply portfolio and increasingly contributing towards a long-term sustainable energy future. In terms of environmental impact, renewable energy generation results in the emission of less greenhouse gases than fossil fuels, as well as fewer airborne particulates and other pollutants. Furthermore, renewable energy generation technologies save on water consumption in comparison with coal-fired power plants.

In South Africa renewable energy accounts for approximately 9% (1999) of total energy consumption (Energy Futures, 2000). Most of this energy is generated from fuelwood and dung and not modern renewable energy technologies. Less than 1% of the total electrical energy used in South Africa originates from renewable energy sources. One of the objectives of this White Paper is to promote biomass energy conservation through the use of more efficient renewable technologies such as solar cookers, improved woodstoves and ethanol gel stoves.

Renewable energy can be generated centrally and distributed for use near its point of production. Providing energy at (or near) the point of use reduces the infrastructure required for energy distribution and energy delivery losses, as well as increasing energy efficiency. Accelerated implementation of technologies in the private, commercial and industrial sector, such as passive solar design technologies and solar water heating systems, should also impact positively on energy demand-side management and thus defer the need for additional power plant capacity.

4.2 RENEWABLE ENERGY RESOURCE ASSESSMENT AND APPLICATION

4.2.1 Background

The mere availability of a renewable energy resource does not mean that that resource can readily be used as an energy source. To utilise a resource several factors need to be considered: the conversion system, quality of the fuel, conversion cost, transport cost as well as the size and location of the demand. This section provides a preliminary overview of South Africa's technical renewable energy resource potential and applications.

The South African Renewable Energy Resource Database (RRDB) is based on the analysis of a comprehensive data set, which covers the whole of South Africa (DME, Eskom, CSIR, 2001). National level data is useful in identifying potential resource types and localised densities or areas of highest probability, but to move from such broad assessments to the identification of potential large-scale utilisation of renewable energy resources requires a lot

more detailed and localised analysis. The RRDB database incorporates such focussed and detailed analysis of specific areas.

4.2.2 Wind

Estimates of wind power potential for South Africa were done by Diab (1995) who concluded that:

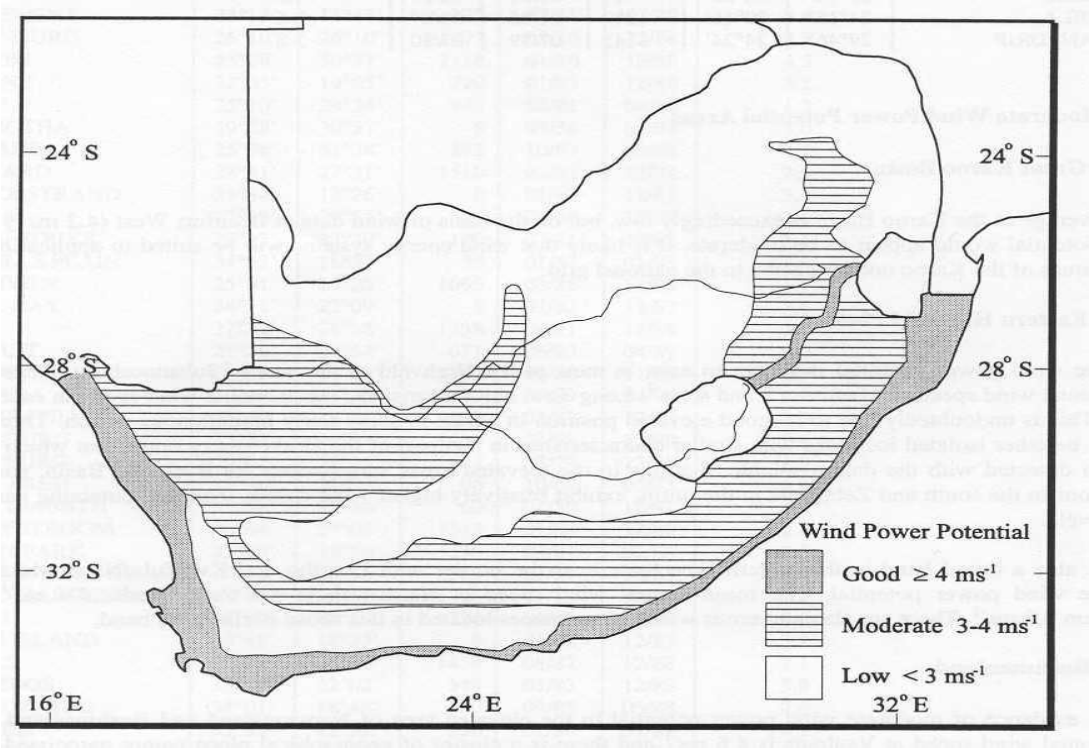
- Wind power potential is generally good along the entire coast with localised areas, such as the coastal promontories, where potential is very good, i.e., mean annual speeds are above 6 m/s and power exceeds 200 W/m^2;
- Moderate wind power potential areas include the Eastern Highveld Plateau, Bushmanland, the Drakensberg foothills in the Eastern Cape and KwaZulu-Natal; and
- Areas with low wind power potential include the folded mountain belt (vast region of very complex and diverse terrain), the Western and Southern Highveld Plateau, the Bushveld basin, the Lowveld, the Northern Plateau, the Limpopo basin, Kalahari basin, the Cape Middleveld and the KwaZulu-Natal interior.

The upper limit of wind energy available to be captured in South Africa is estimated at 3 GW (Diab, 1988). Taking a conservative estimate of 30% conversion efficiency and 25% capacity factor, it is estimated that wind power could supply at least 1% of South Africa's projected electricity requirements (198000 GWh) in 2002. This excludes the offshore wind energy potential which should also be assessed.

Applications

- Wind mills for water pumping are a well established application.
- Grid connected wind farms could supplement the electricity grid through distributed generation, rather than transporting the electricity over large distances with the associated costs and electricity losses. Large wind turbine systems would supplement the grid by providing generation capacity at coastal areas and working with water pumping schemes to "store" the energy which could provide supply at peak times. Careful placement of large wind farms minimises potential noise and visual pollution.
- Moderate wind regimes, for example the large sparsely populated areas of the Karoo and Northern Cape, can be economically exploited in stand-alone or hybrid electricity generation configurations with PV and/or diesel generator sets. A small local supply industry focusing on small stand-alone battery charging systems already exists in the country.

Figure 3: Generalised map of wind power potential in South Africa (Diab, 1995)



4.2.3 Biomass

The main sources of biomass are fuelwood in the rural domestic sector, bagasse in the sugar industry, and pulp and paper waste in the commercial forestry industry for in-house heat and electricity generation. In addition, there is considerable potential (without impacting on food production) for the production of bio-fuels from energy crops such as maize, sunflowers and the Jatropha tree.

The use of biomass as a fuel source for sustainable energy systems is growing internationally. Biomass resources are extensively used for energy production in countries that are dependent on imported fuels for power production. Electricity generated from bagasse contributes some 60% of Mauritius' electricity needs during the 9-month harvesting season (DME, DANCED, 2001).

Fuelwood is the main source of energy for most rural households. Demand exceeds supply in many areas of the country, resulting in environmental degradation caused by unsustainable harvesting practices and past clearance of land for residential and agricultural purposes. Targeted intervention in these areas to manage woodlands for the benefit of rural households is recognised in the *White Paper on Energy Policy*. The Department of Water Affairs and Forestry is responsible for community forestry and is currently preparing a strategy on managing wood supply in the rural areas.

According to DWAF (DWAF, 2003) the key biomass resources that play a role in terms of renewable energy are invasive aliens (e.g. exotic acacia species like black wattle and Port Jackson), commercial plantations and the wood industry, woodlots, trees in the urban environment, woodlands and indigenous forests and trees cultivated as fuel crops.

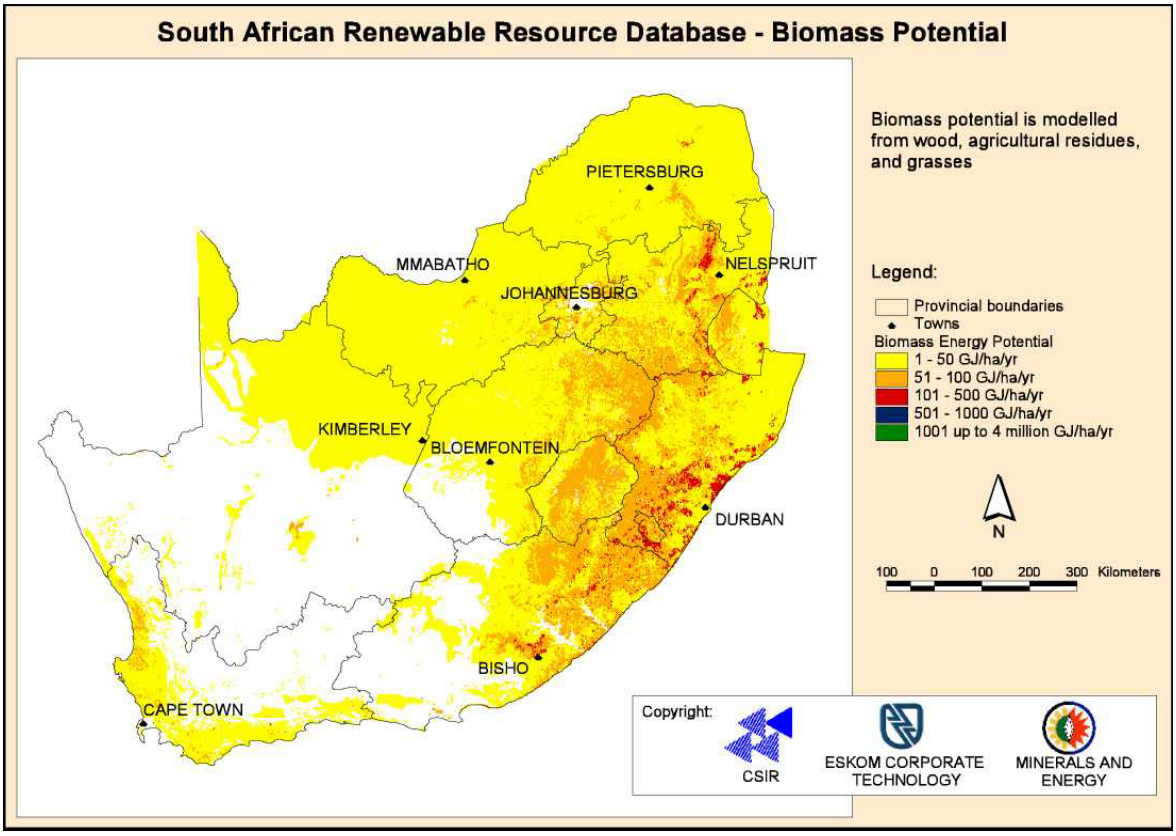


Figure 4: Total biomass energy potential for South Africa (DME, Eskom, CSIR, 2001)

In Figure 4 the total potential biomass energy in South Africa is represented as modelled by the Renewable Resource Database (RRDB). Of particular note are the high energy densities found around the sugar, wood and pulp mills. It is at these mills where the potential lies for Independent Power Producers (IPPs).

Bagasse

Bagasse is the residue that remains after sugar cane has been processed in mills for sugar production. The principal sugar cane growing areas are the KwaZulu-Natal coastlands and the Mpumalanga lowveld. In 1998 there were 400 000 ha under cane with an average yield of 52.5 tons/ha. Therefore some 21 million tons of sugar cane was delivered to the various sugar mills, which produced some 7 million tons of bagasse with a net calorific value of 6.8 GJ/ton and a total energy content of 47.6 million GJ (Wienese, 1999).

With the sugar mills currently generating a significant amount of power for own use and even limited export, bagasse offers some of the best potential for IPP in South Africa using renewable resources. Wienese (1999) estimates that the current production of energy of some 30 kWh/ton can be increased by up to 120 kWh/ton using conventional steam plants running at higher pressures. Using integrated combined cycle combustion technologies the yield per ton of bagasse can be increased up to 200 kWh/ton. Purely through increased efficiency and new technologies the potential of this resource can be increased from the current 210 GWh to 1 400 GWh per annum.

Fuelwood
The RRDB identified the following fuelwood biomass resources:

- Commercial plantations,
- Indigenous woodlands,
- Alien vegetation,
- Deciduous fruit tree off cuts from pruning,
- Sawmills (primary processing) mostly woodchips, sawdust and bark,
- Pulp mills: boiler ash, sludge, sawdust and black liquor.

The viability of wood as an energy source suitable for electricity generation lies within the wood, pulp and paper industries. In these industries there is already some heat and power generation taking place and there is potential for upgrading and expansion. The sector consists of two main components: the production of timber and the production of wood pulp for paper and board manufacturing.

Table 2 below gives the result of the RRDB modelling of the wood and pulp industries energy potential based on availability and energy content of fuels.

Table 2: Annual Fuelwood and Pulp Energy Potential (DME, Eskom, CSIR, 2001)

Type	Tonnage (T/Year)	Energy potential (GWh/year)
Sawmills	1.57 million	7 639
Pulp mills	1 million	4 528

Energy crops and agricultural residues
Energy crops and agricultural residues from the major annual and biennial crops are:

- Maize husks, stalks and leaves,
- Wheat, straw,
- Sunflowers heads, stalks and leaves,
- Sugarcane leaves and topping (excluding bagasse),
- Sorghum heads, stalks and leaves.

These crops constitute more than 98% of annual production in South Africa (DME, Eskom, CSIR, 2001). The RRDB modelling of the energy potential of these crops was based on expected yield per area cultivated and the energy range of the crop residues. The residue amounts per area varied between 0.2 –10 ton/hectare/year with an annual total of 24.4 million tonnes/year. Energy values varied between 2 – 140 GJ/ha/year with sugarcane recording the highest values.

Grass
The potential energy from grass reached 84 GJ/ha/year in the most favourable areas along the low-lying areas of KwaZulu Natal, Mpumalanga and the Eastern Cape (DME, Eskom, CSIR, 1999). By comparison in the savannah regions the yield was negligible.

Manure and Litter

The potential exists to utilise the manure and litter from livestock to generate methane gas through anaerobic fermentation in biogas plants. Most cattle farms in South Africa are free range and the poultry and pig farms have large amounts of manure available on site. An assessment is required to see if the litter and manure from these farms can be used in biogas generators or burned in incinerators on a scale that would warrant classification as an IPP.

In Table 3 only the manure and litter available at a single point such as for feedlot cattle of chicken broilers were included.

Table 3: Potential energy from livestock manure and litter (Stassen, 1996)

Type	Energy Production (GWh/year)
Cattle	3 889
Pigs	306
Poultry	1 417

Applications

Heat and electricity generation: Co-generation of electricity in the industrial sector from biomass in the bagasse and pulp and paper industries is currently taking place but this is used on-site and not exported to the national electricity grid because of the low price of electricity generated from coal and the lack of clarity of the rules applicable to IPPs.

In many of South Africa's neighbouring states charcoal is used extensively as a domestic fuel. In South Africa however charcoal is currently used mainly in the recreation, catering and metallurgical industry, leaving scope for its further exploitation.

Bio-fuels: Various crops can be fermented to produce ethanol (ethanol gel fuel) and sunflower seeds and Jatropha tree nuts crushed and processed to yield bio-diesel. South Africa is dependent on importing crude oil for its liquid fuels requirements. Considerable scope therefore exists to supplement imported petroleum with bio-fuels with their job-creation spin-offs.

Biomass production for energy should not compete and or conflict with food production.

4.2.4 Hydro

A popular perception that the potential for hydropower in South Africa is very low, is often overstated. It has been shown in an assessment conducted by the DME (2002), the "Baseline Study on Hydropower in South Africa" (CaBEERE, 2002) that there exists a significant potential for development of all categories of hydropower in the short- and medium-term in specific areas of the country. Figure 5 shows all areas with hydro potential in South Africa. For example, the Eastern Cape and KwaZulu-Natal provinces are endowed with the best potential for the development of small, i.e. less than 10MW, hydropower plants. The

advantages and attractiveness of these small hydropower plants is that they can either be stand-alone or in a hybrid combination with other renewable energy sources. Further, advantage can be derived from association with other uses of water (e.g. water supply, irrigation, flood control, etc), which are critical to the future economic and socio-economic development of South Africa.

Stephenson (CaBEERE, 2002) identified the Eastern Cape province (particularly the area of the former Transkei) as potentially the most productive areas for macro hydro-electric development in South Africa. Clackson (2002) investigated potential in the Lower Orange river for hydropower plants in series or tandem. It is envisaged that some 12 hydro-electric plants can be installed in series, each site having a potential output of between 6 MW and 25 MW. Table 4 shows the potential of hydropower in South Africa.

Figure 5: Areas with micro hydro potential in South Africa (DME, Eskom, CSIR, 2001)

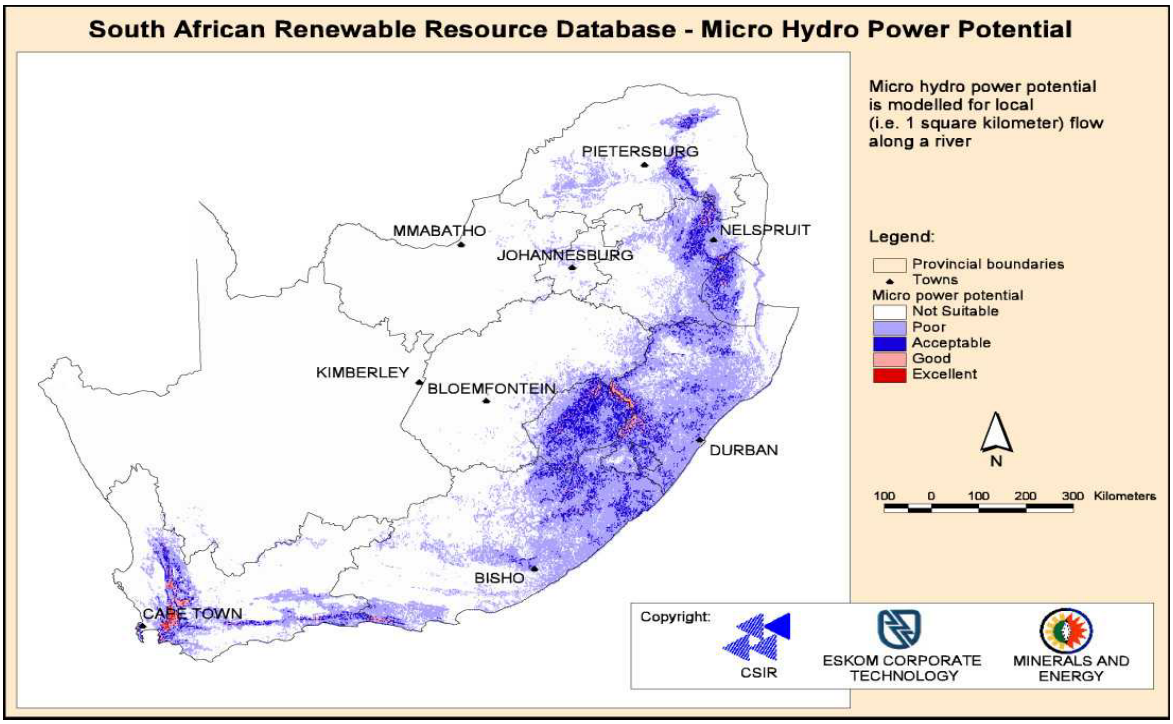


Table 4: Total for macro and small hydropower in SA (excluding pump storage) CaBEERE, 2002)

Hydropower category and size (MW, kW)	Hydropower type	Installed capacity (MW)	Potential for development	
			Firmly Established (MW)	Additional Long-term (MW)
Pico (up to 20 kW)	Conventional	0,02	0,1	0,2
	Unconventional	-	-	60,0
Micro (20 kW to 100 kW)	Conventional	0,1	0,4	0,5
	Unconventional	-	-	3,3
Mini (100 kW to 1 MW)	Conventional	8,1	5,5	3
	Unconventional	-	-	2
Small (1 MW to 10 MW)	Conventional	25,7	27	20
	Transfers	-	25	5
	Refurbishment	-	11	-
Subtotal for small/mini/micro and pico hydropower in South Africa		**33,92**	**69**	**94**
Conventional macro hydropower (> 10 MW)	Diversion fed	-	3 700	1 500
	Storage regulated head	653	1 271	250
	Run-of-river	-	120	150
Total for macro and small hydropower in SA (excluding pump storage)		**687**	**5 160**	**1 994**

Applications

The Southern African Power Pool (SAPP) allows the free trading of electricity between SADC member countries, providing South Africa with access to the vast hydropower potential in the countries to the north, notably the significant potential in the Congo River (Inga Falls). At the same time the countries to the north could benefit through access to the coal fired power resources in the south. Such an arrangement should stabilise the energy requirements of the region as a whole well into this century.

Exploitation of the vast hydropower resources will constitute a significant infusion of renewable energy resources into the energy economy of the Region over the medium to long term. The Lesotho Highland Water Scheme has the capacity to contribute some 72 MW of hydroelectric power to the system already in the short term. Global pressures regarding the environmental impact and displacement of settlements by huge storage dams will likely limit the exploitation of hydropower on a large scale.

Small-scale hydro generators (<10 MW) could be used as a stand-alone or in combination with other renewable energy and conventional technologies (hybrid systems) for power generation.

Irrespective of the size of installation, any hydropower development will require authorisation in terms of the National Water Act (DWAF, 2003).

4.2.5 Solar

South Africa experiences some of the highest levels of solar radiation in the World. The average daily solar radiation in South Africa varies between 4.5 and 6.5 kWh/m^2 (16 and 23 MJ/m^2) (Stassen, 1996), compared to about 3.6 kWh/m^2 for parts of the United States and about 2.5 kWh/m^2 for Europe and the United Kingdom. Figure 6 below shows the annual solar radiation (direct and diffuse) for South Africa, which reveals considerable solar resource potential for solar water heating applications, solar photovoltaic and solar thermal power generation.

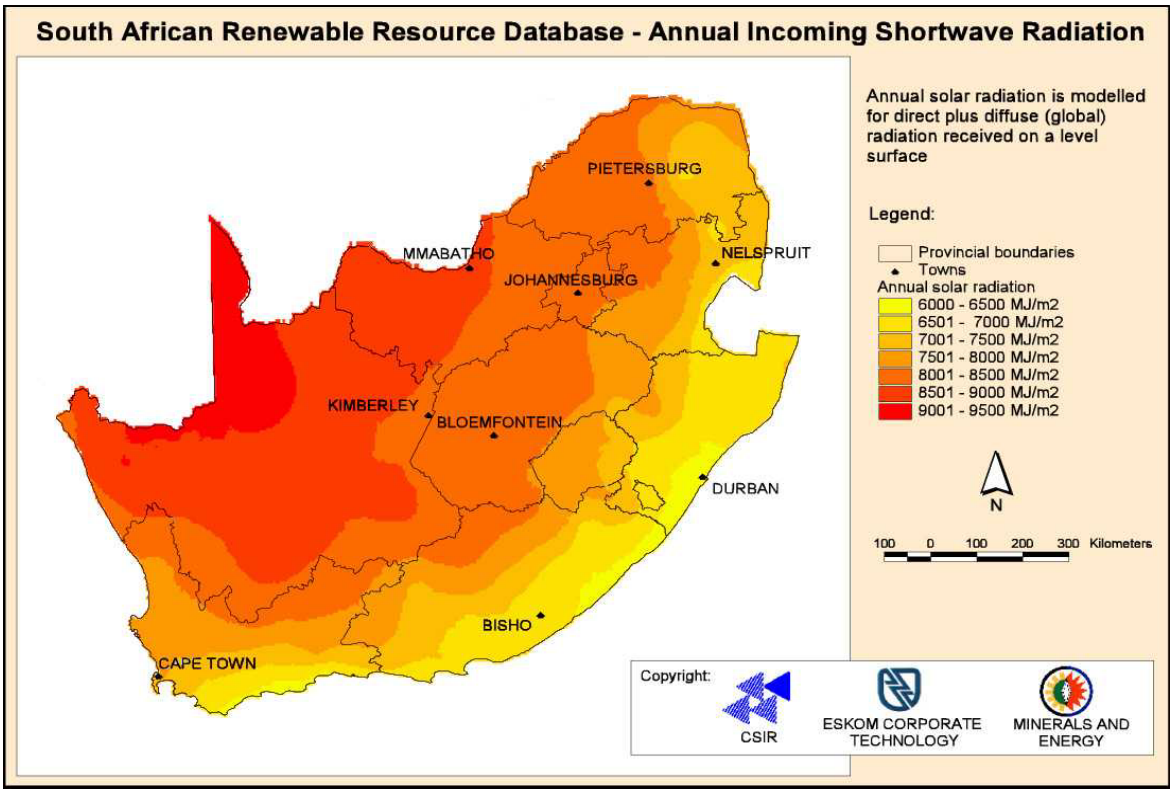


Figure 6: Annual direct and diffuse solar radiation (DME, Eskom, CSIR, 2001)

Applications

The potential uses and applications include:

- Solar passive building design practice for residential, commercial and industrial buildings to minimise thermal energy consumed. This includes the energy that is consumed by the occupants, as well as that which is embedded in the construction of the building.
- Solar water heating for domestic, recreational, institutional and industrial use.
- Solar space heating - closely related to solar passive and active building design practice and can also include solar water heating technologies.
- Solar cookers as an alternative to cooking with fuelwood in the rural areas.
- Agricultural use (e.g. crop drying, greenhouses), especially for small-scale farming.
- For electricity (photovoltaic and solar thermal) generation, ranging from small to medium-scale stand-alone applications to large-scale grid-connected applications.
- Heat pumps for water heating, space heating and cooling.

Potential for specific applications

Photovoltaic: Photovoltaic (PV) systems are widely applied for powering conventional and cellular telecommunications networks in South Africa. They are also applied in small-scale remote stand-alone power supplies for domestic use, game farms, household and community water pumping schemes. Installed PV has solar to electric efficiencies in excess of 8% and typical load factor of 22%. The installed PV capacity is estimated at just over 8 MW_p (2000).

Solar Thermal: The minimum Direct Normal Radiation (DNR) to justify a combined solar thermal power plant is 1800 kWh/m^2 per year (van Heerden, 2002). According to the RRDB, the area exceeding the minimum required DNR in South Africa covers approximately 194 000 km^2. A 100 MW solar thermal plant requires roughly 3 km^2 (1800 kWh/m^2 per year). If 1% (1 940 km^2) of the identified area is available for solar thermal power generation: South Africa has an installed potential of 64.6 GW which is about 36 217 GWh/year or 3 Mtoe/year (16% solar to electric efficiency, 40% capacity factor).

Back-up and energy storage constraints are limiting the wider economical utilisation of solar electricity generation (solar thermal and photovoltaic).

Solar Water Heating: Domestic solar water heating is currently about 1.3% of the solar energy market. Residential consumption of electricity in 2000 amounts to about 32 846 GWh (2.83 Mtoe). Assuming that some 30% of total domestic electricity consumption is used for water heating and that 60% of this electricity can be replaced by solar energy by using a hybrid solar-electric water heating system, then the potential savings for urban residential households come to 5 900 GWh (0.508 Mtoe) (Fecher et al, 2003). This is about 18% of urban residential consumption which is equivalent to a large coal-fired power station (900 MW). There is thus considerable scope to increase the application of solar water heating, which would contribute favourably to electricity demand-side management and deferral of new generation capacity. An increasing market for solar water heating would result in a growth in the relevant manufacturing industry and increased employment opportunities.

4.2.6 Wave Energy

Wave potential along the Cape coastline is estimated as significant, but no exploitation is taking place to date. A mean annual power level of about 40 kW/m wave crest is typical offshore at the Cape Peninsula. An estimated total average power of 56 800 MW is available along the entire coast. However, it is doubtful whether any of this potential energy could be realised on a large scale in the medium-term due to cost considerations (DME, DANCED, 2001). Wave technology is still at an early stage of development. Many-small-scale experimental devices are being tested and several prototype devices are now producing electricity for consumption (Cavanagh *et al*, 1993).

4.2.7 Ocean Currents

Preliminary investigation has revealed considerable potential in the Agulhas Current, one of the strongest currents in the World. The current originates in the Indian Ocean and passes down South Africa's eastern seaboard. It is about 150 km wide and flows at 6 metres/sec, and is estimated to be able to produce some 2 000 MW. At present the technology that employs turbines for electricity production in marine environments is being utilised in several pilot sites across the World. The advantages of ocean currents are that, since water is a dense medium, turbines can be small, flow is predictable, and forecasting is easier. Further assessments are required to establish whether the Agulhas Current is a suitable candidate for this technology, but if so, it could be regarded as a long-term prospect.

4.2.8 Energy from Waste

South Africa disposes of almost all of its refuse to landfill sites. The energy content of the total domestic and industrial refuse disposed of in 1990 amounted to 40.5 PJ per annum. The most feasible area for incineration of refuse from large municipalities would be the Reef area

of Gauteng where it is estimated that approximately 17 PJ could be produced annually. The net realisable energy available from sewage-derived methane in South Africa would be in the order of 36 MWh (1.13 PJ) per annum for electricity generation and 96 MWh (3.0 PJ) for heating purposes (DME, DANCED, 2001). Options for energy production from municipal waste are being examined including biogas projects as well as methane gas from landfills.

4.2.9 Summary of Renewable Energy options for South Africa

Certain renewable energy technologies such as solar water heating and photovoltaics are well developed and are generally readily available. The challenge for South Africa is to identify those technologies that are most suitable for widespread application in South Africa.

Renewable energy power plants have a lead time of approximately 3 years as compared to conventional coal fired plant that has a lead time of approximately 5 years (EIA, 2001). Distributed generation, (many small units) would have the shortest lead time.

Table 5: Renewable Energy Power Plants

Type of plant	Physical characteristics	Economic characteristics (all descriptors are relative)	Role within system or typical running regime
Hydro electricity (pump storage)	Extremely flexible	High capital costs, high marginal costs	Rapid response in either direction and 'peak shaving'
Hydro electricity (+storage)	Flexible	High capital costs, low running costs	For base load and capacity following
Hydro electricity range (run-of-river)	Inflexible intermittent	High capital costs, low running costs	Base load, intermittent renewable generator. Wide of capacity factors
Wind	Inflexible intermittent	High capital costs, low running costs	Base load, intermittent renewable generator. Capacity factors 25-40%
Energy crops and biomass waste	Capable of flexible operation	High capital costs, medium running costs. Energy-from-waste	Base load, steady output renewable generator. Around 80%

		plants running regime dictated by need to deal with waste stream	capacity factor
Landfill gas	Limited flexibility	Low capital cost, medium running costs	Base load renewable generator- 95% capacity factor
Municipal solid waste	Flexible	High capital costs, low running costs. Energy-from-waste plants running regime dictated by need to deal with waste stream	Base load steady output capacity factor around 80%
Solar thermal	Flexible intermittent on backup fuel storage	High capital costs, medium running costs	Base load intermittent

Source: Hartnell, 2000

Note: Most studies confirm that an intermittent renewable energy contribution (e.g. wind, solar photovoltaic) up to 10-20% percent can easily be absorbed in electricity networks (UNDP, 2000)

Technologies that should be further developed and implemented in South Africa in the short-term to meet the proposed target of renew-able energy generation include the following: solar water heating, biomass (including bio-fuels), landfill gas, small-scale hydro, wind and solar electric technologies. In the long term renewable energy technologies should be used to harness substantial wave, tidal and ocean current resources. Fuel cells using hydrogen e.g. generated from renewable energy resources will also become commercially viable at some stage.

Research and Development into cost effective energy storage systems utilising renewable energy will be encouraged.

Local manufacture of renewable energy technologies will be promoted in order to limit the cost of imported equipment and to benefit from economies of scale, as well as creating employment opportunities.

Factors affecting the prospects for renewable energy implementation

The amount of renewable energy that is actually consumed within the next 10 years will be a function of:

- The regulatory framework with regard to electricity, liquid fuels and housing and building markets.
- The evolving electricity pricing structure.
- The incentives provided.
- The availability of supportive international finance – donor and private – as well as Government funds, to enable implementation.
- The fiscal treatment of renewable energy.
- The final operational structure of the power sector and the ease of accessing the national electricity grid and wheeling power to end-users.
- Detailed feasibility evaluation results for individual projects.
- Private investment in renewable energy.
- Public awareness, as well as the creation of a demand for green electricity in various sectors of the economy.
- The affordability of renewable energy technology.
- The market uptake of renewable energy technologies.
- Voluntary GHG mitigation measures
- Enforcement of the CDM

The growth of the renewable energy industry will deliver social, economic and environmental benefits to South Africa. Implementation of a renewable energy programme that meets international requirements will attract investment that would otherwise be lost to the country. In addition, novel approaches to energy provision, such as renewable energy, have the potential for increased industrial growth and employment opportunities by establishing industrial development that is more cost effective and competitive internationally. In addition, renewable energy technologies provide significant potential export market opportunities to the southern African region.

5. RENEWABLE ENERGY TARGET

In order to meet the long-term goal of a sustainable renewable energy industry, Government has set the following 10-year target for renewable energy:

> *10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1667 MW) of the estimated electricity demand (41539 MW) by 2013.*
>
> *This is equivalent to replacing two (2x 660 MW) units of Eskom's combined coal fired power stations.*

This is in addition to the estimated existing (in 2000) renewable energy contribution of 115,278 GWh/annum (mainly fuelwood and waste) (Hughes et al, 2000). More efficient conversion of wood and waste for power generation will contribute to the target.

6. POLICY PRINCIPLES

Policy principles are the fundamental premises that Government will use to apply, develop and test policy and subsequent actions, including decision-making, legislation, regulation and enforcement. The overarching principles of this White Paper are those of the Constitution and Bill of Rights, as well as those in the *White Paper on the Energy Policy* (DME, 1998).

The key policy principles for renewable energy are the following:

Full cost accounting: Pricing policies will be based on an assessment of the full economic, social and environmental costs and benefits of policies, plans, programmes, projects and activities of energy production and utilisation.

***Equity*:** There should be equitable access to basic services to meet needs and ensure human well being. Each generation has a duty to avoid impairing the ability of future generations to ensure their well-being.

Global and international cooperation and responsibilities: Government will recognise its shared responsibility for global and regional issues and act with due regard for the principles contained in relevant policies and applicable regional and international agreements.

Allocation of functions: Government will allocate functions within the framework of the Constitution to the institutions and spheres of Government that can most effectively achieve the objective of a function within the context of energy policy.

Participation: Government will encourage the inclusion of all stakeholders in energy governance with the aim of achieving equitable and effective participation.

7. ESSENTIAL ELEMENTS OF RENEWABLE ENERGY IMPLEMENTATION

In order to develop a policy to address the key issues related to renewable energy several approaches to renewable energy implementation were explored. Essential elements of such approaches are - sustainable development, an enabling environment, institutional arrangements, information and technology.

7.1 SUSTAINABLE DEVELOPMENT

Sustainable development is defined as "the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (*National Environmental Management Act*, 1998). The provision of reliable and affordable energy for business and the domestic market, underpins everyone's quality of life.

Renewable energy that is produced from sustainable natural sources will contribute to sustainable development. As most of the sources are indigenous and naturally available, security of energy supply is improved and not disrupted by short-term international crises.

The challenge of climate change is recognised as one of the major environmental threats facing the world today. Reducing the use of fossil fuels through the implementation of renewable energy will reduce harmful emissions and thereby reduce South Africa's impact on climate change.

7.2 ENABLING ENVIRONMENT

Renewable energy requires an enabling environment for several reasons. The relatively high capital cost of most renewable energy technologies makes them commercially uncompetitive in the short to medium-term. The establishment of an appropriate enabling environment through the development of fiscal, financial and legislative instruments, will therefore be required to simulate increased utilisation of these technologies. This includes Government support for renewable energy to help establish an initial market share and non-discriminatory open access to the national electricity grid (with an appropriate wheeling arrangement) and other energy infrastructure.

Many of the renewable energy technologies are currently under-developed or not fully commercialised compared with conventional options and hence costs tend to be high. There is a reluctance to invest in what are sometimes considered to be risky investments. By undertaking demonstration projects with stakeholders these risks can be clarified and options to address them tested.

Fossil fuels represent a concentrated form of energy, while renewable energy normally uses dispersed sources with low energy concentrations. Renewable energy typically has a different cost structure to conventional energy sources. For some technologies the initial capital cost is high but the operation and maintenance costs are low and the fuel is free or of low cost.

The current price structure for energy derived from coal, crude oil and nuclear does not include environmental externalities and does not reflect the costs that production has on society at large. However, even if externalities were to be included, there would still be a need to support individual renewable technologies in the market until they achieve the necessary economies of scale, technological development and investor confidence. More work is required to quantify the level at which these externalities will be priced and on how to introduce these in the decision-making process (see 9.1). Supporting financial instruments should, however, provide incentives for continued minimisation of costs.

7.2.1 Financial instruments

Overcoming the initial high capital cost and increasing the commercialisation of renewable energy technologies in a market driven energy economy will guide funding for renewable energy technologies. . Government funding will be a catalyst in attracting concessionary, donor and public/private sector funding to drive the commercialisation of renewable energy technologies. Government funding will be sourced through government financial and fiscal measures e.g. budgetary allocation, subsidies, levies, tax rebates or other incentives. This process should be monitored and evaluated in order for the appropriate phasing out of the funding as renewable energy technologies become competitive and are driven by market forces alone.

In the power sector various instruments are applied world wide for incorporating renewable energy power generation into the electricity system, as shown in Table 6. The basics of these instruments could be adopted for other renewable energy applications e.g. bio-fuels, solar water heating.

Table 6: Renewable power generation approaches in different countries

Country	System
Australia	RE certificates (Obligation)
Denmark	RE feed-in tariff
France	RE Fixed Price
Germany	RE feed-in tariff
Japan	RE certificates (Obligation)
Philippines	Renewable Portfolio Standard (Set-aside), RE Levy
Spain	RE Feed-in tariff
United Kingdom	Renewables Obligation Certificates
United States of America	Renewable Portfolio Standard (Set-aside), RE IPP tax credits

Of these, the instruments that have been most successful in promoting renewable energy developments are investment incentives, production incentives, and set-asides (DME, DANCED, 2001).

Investment incentives (e.g. USA "Renewable energy generator tax credit")
These are direct subsidies and/or tax credits to stimulate investment in renewable energy technology.

Production incentive (e.g. Germany "feed-in tariff")
The electricity distributor is obliged by law to buy, at a certain minimum feed-in tariff (c/kWh, higher than existing tariff), electricity from every grid-connected renewable energy generator. Sources of funding to enable the distributor to buy at the grid-feeder tariff are: direct subsidies and/or a cross-subsidy from the electricity consumer (via the price).

Set-aside (e.g. USA "Renewable Portfolio Standard")
A set-aside is a block of energy supply that is earmarked by law for renewable energy capacity. Potential renewable energy generators tender to provide the block of renewable energy supply. Winning projects receive financial support e.g. subsidy per kWh or a guaranteed fixed electricity tariff.

Table 7. Advantages and disadvantages of financial instruments to support renewable energy (DME, DANCED, 2001)

Tool	Advantages	Disadvantages
Investment incentive	Overcomes high first cost barrier	Encourages investment, not production
Production incentives	Easy to implement Easy for developers Encourages Renewable energy production	Does not directly address high first cost barrier Can be abused if incentive too high
Renewable Set-asides	Allows control over amount of renewable capacity added Competitive bidding encourages cost reductions	Can be very bureaucratic Bids may be controlled by one entity May lead to lumpiness in installations

In addition to the points raised in the table, other problems with set-asides are the expensive bidding processes and "lumpiness" in capacity additions if the set-asides are not managed in a smooth progression. Additionally, to ensure sufficient diversity, projects should be grouped in separate categories, so that no one technology will eclipse the other.

Options for South Africa

In South Africa's current position it appears that a combination of a set-aside, coupled with an investment incentive, could form the basis of utilising renewable energy funding for an initial power generation programme. Tradable Renewable Energy Certificates (TRCs) whereby a renewable energy generator obtains a TRC, which he can trade nationally or internationally to users who want the "Green" attribute, also have possibilities to finance renewable energy generation. A "Green" market survey indicated that there is an, albeit small, growing demand by consumers (household and commerce) willing to pay a premium for the benefit of receiving "green" electricity. This "green" premium will further accelerate the commercialisation of renewable energy technologies, thus reducing the Government financial assistance required.

A decision about which option or combination would be in the best interests of South Africa will be based on a Macro-economic analysis and the outcome presented in the Renewable Energy Strategy. This strategy will be closely coordinated with relevant legislation and regulation such as is proposed in the Energy Bill and that governing Independent Power Producers.

Government will support a programme for the introduction of Renewable Energy based on economic efficiency and continuous, sustained growth in renewable energy production that enables Government to easily measure and control its level of support.

The White Paper will be assessed mid-term (2009) and may be revised in light of the progress made in achieving the target.

7.2.2 Legal and Regulatory Instruments

An enabling environment will also require the introduction of certain regulatory measures:

- Generation or refining licenses;

- Introduction of a grid-connection or pipeline connection code which governs the minimum requirements of connecting to the Grid or pipeline network;
- New infrastructure to link renewable energy supplies into the existing transport infrastructure, which will need appropriate mechanisms to facilitate this;
- The procedure and charges for wheeling the power from the generator to a customer through the national electricity grid needs to be defined and regulated in order to keep transport (wheeling) tariffs for renewable electricity low where existing infrastructure is used, and similarly for petroleum products;
- Open access to the national electricity grid and petroleum pipeline infrastructure. This would need to be legally defined and regulated by Government;
- Power purchase agreement of sufficient duration between the generator and the purchaser of the electricity;
- The development of a system to compensate for the cost of electricity generated from different technologies and from different geographic locations, and similarly for petroleum products.
- Minimum contributions to the national energy supply from renewable energy resources.

7.3 Institutional Arrangements

Renewable energy is in its formative stages. Unlike established energy sectors, such as the electricity and liquid fuels sectors, renewable energy requires institutional arrangements to strengthen it.

7.3.1 Electricity Sector

One power producer, Eskom, currently dominates electricity generation and transmission in South Africa. However, the electricity distribution industry is currently undergoing restructuring, including the corporatisation of Eskom and the formation of six new regional electricity distributors.

The *White Paper on Energy Policy* provides for the integration of grid and non-grid technologies into a single National Electrification Programme, which is an integral element of the restructuring of the electricity distribution industry being undertaken. The *White Paper on Energy Policy* also encourages the entry of multiple players into the generation market. However, the appropriate regulatory and legal framework will be needed to support the entry of renewable energy generators.

The National Electricity Regulator (NER) has jurisdiction over the entire industry and regulates market access through licensing of all producers (greater than 5 giga watt hours per annum), transmitters, distributors and sellers of electricity. All electricity tariffs have to be approved by the NER that also regulates quality of supply and mediates disputes and customer complaints. A regulatory framework is being prepared to govern the approach to renewable energy implementation.

7.3.2 Liquid Fuels and Gas

The Minister of Minerals and Energy is responsible for the governance of the liquid fuels industry in South Africa and governance of the liquid fuels sector is commensurate with Government's policy goals for, and level of involvement in, the industry. The industry is also governed by generally applicable legislation such as competition legislation.

Price control is affected by the Minister of Minerals and Energy in terms of the *Petroleum Products Act* (Act 120 of 1977). In terms of the *Petroleum Products Act Amendment Bill (of 2002)*, certain transitional measures are introduced to ensure an orderly process of managed liberalization. The Minister of Minerals and Energy will remain the liquid fuels industry regulator and may prescribe the price at which any petroleum product may be sold or bought, method of trading, publishing of prices and quantities of crude oil or petroleum products to be maintained by any person. The Minister shall furthermore appoint a person in the public service as Controller of Petroleum Products who shall issue licenses in terms of the Act and in issuing such licenses.

Government has accepted a process of managed liberalisation of the regulatory dispensation of the liquid fuels industry. The time-horizon for this process will be determined by the achievement of specific milestones as set in the *White Paper on Energy Policy* (December 1998). A ten-year timeframe is envisaged for the liberalisation of the industry, allowing time for the black empowerment companies to consolidate their positions within the industry.

The *Central Energy Fund Act* (Act 38 of 1977) is enabling legislation in terms of which, *inter alia*, levies may be imposed on liquid fuels products for collection into of the Central Energy Fund and or the Equalisation Fund. These funds can be employed for dedicated energy purposes in a manner prescribed by the Act.
In order to develop the piped gas industry and regulatory framework for the development of a competitive gas industry through granting of licenses for the transmission, storage, distribution and trading of piped gas and matters connected therewith the *Gas Act* (Act 48 of 2001) was promulgated.

The high initial costs for renewable energy necessitates the establishment of funding mechanisms to promote their implementation. The Central Energy Fund has historically been focussed on the management of crude oil and locally produced hydrocarbons. However, increasing the use of renewable energy, biomass derived liquid fuels and energy sources such as bio-diesel, ethanol and landfill gas have been identified as one of its key focus areas in future. Mechanisms, such as the Central Energy Fund and Equalisation Fund, could be harnessed to extend the operational support available to renewable energy programmes. The *Gas Act* and the proposed amendment to the *Petroleum Products Act* will provide a basis for the integration of renewable energy derived liquid fuels and landfill gas into the petroleum and gas industry regulatory framework. Government has already stated that it will incentivise the production of bio-fuels produced from biomass in the form of a 30% reduction in the Fuel Levy (tax) on such fuels (Budget Speech Minister of Finance, February 2002). Government could take the lead by setting supply and demand targets e.g. a percentage of Government (national and provincial) and Government related financial institutions, agencies projects budget invested in renewable energy programmes and a target set for a percentage of renewable energy demand by Government (national and provincial) and related institutions and agencies.

7.4 INFORMATION

There is a limited, albeit significant, use of renewable energy in South Africa. An urgent task is a quantitative "baseline" study to determine more precisely the quantum and nature of renewable energy currently in use, especially data on fuelwood which is highly unreliable. One obstacle to the development of renewables is the lack of information available to the consumer about renewable energy options. There is a need to provide comprehensive, independent and comparative information on renewable energy products and services to customers to support informed decision-making.

The successful penetration and uptake of renewable energy technologies into South Africa depends crucially on growing a market demand in the various energy sectors. However, at present public awareness of the existence of renewable energy or its economic, environmental and social benefits, is limited. It is therefore incumbent upon DME to devise a realistic information dissemination and training strategy to encourage and enable private/public sector renewable energy participation in the energy market (e.g. market rules for a liberalised energy market) thereby increasing the market penetration for renewable energy. This will be done through formal training and education, employing targeted information campaigns using the network of vehicles at its disposal (including integrated energy centres, regional offices, and provincial energy forums) and building upon existing projects to demonstrate the benefits to the public.

Government will facilitate and support information dissemination and training to encourage and enable private/public sector renewable energy participation in the energy market (e.g. market rules for a liberalised energy sector).

8. STRATEGIC GOALS, OBJECTIVES AND DELIVERABLES

Strategic goals and supporting objectives are part of the enabling framework which supports Government's purpose in meeting its commitment to promoting renewable energy. Achieving this requires that the following four key strategic areas are addressed, i.e. financial instruments, legal instruments, technology development, and awareness raising, capacity building and education. In addition to the goals and objectives, associated deliverables have been identified.

8.1 FINANCIAL AND FISCAL INSTRUMENTS

Goal

To promote the implementation of sustainable renewable energy through the establishment of appropriate financial and fiscal instruments.

Objectives

- To ensure that an equitable level of national resources is invested in renewable energy technologies, given their potential and compared to investments in other energy supply options.
- To set targets for the directing of public resources for the implementation of renewable energy technologies in combination with international sources of funding for this purpose.
- To introduce appropriate fiscal incentives for renewable energy.
- To extend existing state financial support systems and institutions and introduce innovative approaches to the establishment of sustainable structures and financing mechanisms for delivering renewable energy systems.
- To facilitate the creation of an investment climate for the development of the renewable energy sector, which will attract foreign and local investors.

Deliverables

- An analysis of the current financial framework and an identification of barriers to the implementation of renewable energy sources.
- An investigation into appropriate financial (e.g., subsidies, and green certificates) and fiscal instruments/incentives (e.g. low interest loans and tax rebates) to stimulate the implementation of renewable energy technologies and practices.
- Incentives and regulations for the promotion of thermally efficient housing in collaboration with the Department of Housing.
- Clarify the role of the Central Energy Fund in financing the implementation of renewable energy initiatives. The Fund could be used for example to facilitate access to green financing, as well acting as a loan guarantor to reduce the risks for financing institutions.
- Monitor and evaluate the effectiveness of financial incentive schemes.
- An equitable electricity tariff structure that will be managed by the National Electricity Regulator that addresses the issue of cost of supply for the different renewable energy technologies, including capital replacement costs for non-domestic users.
- Support a national "green" market survey to ascertain the willingness of customers (households and commerce) to pay a premium for "green" energy.

8.2 LEGAL INSTRUMENTS

Goal

To develop, implement, maintain and continuously improve an effective legislative system to promote the implementation of renewable energy.

Objectives

- To develop an appropriate legal and regulatory framework for pricing and tariff structures to support the integration of renewable energy into the energy economy and to attract investment.
- To develop an enabling legislative and regulatory framework to integrate Independent Power Producers into the existing electricity system.
- To develop an enabling legislative framework to integrate local producers of liquid fuels and gas from renewable resources into their respective systems.

Deliverables

- Appropriate regulations for grid-connection and wheeling of electricity generated from renewable energy.
- Phasing in of regulations requiring power generator's tariffs to be based on full cost accounting and the incorporation of environmental externalities.
- New legislation for the energy sector incorporating renewable energy and energy efficiency that provides equitable opportunities for their development.
- Regulations for the petroleum industry to accommodate locally produced bio-diesel and ethanol.
- Clear rights for property owners to capture solar radiation on their property without interference by other structures or vegetation on neighbouring properties.
- Appropriate legal and regulatory instruments to stimulate the uptake of renewable energy power generation into the electricity system.
- Mechanisms to increase the access of renewable energy to the national electricity grid.

8.3 TECHNOLOGY DEVELOPMENT

Goal

To promote, enhance and develop technologies for the implementation of sustainable renewable energy.

Objectives

- To promote the development and implementation of appropriate standards and guidelines and codes of practice for the appropriate use of renewable energy technologies.
- To promote appropriate research, development and local manufacturing to strengthen renewable energy technologies and optimise their implementation.

Deliverables

- Standards governing the design, installation and performance of renewable energy systems, together with a certification process to verify that systems meet these standards.
- Revise Government tender procedures to include standards for renewable energy technologies.
- Monitor ongoing research and development programmes and identify additional investigations and demonstration projects that would assist in the development and optimisation of renewable energy systems.
- Identify appropriate public/private partnerships for the promotion of renewable energy technology development and implementation.
- Identify and expand areas for international co-operation in the field of renewable energy.
- Identification and enhancement of appropriate mechanisms to gain from technology and skills transfer and to benefit from international experience.
- Cost-effective energy storage mechanisms investigated.
- Integrate renewable energy R&D into the proposed National Energy Research Institute

8.4 AWARENESS RAISING CAPACITY BUILDING AND EDUCATION

Goal

To raise public awareness of the benefits and opportunities of renewable energy.

Objectives

- To promote knowledge of renewable energy and thereby increase its use.
- To promote and stimulate the renewable energy market through the dissemination of information regarding the economic, environmental, social and trade benefits of renewable energy technologies and their applications.
- To persuade the appropriate Government and Government funded institutions to implement training and education programmes with regard to renewable energy.
- To actively involve women in decision-making and planning and promote empowerment in renewable energy programmes or activities.
- To improve communication and interaction between national, provincial and local Government institutions on renewable energy policies.

Deliverables

- Development and dissemination of a "benefits case for renewable energy".
- Development of standards for accrediting renewable energy training programmes that are registered by the South African Qualifications Authority.
- Training programmes on renewable energy for stakeholders funded by the Energy Sector Education and Training Authority (ESETA).
- Awareness raising and marketing campaigns aimed at all stakeholders.
- Establishment of a renewable energy information centre or network of centres, possibly operated in conjunction with renewable energy demonstration centres, regional DME offices, regional ESETA offices and integrated energy centres established by Government.

8.5 TECHNOLOGY SUPPORT CENTRES

The establishment of technology support centres within existing research and development institutes and proposed National Energy Research Institute would facilitate the promotion and ongoing development of technologies and would assist Government in the certification and approval of systems. One essential element in sustainable renewable energy generation will be technological development aimed at reducing costs and increasing efficiency. Innovation and leadership in energy technologies could be highly profitable for developing countries in economic, environmental, and human terms (UNDP, 2000)

9. CROSS CUTTING ISSUES

9.1 INTEGRATED ENERGY PLANNING

By virtue of its size and economic importance, the energy sector periodically requires considerable investments in new supply capacity, which impacts on the economy. Integrated

resource planning decisions around the world now consider not only maintaining security of supply but give full consideration to the economic, environmental and social impacts of all alternatives, such as demand-side management and energy efficiency programmes. This 'levelling of the playing fields' between conventional supply options and more environmentally benign alternatives (such as renewable energy) encourages a shift towards a more sustainable approach.

The current Integrated Energy Plan of the DME does not yet include a quantitative assessment of the cost of externalities but this is a gap that will be addressed. Lastly, the Integrated Energy Plan should adopt an integrated resource planning approach regarding the equitable financial treatment of the different energy sources commensurate with their potential.

9.2 ENERGY EFFICIENCY AND RENEWABLE ENERGY

There are several areas of overlap between Renewable Energy and Energy Efficiency that warrant a brief discussion.

Energy efficiency is a measure of the savings of energy, which is used to produce goods and services while maintaining the desired benefits. Expenditure on energy constitutes some 15% of South Africa's GDP. Therefore energy efficiency is an important facet of integrated energy planning. The two sectors with the greatest potential for energy efficiency/renewable energy interventions are the industrial and household sectors. Coal and electricity constitute the bulk of energy consumption in the industrial sector. Electricity and fuelwood dominate the household sector with coal, paraffin and LPG, also playing a substantial role. In both sectors these fuels are used primarily for thermal purposes; heating and processing.

The widespread installation of solar water heating in industrial and commercial buildings and houses has the potential to defer the need for building new power plants, as the combined heating requirements consume the energy produced by three average power stations. The main constraint on implementing a national solar water heating programme relates to cost, which is a function of the current small market and lack of economies of scale. This lack of demand in itself is due to low public awareness of the technology or its economic benefits. Thermally efficient housing – that is houses designed to save energy, can reduce household space heating requirements. The Department of Housing in collaboration with the Department of Minerals and Energy, has developed appropriate guidelines for the construction of thermally designed housing incorporating passive solar design.

The household sector requires the following measures:

- Regulation of no-cost energy efficiency measures in housing; incorporating passive solar design,
- Heat insulation and air tightness measures in homes,
- Replacement of electric geysers by solar water heaters,
- More efficient home electrical appliances as a result of appliance labelling and enforcement of standards,
- Energy efficient lighting (compact fluorescent lights).

Raising awareness regarding the economic benefits of energy efficiency and renewable energy is an important step in increasing the market demand for these technologies. The development of an information strategy for both energy efficiency and renewable energy is therefore an immediate short-term priority.

Government housing subsidies will require thermally efficient house designs.

Energy efficient standards for electrical appliances will be developed and appliance labelling enforced.

9.3 ENVIRONMENT AND HEALTH

The phenomenon of climate change has only comparatively recently received attention in the energy sector. The lack of infrastructure and inadequate living conditions in many areas of South Africa has meant that millions of people are routinely exposed to fuels which emit several noxious gases and particulates which can be deadly. National statistics show that Acute Respiratory Illness, associated with exposure to particulates, is the second highest cause of mortality in children under the age of five.

The costs to society of health care for such victims is difficult to determine but estimates are shown in the table below.

Table 8: Valuation estimates for the annual mortality and morbidity burden of household coal pollution (Qase *et al*, 2001) in millions of Rands.

Health Outcomes	Low Estimate		Central Estimate		High Estimate	
	2000	2001	2000	2001	2000	2001
Asthma attack	6.45	6.82	15.15	16.01	63.96	67.61
Acute Bronchitis	120.62	127.50	241.24	254.99	361.00	381.58
Chronic Bronchitis	38.29	40.47	103.65	109.56	197.48	208.74
Outpatient/GP visit	0.14	0.15	0.28	0.30	0.56	0.59
Mortality	11.22	11.86	28.61	30.24	63.96	67.61
Respiratory. symptom day	3.37	3.56	10.52	11.12	20.06	21.20
Respiratory hospital adm.	0.14	0.15	0.42	0.44	0.84	0.89
Restricted activity	11.64	12.30	31.00	32.77	60.59	64.04
Total	191.87	202.81	430.86	455.43	769.44	813.30

Blignaut and King, 2002, stated that the environment and society are subsidising the coal combusting industries on average by an amount more than the private cost of coal.

The medium term priorities of the White Paper on Energy Policy include the mitigation of the negative environmental and health effects of air pollution from coal and fuelwood use in household environments.

9.4 ENERGISATION

The DME is spearheading the implementation of the concept of "Energisation" in the rural areas in conjunction with the rural electrification programme in order to address the energy needs of communities in a sustainable and consistent manner. An electrification programme, particularly if it has a strong non-grid component, has to form part of a holistic approach to energy provision, if it is to succeed. Electricity supply through photovoltaics (solar home systems) is (economically) insufficient to cater for thermal energy requirements of households, while experience shows that even if grid-electricity is supplied the energy intensive thermal requirements are often satisfied through fuelwood and conventional fuels (e.g. paraffin, LPG). In order to provide affordable access and to attract the market and banking sector to service communities with a package of energy services (photovoltaic systems, paraffin, LPG, and renewable alternatives such as gel fuel and solar cookers) sustainable, effective and efficient micro-credit schemes and other financial support mechanisms have to be developed and implemented. The services will be available locally through a chain of integrated energy centres and 'one-stop' energy shops to increase ready access and cut down on transport costs to distant towns. This will also lessen the dependency on fuelwood and contribute to environmental conservation. It is intended that ready access and lower prices will shift demand towards cleaner, more efficient fuels and technologies.

9.5 INTEGRATED ENERGY CENTRES

Government is setting up Integrated Energy Centres in cooperation with stakeholders. Like the energisation concept, the Government will be seeking to bring energy services (fuels and appliances) to the disadvantaged communities as well as to address health, environmental, economic and other needs. The integrated energy centres encourage the development of cooperatives, and thereby enhance economic development activities. The energy centres link energy needs with other needs; health, job creation, environment and tourism. As such they will require co-ordination with the Integrated Development Plans of provincial and local authorities.

9.6 GENDER AND ENERGY

Energy plays an important role in the lives of all people who use different kinds of energy for various purposes. However the disparities in modern energy service provision brought about by lack of access to infrastructure impacts largely on poor urban and rural people. In the rural areas women are the main users of fuelwood for meeting household energy needs but also bear the burden of collecting fuelwood. Woodlands have been depleted in many areas and in others they are under heavy pressure. Here women have to walk even longer distances.

Conventional energy approaches virtually exclude women's concerns. Consequently economic growth has been accompanied by severe gender disparities. In South Africa 80% of rural households are female-headed. These households typically cook daily with fuelwood and crop residues while urban women, especially on the Highveld, use untreated coal. Since entrepreneurial home-based industries depend on biomass supplies, women spend long hours working in survival activities – cooking, fuelwood collection, water carrying and food processing. The time spent in these activities represents a high social and economic cost to the family and society, where access to affordable, safe and sustainable fuels is limited. Providing access to alternative fuels or to efficient stoves would improve this situation as well as mitigate the indoor air pollution associated with the use of fuelwood.

Sustainable energy development could have a positive impact for women. But this can only be realised when women's concerns are properly reflected in energy policy-making and there is more emphasis on end-users. This will lead to:

- Recognition of women's non-market labour time as human energy and to the relief of this burden as an objective of energy policy,
- Involvement of women in policy formulation and planning for fuels and appliances,
- Bridging the gap between designer and end-user regarding energy efficiency improvements in stoves and other appliances,
- Availability of more information on alternative sources and technologies,
- Recognition of energy needs in transportation, food harvesting, drying and processing,
- Diversifying fuels to substitute fuelwood by more efficient and cleaner technologies,
- Involvement in decision making regarding energy matters at energy forums,
- Assisting women to develop entrepreneurial skills through productive uses of renewable energy technologies.

Among the energy sector stakeholders women are poorly represented and this calls for training and skill development among women. Career guidance should be offered at schools to encourage more young women and men to acquire appropriate skills.

9.7 BLACK ECONOMIC EMPOWERMENT (BEE) AND JOB CREATION

Since the *White Paper on Energy Policy* was published in 1998 great strides have been made in empowering historically disadvantaged South Africans (empowerment) in order to redress historical racial and gender imbalances in employment.

The emergence of a Renewable Energy Industry provides potential for empowerment and job creation. This is particularly so in the liquid fuels sector. The reduction in the Fuel Levy by 30% on bio-diesel in 2002 creates opportunities for empowerment in bio-fuels where small farmers' co-ops, and entrepreneurs could grow and refine energy crops to produce bio-diesel and ethanol. This will go hand-in-hand with Government initiatives to mitigate the impact of oil prices on South Africa's economy. Insofar as Government provides subsidies or other specific support to a renewable energy project, it will be in a position to specify a measure of empowerment in such projects.

> *Renewable energy projects that receive Government assistance will be required to incorporate empowerment.*

The job creation potential of the renewable energy industry lays not so much in the operation and maintenance of such facilities, but rather in the manufacture of such technologies. This can be observed in countries where renewable energy industries have been promoted. In such examples it can be seen that, providing there is local manufacture of renewable technologies, the amount of jobs as a function of units of energy produced is much higher compared to conventional energy technologies. The manufacture of renewable technologies is more labour-intensive than conventional energy technologies and requires an appreciable labour force for manufacturing as can be seen from Table 9.

However, in order to make local manufacture viable, economies of scale, that is significant demand, will be required. Since significant levels of demand will be partly a function of Government support, and since in the short-term at least, South Africa will face many pressing demands, employment expectations should not be unduly raised.

Table 9. Potential renewable energy job creation compared to coal-fired power stations (DME, DANCED, 2001)

Resource	Information Source			
	Danish Study[a]	New York State[b]	AWEA[c]	World Watch Institute[d]
	[man-years, same amount of energy]	[jobs per mil. US$ invest.]	[jobs per mil. US$ invest.]	[jobs per TWh]
Coal fired power plant	6 200	13.1	13	116
Photovoltaics		7.4		
Solar thermal electricity				248
Wind-generated electricity	14 200	10.0	14	542
Biomass-derived electricity		17.0-22.6		
Hydro-derived electricity		4.0	8	

[a] Source: l. Munksgaard, J Rahbæk Pedersen. T. Jensen Societal benefits of wind turbines, part 3 Employment and balance of payment. (in Danish, AKF 1995)

[b] Source: 1994 New York State Energy Plan, Volume III: Supply Assessments, Table 57, p. 612.

[c] Source: American Wind Energy Association (AWEA) (1995)

[d] Source: Scheer (1993), p. 110.

In order to equip the work force, the Energy Sector Education Training Authority (ESETA) is mandated to ensure, in consultation with the renewable energy industry, that appropriate, nationally recognised, renewable energy training and education unit standards and curricula are developed and registered with the South African Qualifications Authority (SAQA). This will equip artisans and technicians with the necessary skills to undertake the design, installation, operation and maintenance of renewable energy technologies and appliances and this provide a new career path. The benefit to the industry is having access to qualified artisans and technicians.

9.8 TRADE AND INTERNATIONAL CO-OPERATION

The SADC Trade Protocol is one of the cornerstones of the SADC regional integration process. It envisages the creation of a Free Trade Area within eight years of entry into force. (DFA, 2001). This has export market implications for the local manufacture of renewable

energy technologies. At present such technologies include photovoltaic systems, solar water heaters, small wind turbines and so on. The photovoltaic systems also include 'balance of systems' - inverters, regulators and batteries. Biomass conversion technologies, from fuel-efficient woodstoves, biogas digesters, bagasse and wood pulp power plants are all produced locally and have export potential. In the short-term solar cookers also may be mass-produced locally and have an export market in Africa.

In the medium-term full-scale wind turbines could be locally produced (as in India, which has the fourth largest power generation from wind, where 14 manufacturers export their products to Asia and Africa). For remote areas an industry in hybrid systems and micro-hydro for either stand-alone applications or mini-grids waits to be developed.

In the long term solar thermal power plants and turbines could be produced locally if the results from the first demonstration plant runs successfully in 2003.

It is envisaged that with the launch of the African Union and the New Partnership for African Development (NEPAD) in 2002, the African Continent will harness its natural resources and share information and technologies regarding renewable energy.

10. GOVERNANCE AND PARTNERSHIPS

The Constitution requires that the legislative and executive authority of different spheres of Government operate within a framework of cooperative governance.

> *The Department of Minerals and Energy will take overall responsibility for renewable energy policy coordination in South Africa, working closely with the relevant Government Departments and institutions.*

The Department will work with the relevant Government Departments to establish the appropriate enabling environment to ensure that activities undertaken by other stakeholders are coordinated, uniform and effective. Furthermore, the Department intends to facilitate the implementation of this policy in cooperation with other key national departments including the Departments of Environmental Affairs and Tourism, National Treasury, Trade and Industry, Arts, Science and Technology, Housing, Provincial and Local Government, Water Affairs and Forestry, Agriculture and Transport.

An underlying principle in allocating governance functions is the devolution of responsibility to the most appropriate sphere of Government. Where the allocated sphere of Government does not have the resources or capability, the next higher sphere of Government will execute the function, where possible.

Department of Minerals and Energy: The Department will carry out the following functions within its jurisdiction and budgetary constraints related to renewable energy policy and policy implementation:

- Development of policy, strategy, action plans, legislation, regulations and enforcement,
- Coordination,
- Dissemination of information,

- Monitoring, auditing and review,
- Monitoring of publicly funded research development,
- Promote capacity building and empowerment.

National Electricity Regulator: All electricity utilities are subject to regulation by the National Electricity Regulator (NER). Furthermore, the NER advises the Minister of Minerals and Energy on any matter relating to the electricity supply industry. The NER will undertake the following functions related to renewable energy policy implementation:

- Implement regulations requiring electricity distributors to purchase power in accordance with renewable energy policy,
- Implement regulations requiring network service providers to provide non-discriminatory access to electricity networks to enable the participation of small generators and consumers in electricity production,
- License or register renewable energy generators,
- Regulate electricity market access through licensing of all producers (greater than 5 giga watt hours/annum), transmitters, distributors and sellers of electricity,
- Regulate the prices at which power is purchased from generators, both Eskom and the Independent Power Producers,
- Approve electricity tariffs,
- Regulate quality of supply and mediate disputes and customer complaints.

South African Bureau of Standards (SABS): The mandate of the SABS is to provide for the promotion and maintenance of standardisation and quality in connection with commodities and the rendering of services. To execute this role it undertakes the following functions:

- Facilitate the development and updating of standards, specifications and testing methods,
- Laboratory testing of products, commodities, technologies and appliances,
- Issuing of a mark of approval or certification of quality for the above, and the enforcement of compliance of specifications to ensure that these are met.

SABS will have an important role to play in determining standards for a range of items such as fuel specifications, housing (solar passive design), solar water heaters etc.

Central Energy Fund: In terms of the *Central Energy Fund Act* (1977), CEF is mandated to engage in the acquisition, exploitation, generation, manufacture, marketing and distribution of energy and to engage in research relating to the energy sector. The key focus area of the CEF is aimed at contributing to the development of South Africa's energy sector by contributing to the universal access to energy, including the increased use of renewable energy. The CEF also renders operational support to the energy sector in the form of treasury services, including the raising of funds both locally and internationally. Mechanisms will be investigated to extend the operational support available from the Central Energy Fund to renewable energy programmes.

Partnerships: The Department of Minerals and Energy will promote a partnership approach and an integrated focus for national renewable energy initiatives. Key stakeholders in these partnerships will include: the renewable energy industry, industry in general, electricity utilities, independent power producers, provincial Governments and local Governments (as provided for in the Constitution), state owned enterprises and institutions, communities, non-Governmental organisations and consumer forums.

11. THE WAY FORWARD

A Strategy on Renewable Energy will be developed, which will translate the goals, objectives and deliverables set out herein into a practical implementation plan. Underpinning the Renewable Energy Strategy is a Macro-economic analysis to guide cost efficient Government financial assistance based on a least-cost and employment maximising supply model in reaching the target. A number of important investigations will be undertaken during the Strategy development, including, *inter alia*, how the renewable energy target will be periodically reviewed with respect to the different primary energy carriers, the mechanism that is selected for the feed-in of electricity generated from renewable resources into the national electricity network, and the modalities of the various financial, legal and regulatory instruments to be employed as part of the enabling framework of mechanisms to support the promotion of renewable energy.

The main aim of this White Paper is to create the conditions for the development and commercial implementation of renewable technologies. Government will use a phased, managed and partnership approach to renewable energy projects that are well conceived and show the potential to provide acceptable social, environmental and financial returns for all investors and stakeholders. This will lessen the strain on fiscal resources and hold greater potential for successful implementation. The focus will be on delivery. An appropriate enabling environment towards full commerciality will nurture the technologies that are proven to best meet Government's policy objectives. Through this policy document Government is venturing into an entirely new area.

Progress towards meeting the targets, objectives and deliverables of the White Paper will be evaluated mid-term, after five years, to see if these are being achieved and to determine whether the policy direction remains appropriate. The White Paper may be revised in the light of progress made. Sustainable development criteria – economy, environment and social priorities - will continue to guide strategy in a balanced way for the longer-term. At the same time, Government will monitor worldwide technological developments in renewable energy with a view to identifying technologies that may be particularly appropriate to the South African situation in the long-term, making the best use of partnerships where possible, both locally and internationally.

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