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Accelerating the Market Penetration of Renewable Energy Technologies in South Africa

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Action Plan Summary

Available on the Internet at http://www.uccee.org/RETSouthAfrica

Preface

This report is an extended summary of the full report under the European Commission Synergy Programme project "Strategy to accelerate the Market Penetration of Renewable Energy Technologies in South Africa", registered under contract number 4.1041/D/99-033. This extended summary includes a summary of the chapters plus an overview of the recommended actions. The Netherlands Energy Research Foundation ECN (co-ordinator), CSIR, Risø National Laboratory through the UNEP Collaborating Centre on Energy and the Environment, and Richard Morris and Associates have carried out this project between December 1999 and March 2001. Authors of the report are:

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The rationale for this Synergy project evolved during the execution of a European Commission THERMIE Programme co-funded project entitled "Renewable energy sources for rural electrification in South Africa". This project was done under contract number STR/1388/97-GB and was co-funded by the CSIR. The project partners were the CSIR, Garrad Hassan & Partners Ltd and the Netherlands Energy Research Foundation (ECN). The primary objective of the THERMIE project was to identify commercially viable opportunities for rural electrification in the Eastern Cape Province of South Africa. It became clear that there were many barriers that prevent the more widespread use of renewable energy in South Africa and the CSIR initiated the formulation of this Synergy project. It is intended that the resultant Action Plan developed in the Synergy project will contribute towards overcoming these barriers.

During the research stakeholder analysis was carried out from 7 to 17 August in South Africa. During the stakeholder analysis, various stakeholders in the South African renewable energy sector have been interviewed, including representatives of renewable energy industry, the Solar Energy Society of South Africa Department of Minerals and Energy, ESKOM, research institutes, municipality and private consultants. At the end of the project, the results of the study have been discussed at a 2 - day workshop at the CSIR premises in Pretoria. The proceedings of the workshop are on the Internet: http://www.uccee.org/RETSouthAfrica/workshop.htm or http://www.ecn.nl/unit_bs/resa/main.html. The project team would like to express its sincere gratitude to all those who have taken their time and effort to provide us with information and their views on the various aspects of renewable energy in South Africa. These inputs have considerably improved the quality of our work.

The mentioning of the term "strategy" in the title of this study is somewhat misleading. The aim of this study is not to present an overarching strategy which substitutes the current initiatives in South Africa with a new one. We believe that such a task is beyond the scope of a team of outside researchers. Rather we have attempted to incorporate current initiatives in our analysis and complement them with our own recommendations. Apart from existing policy initiatives we have also attempted to complement existing studies in the research field. Particular reference should be made to the DANCED/DME study on Bulk Renewable Energy Independent Power Producers (DANCED, 2001), which provided major input in recommendations for grid-connected renewable energy.

This study was awarded funding under the EU Synergy Programme in 1999. Besides the European Commission Synergy Programme each of the respective participating organisations contributed half of their expenses under this project. The support from the European Commission and each participating organisation has been highly appreciated. The funding by

the EU does by no means imply that this report contains EU-statements. The responsibility of the text, including its inevitable flaws, remains with the authors.

Contents

LIST OF ACRONYMS AND ABBREVIATIONS

€	Euro
AEBIOM	European Biomass Association
AEC	Atomic Energy Corporation
AIJ	Activities Implemented Jointly
AMEU	Amalgamated Municipal Electricity Undertakings
ANC	African National Congress
Bcm	Billion cubic metres
BIT	Bilateral
BOO	Build, Own, Operate
BOS	Balance Of System
CAM	Wind Analysis programme
CARI	Spanish Agreement on Reciprocal Adjustment of Interest Rates
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CESCE	Spanish Export Credit Insurance Company
CNS	Council for Nuclear Safety
CO_2	Carbon Dioxide
COGEN	European Association for the promotion of Cogeneration in Europe
COP	Conference of the Parties
CPPP	Community Public Private Partnerships
CSIR	South African scientific research council
DACST	Department of Arts, Culture, Science and Technology
DANCED	Danish Co-operation for Environment and Development
DBSA	Development Bank of Southern Africa
DEAT	Department of Environmental Affairs and Tourism
DME	Department of Minerals and Energy
DoH	Department of Housing
DTI	Department of Trade and Industry
DWAF	Department of Water Affairs and Forestry
EC	European Commission
ECCP	European Climate Change Programme
ECN	Netherlands Energy Research Foundation
EDF	Electricité de France, French National Utility
EDI	Electricity Distribution Industry
EDRC	Research and Development Centre
EFTA	European Free Trade Associations
EOLE	French Utility Wind Energy Programme
ESI	Electricity Supply Industry
ESKOM	South Africa's National electricity utility
ET	Emissions Trading
EU	European Union
FAD	Spanish Development Aid Fund
FEV	Spanish Fund for Feasibility Studies
FFS	Fee For Service
FIB	Friedenheim Irrigation Board
GDP	Gross Domestic Product
GEAR	Ingredients of RDP: Growth, Employment and Redistribution
GEF	Global Environmental Facility
GEF	Global Environment Facility
GGP	Gross Geographical Product

GoSA	Government of South Africa
GSR	Guarantee of Solar Results
GWh	Giga (10^9) Watt Hour
ICEX	Spanish Foreign Trade Institute
IDC	Industrial Development Corporation
IDP	Integrated Development Planning
IDT	Independent Development Trust
IEP	Integrated Energy Planning
IPP	Independent Power Producer
IPPF	Investment Project Preparation Fund
IRP	Integrated Resource Planning
ISRD	Integrated Sustainable Rural Development
ISRE	Implementation Strategy for Renewable Energy
JOULE	Non-Nuclear RTD Programme of the European Union
KVA	Kilo Volt Ampère, measurement of power
KWh	Kilo Watt Hour, measurement of power
LPG	Liquid Propane Gas
MEPC	Mineral & Energy Policy Centre
MW	Mega Watt (or 10^6) Watt
MW_p	Mega Watt Peak
NAFTA	North American Free Trade Agreement
NCCC	South African National Climate Change Committee
NEF	National Electrification Fund
NER	National Electricity Regulator in South Africa
NFFO	Non-fossil Fuel Obligation
NFPA	Non-Fossil Purchasing Agency
NGEP	Non-Grid Energy Plan
NREL	National Renewable Energy Laboratory, USA
NRTF	National Research and Technology Foresight Study
Nufcor	Nuclear Fuel Corporation
NUON	Large Dutch Utility
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
ORET/MILIEV	Dutch Export Promotion Programme
PESP	Dutch Programme Economic Co-operation Projects
PIMS	Planing and Implementation Management Support
PJ	Pèta (or 10^{15}) Joule
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PSOM	Dutch Programme Co-operation Upcoming Markets
R	Rand
R&D	Research & Development
RDP	Reconstruction & Development Plan
RE	Renewable Energy
REC	Regional Electricity Companies
RED	Regional Electricity Distribution Companies
RES	Renewable Energy Sources
RISØ	Danish National Research & Technology Centre
RTD	Research Technology Development
SA	South Africa
SABRE-Gen	South African Bulk Renewable Energy – Generation
SADC	Southern African Development Community
SDI	Spatial Development Initiative
SHS	Solar-Photovoltaic Home System
SLOT	School Leaver Operational Training

SME	Small and Medium Sized Enterprises
SWOT	Strength, Weakness, Opportunities, Threats
The Government	The national Government of the Republic of South Africa
THERMIE	Demonstration Component of the Non-Nuclear RTD Programme of the European Union
TWh	Tera (10^{12}) Watt Hour
UNDP	United Nations Development Programme
UNFCCC	The United Nations Framework Convention on Climate Change
VAT	Value Added Tax
WASP	Wind Atlas Analysis and Application Programme
WPEP	White Paper on Energy Policy

1. INTRODUCTION

South Africa boasts a relatively sophisticated energy sector which reflects the abundance of mineral resources (coal in particular) and economic characteristics (a significant industrial base) of the country, as well as past priorities of the Government of the day. Whilst this degree of sophistication has catered adequately for the supply of energy services to the economic sectors such as industry, mining, commerce, agriculture and transport, there is a serious problem in meeting the basic needs of a significant portion of the population, the majority of whom reside in rural areas.

Renewable energy has the potential to contribute to a number of key challenges in South Africa, in particular in providing cost effective modern energy services in rural areas and facilitating job creation. This has been recognised by the Government of South Africa.

The oil crises in the seventies, but also increasing environmental concerns such as acid rain and climate change, have stimulated in the past the development and deployment of renewable energy. Over the years, the Member States of the European Union (EU) have acquired considerable knowledge and experience on the issue of how government and market initiatives can be used to overcome financial and institutional barriers in renewable energy development.

The CSIR initiated and catalysed a project that it undertook with Garrad Hassan and Partners and the Netherlands Energy Research Foundation (ECN) that was entitled “Renewable energy resources for rural electrification in South Africa”. The CSIR and the European Commission THERMIE Programme co-funded this project under contract number STR/1388/97-GB. The primary objective of this THERMIE project was to identify commercially viable opportunities for rural electrification in the Eastern Cape Province of South Africa. During the execution of this project it became clear that there were many barriers that prevent the more widespread use of renewable energy in South Africa. Consequently the CSIR and ECN formulated the framework of this Synergy project and was fine-tuned with inputs from RISØ and Richard Morris and Associates. It is intended that the resultant Action Plan developed in this Synergy project will contribute towards overcoming these barriers.

The focus of the study was in particular on solar, biomass, wind and mini-hydro renewable energy technologies[1]. The outcomes of the study consist of two parts. Firstly, recommendations will be provided for supporting the formulation of sound government policy for the implementation of renewable energy technologies. These recommendations will be the result of:

- a thorough analysis of South Africa's specific constraints and barriers to renewable energy implementation.
- the consideration of current proposals on policy and strategy being discussed by government and stakeholders
- the lessons learnt from Member States of the EU on the promotion of renewable energy development.

Secondly, the study aimed at identifying actions for European - South African co-operation to increase investments in renewable energy technologies in South Africa. This actions will

[1] It should be noted that this analysis is limited to electricity generating renewable energy technologies. Considering the wide range of applications of renewable energy technologies and the diversity in the different markets it was felt among the project team members that clear focus was required. This focus has been put on renewable electricity generating technologies as this is the area where the most relevant linkages can be found between South Africa and Europe.

contain a list of potential renewable energy projects, will complement and build on existing initiatives in South Africa and will identify opportunities for co-operation between these initiatives and the European renewable energy industry.

- Phase 1 - Review of the role of Renewable Energy in South Africa
- Phase 2 - Identification and Evaluation of Concrete Renewable Energy Projects in South Africa
- Phase 3 - Determination of the potential European contribution to renewable energy development in South Africa in terms of lessons learnt, useful technologies and investment programmes
- Phase 4 - Recommendations and dissemination of results

The first part of the project consisted of fact funding: identifying the needs and opportunities for renewable energy technologies in South Africa by means of a literature analysis (phase 1) and a stakeholder analysis (phase 2). During the stakeholder analysis, various stakeholders in the South African renewable energy sector have been interviewed, including representatives of renewable energy industry, the Solar Energy Society of South Africa, DME, ESKOM, research institutes, municipality and private consultants.

Section 1 of this report reports the results of our fact-finding. Chapter 2 provides background information on the key energy issues in South Africa. The opportunities and barriers for renewable energy technologies are highlighted in Chapter 2.

The second part of the project consisted of reviewing the experiences and potential contributions from Europe and identifying the potential contribution of the EU and its member States to the market of development of renewable energy in South Africa. The chapter 3 provides an overview of the EU review in terms of technologies, policy experiences and the promises of international climate initiatives for renewable energy collaboration.

The resulting recommendations have been discussed during a final workshop in Pretoria. The workshop has resulted in re-evaluation and prioritisation of the proposed actions, which have been integrated in the recommendations of the report. Chapter 4 provides an overview of the recommended actions to further stimulate the market penetration of renewable energy technologies in South Africa. They are structured in:
- Actions to enhance the policy framework for renewable power generation;
- Actions to enhance the policy framework for off-grid renewable energy; and
- Recommendations to stimulate renewable energy project development.

2. SOUTH AFRICAN DEVELOPMENTS

There exists a big potential for renewable energy technologies in South Africa. Despite the fact that rapid growth of the application of renewable energy is taking place in many parts of the world, the current installed renewable capacity in South Africa is negligible. As is clearly indicated in the White paper on the Energy Policy of the Republic of South Africa, in the past South Africa has neglected the development of renewable energy applications.

To redress this problem, the Government of South Africa intends to formulate policy specifically oriented towards renewable energy. The policy is meant to:
- ensure that economically feasible technologies are implemented,
- ensure that an equitable level of national resources is invested in renewable technologies,
- address the constraints on the development of the renewable industry.

Due to various problems that South Africa faces, it is understandable that environmental concerns, included the implementation of renewable energy, are relatively low on the priority list of the South African government. Cheap coal is abundantly available which allows the national utility ESKOM to produce electricity at low costs. The main barrier in 'energising' all African households, which is one of the governments priorities, is formed by the extension of the grid rather than by increasing the electricity generation capacity. The extension of the grid is an enormous project and will take decades to be finished.

Given this background, the main drivers for renewable power generation are not related to environmental concerns, but rather to:

- economic advantages above centralised production,
- supporting the transformation of state-owned entities, including the reshaping of governance principles,
- increasing the socio-economic welfare within communities.

2.1 Grid-connected renewable energy

2.1.1 ESKOM's role

ESKOM's motivation to start activities in the field of renewable energy also reflects the above mentioned drivers, together with some additional, more strategic drivers:

- possible future environmental pressure (health on national level and climate change-related on international level,
- because it is possibly a cost-effective means to meet the challenge of electrification (eventually enhanced by climate change-related financing, mainly CDM[2]),
- to avoid being forced (by the government) to investigate and finance projects that are initiated outside of ESKOM which from their point of view are not viable,
- the need for diversification in fuel-input.

ESKOM initiated the South African Bulk Renewable Energy Generation (SABRE-Gen). This is an extensive programme to evaluate whether utility scale, renewable electricity generation is a viable supply-side option for ESKOM and South Africa. Of the four focus areas, namely wind, solar thermal, biomass and wave, the first two are the most advanced, with demonstration projects to be implemented soon. Apart from this program, ESKOM is involved in four small hydro power plants in the present Eastern Cape province. The total capacity amounts to some 60 MW installed capacity.

2.1.2 Regional Electricity Distributors and Independent Power Producers

The above overview illustrates that the renewable power generation market is still underdeveloped. ESKOM's initiatives are still in their early phase and have explicitly an investigative and demonstrative character. It is not expected that the program will develop into a full-blown renewable power programme. With regard to independent power producers (IPPs) the situation is even worse. Only a few licences have been awarded for relative small installations.

Given the monopolistic character of ESKOM, the reformation of the power sector is going to be difficult. At the moment there are no large IPPs. The environment for setting up green IPPs is far from ideal.

A first barrier: financial viability

[2] Clean Development Mechanism, foreseen in the Kyoto Protocol

A first main barrier is the financial viability. The wholesale price of ESKOM's electricity varies greatly depending on geography and scale of the body buying the electricity. In general it can be stated that, although IPPs will not have the large transmission costs that are included in ESKOM's tariffs, it will be hard for renewables to compete with ESKOM's centralised coal-based power generation. Fossil fuel-based IPPs in key locations may be already competitive by avoiding transmission costs. Renewable IPPs will always need the 'external' costs to be accounted for in order to compete.

When some hidden costs are included, like the subsidising of ESKOM by not subjecting it to taxation, dividend withdrawal environmental costs and health impact, the picture will be different. Incorporating all these costs will put renewables in a much better position. In the framework of the restructuring of the power sector, ESKOM will face a reduction of the 'hidden' subsidies, but the incorporation of environmental costs and health impact is not a policy issue for the time being.

A second barrier: unclear policy with regard to restructuring of the power sector

A second major barrier is the unclear policy with regard to the restructuring of the power sector, the possibility of negotiating long-term power purchase agreements (PPAs), the role of the National Electricity Regulator (NER) and the open access to the National Transmission System. The South African Government is currently considering implementing reform initiatives in both the Electricity Distribution Industry (EDI) and the Electricity Supply Industry (ESI). Reform of the EDI is being initiated primarily because the industry is fragmented, with many distributors not being financially viable. ESI reform follows international trends whereby competition and greater private sector participation is being called for.

As a first step in the restructuring of the electricity industry, the Government plans to corporatise ESKOM, subjecting it to taxation and dividends withdrawal. As part of the restructuring process, the distribution part will be divided in six regional Electricity Distributors. Due to the policy of transformation of state-owned entities and the reshaping of governance principles, there will be room for IPPs to enter the market in the near future, but apart from some smaller entities, the first one still has to be established. This first IPP is facing a lot of organisational and juridical troubles, but will in the end probably pave the way for other initiatives.

It may be concluded that rationalisation of the Electricity Distribution Industry (EDI) will not in itself impact considerably on the fate of renewable energy generation in South Africa. However it provides an essential step towards a better environment for IPPs because ESI reform initiatives assume a maximum number of financially viable regional electricity distributors (REDs) operating in a more competitive environment, and one in which there is ultimately more private sector participation.

An important issue for private investors is the possibility of negotiating a long-term PPA. In the present environment, securing a PPA is critical to the success of IPPs. A long-term PPA is essential for obtaining commercial financing for the project. Unfortunately NER has stated that it will not approve applications for generation license involving a long-term PPA. Since NER requires such a license for generation above 5 GWh/year, this stance is a very critical barrier. One of the reasons for NER's stance is the perceived risk of allowing competition too early in the restructuring process. IPPs will have to arrange their contracts with NER. At this moment the NER is opposing contracts with clients or with IPPs for longer than 5 years. Current plans are to allow big consumers (over 100 MW) buying their electricity from any supplier nation wide.

The White Paper on Energy Policy (1998) notes that IPPs will be allowed to enter the electricity market, but that full competition will not occur until the distribution sector restructuring and electrification is completed. In the interim period, before the advent of full competition, the

White Paper envisages ESKOM's transmission business publishing ‘approved tariffs for the purchase of co-generation and independently generated electricity on the basis of full avoided costs’. This establishes a situation where IPPs and co-generators act as contractors to ESKOM in meeting customer's electricity needs, but do not compete openly with ESKOM. The WPEP requires the NER to approve the tariffs paid by ESKOM Transmission to IPPs and co-generators. An important consideration will be whether the tariff arrangements proposed by ESKOM adequately reflect the full avoided costs of purchasing electricity from IPPs and whether they are sufficient to encourage the entrance of new players. The NER will also be required to issue licenses to these new players and to make the necessary amendments to ESKOM's licences. Licences will stipulate for how long the proposed tariff arrangements will last and to whom IPPs are allowed to sell during the interim period.

The White Paper recognises ***that open non-discriminatory access to the transmission lines*** is a prerequisite for open competition in the generation market. This requires the NER to ensure that neither the technical terms on which access is provided, the access charging levels, nor the method of calculating use of the transmission system forms a barrier to entry for independent generators. In this field many arrangements still have to be made. It is clear that these policy-related issues, as long as they are unclear, do not offer a stimulating environment for IPPs to enter the market.

2.2 Off-grid Renewable Energy

One of the main priorities in South Africa is job creation. The issue of improving energy services in rural areas is very much inter-linked with job creation as well as with the broader concept of rural development. There seems to be a vicious circle of households not being able to pay for improved energy services, while the absence of these services inhibit rural households from a large selection of income generating activities. With regard to broader rural development, energy plays also a key role in enabling other social services, such as health and education. The key challenge for rural energy in South Africa is therefore how income generation activities and rural energy provision can be promoted simultaneously.

2.2.1 Rural electrification policy

Electrification of households is one of the core objectives of the Reconstruction and Development Programme adopted by the Government of South Africa in 1994, with a target of 72% electrification by 2000. The South African Department of Minerals and Energy (DME) considers electrification as the most important policy objective of the White Paper in the electricity sub-sector. The White Paper recognises the potential role for solar home systems (SHS) and other renewable energy technologies in providing energy services to remote rural communities.

Throughout South Africa, two-thirds of the households have been electrified, while in rural areas, more than half the population is electrified. Since 1992, ESKOM has launched the campaign ‘Electricity for all’ and embarked upon an ambitious programme to electrify South Africa. Despite an impressive record by ESKOM in terms of connecting people, it is estimated that 3.3 million households are not connected to the grid and that 2.1 million of these will not receive ESKOM electricity in the near future.

2.2.2 The Non-Grid Rural Energy Programme

The DME has developed a mechanism to provide electricity and power to those communities that are not planned to be connected to the electricity grid. In 1999, a process was started in which private companies were awarded concessions to supply energy services to rural households beyond the reach of the national grid by means of the fee-for-service (FFS)

approach. The objective of the concession pilot programme in South Africa is to provide rural energy services to 300,000 households in the next 5 years, with each concessionaire being responsible for 50,000 households.

In terms of its size, structure and challenges, the concession programme is a unique project embarked upon by the Government of South Africa, and belongs amongst the cutting edge policy approaches of off-grid rural electrification in the world. If it is to be successful, it will have provided 300,000 households with off-grid renewable energy (mostly Solar Home Systems) and will have set the stage for further large-scale deployment of renewables to rural communities in South Africa. It is largely financed by the GEF.

In anticipation of implementation, the following hurdles may be expected:

- ESKOM/Concessionaires relations with regard to Eskom disclosing grid extension programmes in the assigned concession areas,
- fee-for-service concept is a new approach and still needs to be proven in the South African context, especially in terms of payment discipline and ownership issues,
- social impact: if poor households cannot afford the monthly fee, the Non-Grid Electrification Programme ends up benefiting only more affluent households in rural areas,
- bad image of photovoltaic (PV) in rural areas in South Africa through fly-by-night companies that sell low-quality systems without technical backup.

2.2.3 The commercial SHS market

An estimated 50,000-80,000 PV Solar Home Systems have been installed in South Africa so far, providing basic electricity services. This amounts to less than 1% of the initially un-electrified community. This market has made limited use of credit mechanisms to increase market size. Fee for Service has only been implemented in 6,000 systems that were part of a pilot-phase of the Shell-ESKOM concession area. A number of other initiatives in the field of off-grid rural electrification are summarised below.

Apart from the commercial SHS market, there exists a PV market in South Africa for the electrification of schools and clinics, telecom applications and water pumping. In the report an analysis of the opportunities and barriers of the different markets has been made, providing input for the following recommendations, in which the EU and its member states could offer major contributions.

2.2.4 Pilot projects

In 1994 the Lubisi Dam project was started to demonstrate the use of renewable (hydro, wind, solar and biomass) energy to accelerate development in a rural area. During the first 18 months of the project, no technology flow occurred at all, as the time was spent on the sociological aspects of encouraging the local people to form a representative structure which represented all the persons in the society. Their priorities were found to be: (1) Water supply, (2) Agriculture, (3) Job creation through Small and Medium Enterprises, (4) Transport and transport infrastructure, (5) Energy and electricity. Even though energy is last on this list, it was felt to be key to any future development.

The CSIR subsequently assessed a number of options for improving the livelihoods of the people, including water supply, fish farming, road upgrading, cotton farming, fence making, etc. A project based on small wind turbines is now in operation.

Another initiative currently being undertaken is a remote area power supply programme of the Independent Development Trust (IDT), which will provide an opportunity for partnerships to bring the greatest impact in rural economic development through the provision of energy

services. It is envisaged that the programme will be launched through the initiation of 50 pilot projects sites across the country. The technology for viable off-grid electrification of communities (rather than households) based on renewables is available, proven and reliable. Financing for piloting off-grid projects to accelerate the pace of rural electrification is available from a variety of concessional sources.

Hluleka Nature Reserve provides an anchor for new economic activities that could benefit the nature reserve as well as create new jobs for the adjacent community. Discussions with ESKOM have revealed that it is unlikely that the electricity grid will be extended to the Hluleka Nature Reserve area. Consequently, if the potential demand for electricity and power is not stimulated through the establishment and stimulation of new economic activities, it is unlikely that sustainable socio-economic upliftment of the area will occur. As it is unlikely that the grid will be extended to the Hluleka Nature Reserve area alternative options need to be implemented to provide adequate electricity and power. An option that will be considered is the establishment of a mini-grid. The power station and distribution network will initially not be connected to the Eskom grid.

2.2.5 Integrate energy with other development initiatives

Co-ordinate electrification with other development programmes

It is important to recognise that the relation of rural electrification to economic development is not straightforward. Apart from the provision of electricity, there are a number of other conditions which have to be met in order for rural electrification to result in net economic benefits for rural areas (these conditions were identified by the World Bank in 1985 (Annecke, 1998). Electrification may contribute to economic development provided that:

- The quality of infrastructure, particularly of roads is reasonably good.
- There is evidence of growth of output from agriculture.
- There is evidence of a growing number of productive uses in farms and agro-industries.
- There are a large number of villages, not too widely scattered.
- Income and living standards are improving.
- There are plans for developing the area.

Apart from these, the provision of telecommunication and basic multi-media services is often considered an important element. Besides the focus on economic development, the contribution of electrification towards social development will require additional support.

To improve the impact of energy services on development requires an integrated approach in which the provision of improved energy services is co-ordinated with other development approaches. The actors for off-grid renewables will be the concessionaires, ESKOM and future REDs.

Thom et al. (2000) list a number of recommendations regarding the co-ordination of the rural energy programme with other development programmes, including:

- Domestic water supply projects - Department of Water Affairs and Forestry (DWAF).
- Irrigation projects as part of small-scale agricultural schemes involving collectives of small growers.
- Clinic electrification programme - Department of Health.
- School electrification programme - Department of Education.
- Institutions responsible for Small and Medium Scale Enterprise development (for example Ntsika Enterprise Promotion Agency).

Other areas for collaboration are:

- The business development programmes for which the Department of Trade and Industry is responsible.

- Department for Provincial and Local Government to co-ordinate development efforts and to strengthen local development initiatives.

3. THE EUROPEAN EXPERIENCES

3.1 European Experience with Renewable Energy Technology

During the last decades, European countries have gained a lot of experiences with renewable energy technologies (RE). The main categories that are commercially viable are Hydro, Wind, Solar and Biomass. Wave Energy is now being developed commercially. This paragraph provides a short overview of these technologies.

3.1.1 Wind energy

The last twenty years have seen considerable developments in wind turbine technology. Wind turbines have fallen in price and increased in size and reliability. In Europe wind turbines are currently generating power at prices close to being commercially viable. A problem with wind energy in many areas is the seasonal and diurnal variability of the resource. This it makes it more difficult to use a resource. In Europe, wind energy is being used in a fuel substitution role with the back up of a grid system. This is a practical system but is not representative for situations in many other parts of the world.

Wind energy has grown at 40% per annum for the last five years, which makes it the fastest growing renewable energy source. Almost $4 billion of sales were recorded in 1999 according to BTM, the Danish consultancy group. Total installed capacity is now around 14,000 MW of which 4000 were installed in 1999. Europe is now the leading area for wind energy with Germany and Spain as the leading countries. In both countries attractive tariffs have been established to encourage investment.

The high volume of sales reflects many things. The technology is increasingly regarded as mature, the size of the wind turbines has increased and reliability is now high. Productivity of new machines has increased from around 1300kWh per installed kilowatt in Denmark in 1983, to 2000 kWh/kW in 1996 Capital costs for new large machines >500kW are $1000 per installed kW. Maintenance costs for new machines are between $0.006 to $0.01 per kWh. A number of companies are now manufacturing machines of 1MW or greater. Many now consider machines of <500 kW as small.

Almost all of the installed capacity is on-shore. Offshore developments have been slow to develop due to the high cost of foundations but a few offshore wind farms are now in operation, showing the successful exploration of a very large future potential.

3.1.2 Hydro power

Although hydropower in Europe is only considered renewable below an installed capacity of 10MW, it is discussed here generally. Hydropower has been established as a highly efficient and reliable power source over many years. It provides the bulk of the renewable energy generated on a global basis. In Europe, the 92 GW was installed in 1995, generating a total of 307 TWh. This accounted for 92% of the renewable energy generated. World capacity is about 660 GW.

The technology is regarded as very mature, with very limited scope for technical improvement. Developments are very site specific and in Europe there are increasing environmental concern

regarding the construction of major new schemes. There is more scope for developing smaller schemes (under 10MW), including run-of-river schemes. Unlike many other renewable energy sources, hydropower is usually continuous and often has some element of energy storage built in.

3.1.3 Wave power

Over the last five years there has been renewed interest in this field. Wave power has long been recognised to have huge potential but efforts to develop viable schemes have proved very difficult. The power of the sea has proved difficult to harness in an economically viable structure.

Wave energy devices can be split into three categories - Shoreline, Close to shore and Offshore. Shoreline devices have the obvious advantage of ease of access for both construction and maintenance. However the wave regime is usually weaker at the shore unless steps are taken to focus the waves.

The most common device employed on the shoreline is the oscillating water column (OWC). Wavegen of Scotland commissioned a 500 kW Limpet on the island of Islay of the West Coast of Scotland in December 2000. This is in operation. Other sites have been developed in the Azores, Australia and in Norway.

An example of a close-to-shore device is the Osprey. The operating principles are the same, but the device is deployed off shore. A 2MW model was built in 1995, which was destroyed during installation. Modified designs have now been produced and it is planned to build a second device in the near future. The design also incorporates an offshore 1.5 MW wind turbine giving a total output of 3.5 MW.

Lastly, there are a wide variety of devices that have been tested at the prototype stage. These are reviewed by Thorpe. These are mainly low output devices up to a few hundred kilowatts with larger units being multiples of smaller ones. None of these is as yet at a stage when commercial deployment is close.

Wave power is in its infancy. Commercial units are only now being developed and generating costs are therefore higher than they will be in a few years time. It is expected that wave power development will be similar to wind power where it took a number of years for it to become competitive.

3.1.4 Solar energy

Solar energy can be used in two forms. Either as thermal energy by heating a fluid or by converting it into electricity using photovoltaic arrays (PV). In either event solar energy is a diffuse source of energy and requires large collectors, which tend to be expensive and require access to large areas of land that can often be problematical. Solar energy in whatever form has the drawback of being only available part of the time. This means that any device using this as a source has to have back-up storage or it has to shut down.

3.1.5 Solar Thermal - Water & Space Heating

Solar thermal systems are so widely used that they can be considered conventional. Over the last 20 years, it would be safe to say that all the known product types of solar thermal equipment have been sold in Europe. A wide variety of collection devices have been developed to harness thermal energy. The most common is the flat plate collector. These are widely used domestically to provide domestic hot water. These have been continuously refined over the years and now provide a very reliable and economical form of water heating in many countries.

These are also being used in some northern areas to provide space heating as well. These combined systems are much larger in area than the simple water heater with entire roofs or south facing walls being covered in solar panels.

3.1.6 Solar Thermal - Electricity Production

Thermal systems have also been developed for power generation. These systems need to generate energy at higher temperatures and consequently use more sophisticated focussed collection arrays. In these, the heating medium flows through a tube, which is surrounded by a parabolic reflector focusing the solar energy on to the tube through which the heating medium flows. Alternatively tracking mirrors can be used to focus the thermal energy to a central boiler. A whole variety of such devices are currently under development. None can be said to be commercial at this time.

At present, the cost effectiveness of grid connected solar thermal power production, even in South Europe, is considered to be barely sufficient for commercial development. However, European technological know-how can be exported to sunnier places. European engineering companies are involved with several large international solar thermal projects; for example, the 2.5 million square meters of parabolic trough mirrors, used in the solar electric generating plants in California, were manufactured in Germany.

3.1.7 Solar - Photo Voltaic

Photovoltaics are specially designed semiconductor devices that convert sunlight directly into electricity. PVs are modular devices. Thus, they can be used to provide electricity for low power consumer products such as calculators and watches, or to cover higher power requirements for village electrification or MW range centralised power stations.

R&D efforts have concentrated on the development of improved solar cell designs for the already widely used materials and on lowering the cost of the PV module manufacturing processes. New designs aim to increasing solar cell efficiencies (that is the ratio or electric energy produced by the solar cell to the incident solar energy) but without substantial increases in manufacturing costs. A complete PV system may include also other components (balance-of-system, BOS) such as structural parts (e.g. support structure, tracking structures), power conditioning (e.g. inverters).

3.1.8 Biomass

Biomass fuels are derived from four sources: forestry residues - as a by-product of timber and pulp production; agricultural residues - e.g. straw from cereal production; agro-processing residues - from crop processing; and energy crops grown specially for use as a fuel. These can be used to generate electricity in thermal power plant.

Conventional combustion technology is relatively expensive and has limited development potential for biomass electricity. Advanced technologies that convert the biomass to gas or liquid before combustion show the promise of lower overall costs. Co-utilisation with fossil fuels in an existing boiler is potentially the lowest cost option but is limited to use in areas with existing coal plants.

Substantial use of forestry residues within the EU is currently limited to Sweden and Finland, although there is scope for other EU countries to follow this lead. Agricultural residues are a difficult fuel to burn efficiently, but the technology is being developed and there is now some deployment, mainly in Denmark. Agro-processing residues are not an important resource in the EU, but represent an export opportunity for the power engineering industry.

Coppiced wood species, e.g. willow and poplar, are the most widely used energy crops. Other crops such as grasses that may have higher yields, especially in the more southern EU Member States, are being developed. Energy crops are important to the long-term strategy of the EU because they are the only biomass fuel that can be expanded sufficiently to significantly shift the pattern of EU energy supply. The use of wood residues in the wood processing industry is widespread and the equipment used can be considered mature.

3.1.9 Tidal Energy

Tidal energy can be exploited in two ways: (1) by building semi-permeable barrages across estuaries with a high tidal range and (2) by harnessing offshore tidal streams. Barrages allow tidal waters to fill an estuary via sluices and to empty through turbines. Tidal streams can be harnessed using offshore underwater devices similar to wind turbines; tidal stream technology is in its infancy, with only one prototype 5kW machine operational in the world. Tidal energy is currently more expensive to generate than many other renewable sources. The potential for South Africa is limited.

3.2 Support for Renewable Energy in the European Union

3.2.1 Renewable Energy policy background

All of the countries in the EU are committed to developing their RE resources. Environmental aspects, linked to national greenhouse gas reduction targets, are the main motivation for governments to promote RE, together with energy supply security. There is a commitment following the Kyoto conference to reduce the emission of greenhouse gases 8% by the period 2008-2012 relative to their levels in 1990. Other important factors include job creation and the increasing competitiveness of renewable energy sources. The target for 2010 is to cover 10% of European total energy demand with RE. This would be approximately 23% of the total electricity demand.

Currently renewable energy accounts for around 6% of European total energy usage and 15% of electricity consumption. The pattern of RE usage varies widely across the EU and is mainly determined by geographical factors. Biomass is used in the form of forestry waste products in the northern countries where there are abundant resources. Hydropower has been in use for many years and accounts for 30% of the total. It is well developed in the areas where mountains and rainfall permit. Wind is undoubtedly the fastest growing renewable energy sector. A lot of attention is also given to the introduction of photovoltaic energy, although the contribution of this technology, in absolute terms, is rather small.

The characteristics of the RE technologies vary greatly: some provide electricity, others heat. Some are small-scale and decentralised others are in the multi-MW-range. Some are economically competitive; others still need - apart from niche market applications - additional support. Some are ‘classical’, others still in the experimental stage. This diversity needs flexible ‘tailor-made’ promotional instruments and the survey clearly show that Member States are generally looking for packages of appropriate instruments.

All national Member States acknowledge that independent power production is necessary for ‘green’ electricity to be injected into the grid. All the Member States have special, favourable premium prices for electricity generated from RE. The approaches, however, vary greatly. Such premium prices may be subject to competition, may be mandatory on utilities at a price level fixed by the government, or may be the consumer's choice. Premium prices may also vary in relation to the energy source in question (higher for PV, lower for wind, biomass and small hydro).

Governments generally consider premium pricing alone as insufficient to trigger wide-scale RE dissemination, and therefore provide additional assistance in form of grants, low-interest loans, or tax incentives. Such support may be given for RE producing heat (solar collectors, firewood, biofuels), those electricity generating RE considered to be not yet economically competitive or to balance less favourable boundary conditions (e.g. wind in off-coast areas).

3.2.2 Renewable Energy RTD

Renewable energies are a classical field for research and technology development (RTD). In the majority of the European countries, there are national RTD programmes. These may be limited to institutional support to research centres/ universities, but also include programmes for the support of individual projects. RTD programmes generally focus on the RE offering the largest national potential, and on photovoltaics, considered to be the sector offering the most important cost reduction potential via technological innovations.

In many countries attention is also given to demonstration programmes, in order to bridge the gap between lab-scale or pilot plants (as the result of an RTD project) and large-scale dissemination

Technology- and investment-related support measures are usually accompanied by actions addressing legislation and standardisation, information and advice to potential consumers as well as professional training activities.

3.2.3 Different support mechanisms

Several economic RE support mechanisms are currently used in various EU Member States. These support mechanisms can be distinguished in competitive quota-based mechanisms, i.e. tendering and tradable green certificates, and non-competitive subsidies and feed-in tariffs. Furthermore, support may be targeted towards RE capacity or RE generation. Support mechanisms that reward a RE generator for its generated output provide a strong incentive to maintain and improve operational performance and to increase the generator's output. This is preferable to capacity support if a government seeks to increase the share of electricity from renewable sources in the overall generation mix. Output subsidies and feed-in tariffs, however, can become very costly as the renewable electricity generation increases. Contrary to output subsidies and feed-in tariffs, quota-based mechanisms stimulate competition and thereby provide a strong incentive to reduce the cost of renewable electricity. Furthermore, fiscal instruments can be employed to reduce the cost differential between renewable and non-renewable electricity generation.

3.2.4 Different incentive schemes

Most EU Member States employ several policy instruments in parallel to promote the generation of electricity from renewable sources (see http://www.agores.org and http://www3.jrc.es/ projects/eneriure). Table 1 lists the main and additional policy instruments per Member State. It should be noted that, in addition to specific RE policies, other policies, such as grid access and tariff regulations or local spatial planning procedures, may also be very important to the development of the RE projects. Both often impose significant barriers to RE project realisation.

Another aspect that deserves some attention is the quality of the installed equipment. RE technology often has to meet certain safety requirements. These can be technology specific, as is the case for wind turbines, or they can coincide with sector or industry codes, such as building codes for the integration of photovoltaic systems in rooftops. There are no requirements

concerning the operational quality of the equipment, such as the amount and reliability of output and the conversion efficiency. Incentives to maintain and increase operational performance can be tied to the support mechanism that is used. Subsidies on output provide a strong incentive to improve operational performance, since the amount of subsidy is directly proportional to the output that is generated. Support mechanisms that are based on competitive mechanisms, such as tendering and tradable green certificates, also reward RE generators for maintaining and improving continued generation, reliability and efficiency. Moreover, competitive mechanisms provide an incentive to reduce the cost of renewable electricity generation at the same time.

Table 1 *Overview of renewable energy policy instruments per EU Member State*

	Investment subsidy	Feed-in tariff	Tender	Fiscal or tax	Green certificates
Austria	O	+	o		
Belgium		O		o	+
Denmark		O		o	+
Finland	+			o	
France	+	O	o		
Germany	+	+			
Greece	+	+		o	
Ireland	+		+	o	
Italy		O		o	
Luxembourg		O			
Netherlands	+			o	+
Portugal		O			
Spain		O		o	
Sweden	+	O			
UK			+		

+ = main instrument
o = additional instrument

3.3 Climate Change support mechanisms for renewables

The EU and its member countries support activities addressing climate change in developing countries not only through contributions to the GEF but also directly and through other multilateral channels.

One of the priority themes is assisting developing countries in the implementation of their obligations within the UNFCCC. Specific priorities for funding are preparatory activities for the implementation of the Clean Development Mechanism (CDM), energy efficiency and renewable energy.

3.3.1 The European Commission

The EC is contributing to capacity building of institutions in non-Annex I countries. Such projects should give incentives to the private sector in the host country to invest in CDM projects (research, education, communication and public awareness) and should assist the public administration to put in place the necessary structures for the identification, evaluation and selection of projects. Priority must be given to projects which favour the development of clean technologies (for example, renewable energies) and/or which involve NGOs in the process of selecting projects.

3.3.2 EU member countries

To what extent EU members states will be engaged in CDM depends on their national reduction targets in relation to the costs of greenhouse gas abatement in their own countries. Certainly not all countries will be actively looking for purchasing CDM credits. These countries also use multilateral institutions like the UNDP and World Bank[3] to promote capacity building and to purchase credits. EU member countries which do have already concrete initiatives on CDM are: Denmark, Finland, the Netherlands and Sweden. Other countries include Norway and Canada.

3.3.3 Climate Change in South Africa

Climate change issues are officially dealt with by the Department of Environmental Affairs and Tourism (DEAT). The National Climate Change Committee (NCCC) is mandated to advise DEAT in these matters. NCCC is formed by representatives of many sectors including government, large industries (ESKOM, Sasol, etc.), industry associations, universities, research institutions and NGOs, and chaired by DEAT.

One of the few projects to enable South Africa for CDM was developed by the Energy and Development Research Centre (EDRC) This project prepared a scan of potential CDM project areas. The areas identified for renewables are further commented as follows:

- *Wind farms*
  There is increasing interest in the development of small-scale wind generating stations in the Western Cape. While these projects will be small compared with overall capacity, their viability may be improved significantly if included in a CDM initiative.
- *Solar energy*
  Small scale and stand-alone photovoltaic systems represent a cost-effective solution to remote area power supply. Again, this is unlikely to make a large impact on the overall supply of energy but represents a niche opportunity for CDM projects.
- *Electricity from biomass*
  The combustion of plant material grown expressly for electricity production.

Co-generation (of heat and power) as mentioned by EDRC may include the use of renewables. The most likely case in South Africa is increasing cogeneration in sugar mills and sawmills over their internal power demand, thus feeding the excess to the grid. In certain conditions, pulp and paper mills can also co-generate and sell excess power.

For off-grid renewable energy projects to be viable within the CDM, the transactions costs of their participation must not outweigh the value of Certified Emission Reductions (CERs) they generate. In order to keep transaction costs low, CDM eligibility rules should be fit for purpose and CER calculation procedures kept simple. This would be stimulated if the Government of South Africa would adopt a special CDM window for off-grid renewable energy systems under the CDM.

[3] Most notably the Prototype Carbon Fund of the World Bank will be actively looking for purchasing CDM credits.

4. ACTIONS FOR SOUTH AFRICAN - EUROPEAN CO-OPERATION ON RENEWABLE ENERGY

Although the deployment of renewable energy varies throughout the EU, the member states have in general an advanced renewable energy development programme compared to South Africa. This can be advantageous for South Africa in two ways:

- South Africa can benefit from the experience gained in the use of financial incentives and institutional arrangements for the promotion of renewable energy technologies,
- South Africa can benefit from the experience gained and the availability of mature renewable energy technologies together with a developed renewable energy industry including producers, developers and investors.

In this chapter, further actions are recommended to stimulate the market penetration of renewable energy technologies in South Africa. They are structured in actions to enhance the policy framework for renewable power generation (4.1), actions to enhance the policy framework for off-grid renewable energy (4.2) and recommendations to stimulate renewable energy project development (4.3). The text box below provides a summary of the actions.

Text Box – Summary of recommendations to stimulate the market penetration of renewable energy technologies

Actions to enhance the policy framework for renewable power generation
Action 1: Development of a 200 MW set-aside programme
Action 2: Develop and implement power purchase regulation
Action 3: Capacity building

Other policy related actions
- Disseminate successes and failures
- Integrated resource planning
- Tariff Structure
- Innovative financing
- Green power Marketing

Actions to enhance the policy framework for off-grid renewable energy
Action 1: Government stakeholders should convey the same message
Action 2: Raise awareness of end-users on electrification planning, the non-grid rural electrification programme, and renewable energy technologies
Action 3: Make electrification planning more transparent
Action 4: Integrate energy planning into Integrated Development Planning Process
Action 5: Capacity building to support the implementation of the non-grid electrification programme focusing on:
1) improved monitoring and evaluation capacity at DME, NER,
2) technical and financial assistance for concessionaires.

Other relevant actions:
- Conduct research on the optimal rural energy service structure
- Concessionaires should be responsible for all non-grid energy services in their concession area
- Special risk mitigation measures for economic activities
- Launch integrated PV follow up programme

Actions to promote demonstration and commercial projects
Action 1: Provide financial support
Action 2: Capacity building
Action 3: Provide technology

The recommended actions are based on the analysis done by the Synergy Project team, the results of which have been discussed at the workshop held with relevant stakeholders in February 2001 in Pretoria. In this workshop the recommendations were evaluated, elaborated, discussed and prioritised. Of course, the responsibility for the recommendations lies entirely with the project team.

4.1 Actions to enhance the policy framework for renewable power generation

In order to utilise the EU experiences, activities like knowledge transfer, studies and co-operative research should play an important role. This paragraph elaborates upon the potential role of the EU and EU countries in policy related activities.

It is important to note that since 1998 DME and an EU party, the Danish Co-operation for Environment and Development (DANCED), have taken steps to support bulk wind energy generation in South Africa, using the Darling Wind Farm as a pilot project. Studies for the development of the farm would be financed by DANCED and the United Nations Development Programme (UNDP), with some of the funds coming from the Global Environment Facility (GEF).

The first step was research on independent bulk power production with renewable energy sources. The initial outcomes were discussed with relevant stakeholders in September 2000. The resulting DME/DANCED study presents recommendations to DME and NER on the way forward. The actions presented below are in line with many of those recommendations

***Action 1**: Development of a set-aside programme*

The SA government commits itself to the development of a set-aside programme. The aim of this programme is to reserve a fraction of the total power demand (an initial block of 200 MW is being proposed) to the most competitive renewable energy producers. The distribution companies would be obliged to purchase the renewable power at premium prices.

Expertise would be required to assist DME and NER in designing the pilot phase of the set-aside and fitting it in the ESI and EDI restructuring processes. Interested developers and investors would also need assistance to participate in the selection process and then in the development of the IPPs.

Potential EU collaboration for the above may be requested from implementing bodies of countries already well experienced on set-aside programmes, notably the Department of Trade and Industry in the UK, responsible for the Non-fossil Fuel Obligation (NFFO). EU developers and investors participating in the national set-aside programmes could also be linked to their counterparts in South Africa in need of assistance, in order to develop collaboration and partnerships.

The majority of the Synergy workshop participants regarded the development of a set-aside programme as the most important action to be implemented on short term. Some additional remarks were made:

- The 200 MW set-aside should be seen as an initial target, not as a limit.
- Legislation should be adapted in order to put the set-aside in place.
- Clear and transparent rules must be developed and applied in order to enable a fair and proper competition.
- It should be clarified whether Eskom should be able to participate in the competition; the general feeling was that this should be the case, but that ‘small’ producers should be protected against large ones.

For most stakeholders, it is unclear what they have to expect in the near future. In order to develop strategies and plans, it is essential for DME to develop and communicate a clear policy, including a time frame with deadlines, available budgets and responsible bodies. EU contributions in the policy field should be clearly focussed on assisting DME in realising this short-term target.

***Action 2**: Develop and implement power purchase regulation*
Renewable IPPs and utilities have conflicting views on the value of the power to be transacted, so the purchase needs to be regulated by an independent body (e.g. NER). In the DME/DLANCED study an interim regulation is proposed from the beginning of the set-aside programme, to be later amended to encourage renewable IPPs beyond the set-aside.

Some expertise is needed to help the power purchase regulator in developing key issues (e.g. determination of avoided costs, compensation for externalities…). Bodies responsible for regulation and/or tariff setting in most EU countries (e.g. Germany, Denmark, Spain, just to mention some) have experience on these issues that may be relevant to South Africa.

The Synergy workshop participants regarded this action as highly important. The following items were addressed during the workshop:
- The roles and mandates of NER and DME should be updated. Their competence should be clearly defined to avoid mutual interference and conflicts.
- NER should revise the 5-year limitation to PPA currently in place.
- NER should conduct capacity planning aimed at ensuring continuity of electric supply.

Also for this action it is essential for DME and NER to develop and communicate on short term a clear policy, including a time frame for actions with deadlines and responsible bodies. Both DME and NER could benefit largely from specific assistance of relevant EU bodies.

***Action 3**: Capacity building*
The pending restructuring process of the electricity sector will be very demanding for DME and NER, especially if the development of grid-connected renewables is to be integrated in the process. Both institutions feel that their capacity on renewables should be further developed.

It is important to note that DANCED is preparing a possible support to the DME on renewables and energy efficiency. A study tour to Denmark was arranged for August 2000 with participants from DME and NER, aimed at providing them with a direct insight of the Danish policies, strategies, regulation and institutional arrangements regarding renewables and energy efficiency.

Additional support on the implementation of grid-connected renewables may be obtained from other EU parties with relevant experience. For example, the current collaboration between DME, CSIR and the Netherlands (e.g. ECN) may be enhanced towards complementing the possible support by DANCED.

Bilateral programs between EU countries and South Africa have been shown to be effective and should be extended and further developed.

Other policy related actions

- *Disseminate successes and failures*

Europe has gained a lot of experience in matters of policy, regulation, market liberalisation, standards, project implementation, etc. Many South African stakeholders are interested to hear about the lessons learnt in Europe. This dissemination of success stories and failures should be organised in a structured way.

- *Integrated resource planning*

The WPEP requires the implementation of Integrated Resource Planning (IRP) in the ESI. IRP entails formulating plans to meet the country's future electricity needs at the lowest possible cost. Grid-connected renewables should be properly considered among the alternatives to conventional power supply, in order to ensure the gradual incorporation of the renewable potential in the energy system.

Expertise is required at DME and NER to include renewables in the modelling and forecasting procedures that will produce data for the IRP exercise. Some collaboration is already on the way between DME and the Netherlands Energy Foundation (ECN) regarding integrated energy planning at the sectoral level. This could be extended to cover the above mentioned needs of DME and NER, with the eventual participation of other relevant EU parties.

- *Tariff structure*

The WPEP states that tariffs for IPPs should consider full avoided costs; furthermore, it notes that environmental costs should be included in order to promote renewable generation. Along with power purchasing agreements, tariffs are the most important issue for making renewable IPPs viable beyond the set-asides.

Expertise is needed to design a tariff structure that promotes competition and efficiency, and at the same time considers the inherent disadvantages of renewables, especially environmental externalities. As mentioned earlier, bodies responsible for tariff setting in most EU countries have extensive expertise to share with South African counterparts.

- *Innovative financing*

Renewable IPPs face much more expensive finance as compared to conventional utilities. Expertise is required to assess the real risks of lending to renewable IPPs and to develop innovative finance packages addressing the particular characteristics of renewable grid generation, e.g. equity and debt capital, risk guarantee schemes, etc.

Most EU governments are familiar with specialised financing for renewables, notably in France, the UK, Spain, Germany and Italy. Implementation bodies in EU countries may be in position to collaborate with South African parties in the development of appropriate financial mechanisms.

- *Green power marketing*

Demand for green energy is slowly emerging in South Africa, initially from companies seeking to provide environmentally friendly products in foreign markets. Such demand should be linked to renewable IPPs as a way of covering their incremental costs.

Expertise is required to design the green energy option within the regulatory framework. Initially the regulator would approve the green tariff in a case per case basis. A market-based approach could be developed in a later stage, e.g. through green certificates.

Many EU member countries are involved in green investment funds, tariffs and/or certificates (Denmark, the Netherlands, Belgium, Germany, Italy, Finland, Sweden and the UK). Some of these experiences may be used to assist South African parties as required.

4.2 Actions to enhance the policy framework for off-grid renewable energy

In all the actions, mentioned below, the main actor to move is the Government of South Africa, and in most cases DME. The EU and European Governments could play a catalysing role by providing financial support and sharing their technical expertise for these actions. In Europe there is vast experience with the technical assistance and policy support for off-grid renewable

energy projects gained through Official Development Aid and international climate change programmes. Apart from such knowledge transfer from Europe, direct exchanges with institutions from other developing countries responsible for rural electrification should also be stimulated.

Key actions:

Action 1: *Government stakeholders should convey the same message.*

One of the main problems perceived by the concessionaires is that DME and ESKOM (Distribution) provide different interpretations/messages on the concession programme. Action required is: DME, ESKOM-D, NER should convey the same message. Also participation of the concessionaires in the whole design process should be ensured by means of formal representation.

Action 2: *Raise awareness of end-users on electrification planning, the non-grid rural electrification programme, and renewable energy technologies*

PV suffers from a bad image in South Africa.This may distort consumer choices to participate in the Non Grid Electrification Programme and lead to misconceptions of what to expect from SHSs. This is due the lack of clarity in the government plans with regard to grid electrification and non-grid electrification and enforced by the 'Electricity for all' promise of ESKOM in the early nineties. Another reason for the bad image of SHSs is the bad experience with inferior PV products sold in the past by commercial 'fly-by-night' operators.

During the workshop participants argued that the effort required to address this lack of awareness is beyond the scope of the private sector participants but should be a task for the government. The objective of such an awareness programme is to enable end-users to make informed choices on the rural energy services options provided to them either via electrification, the Non-Grid Electrification Programme (NGEP) or commercial channels. Important components of such an awareness programme are:

- electrification planning for communities,
- explanation of the NGEP,
- explanation on SHSs and other relevant renewable energy technologies, the services it does and does not provide, different available technologies and important questions to ask.

Action 3: *Make electrification planning more transparent*

One of the most important issues, which has stalled the finalisation of the concession programme, is the lack of clarity on grid extension planning. Often grid extension plans are lacking, or promises have not been fulfilled. The lack of transparency of grid extension planning may have two causes. ESKOM may not be willing to disclose information because it may expose it to more political pressure. On the other hand, disclosing such information accurately over a long period of time is also quite difficult, especially given the scale and speed of ESKOM's operations. These two issues should be approached together. Special legislation may be adopted to tackle the first issue and capacity building to tackle the second.

Action 4: *Integrate energy planning into Integrated Development Planning process*

The major challenge when trying to integrate energy into other development activities is the level where the integration will take place. In the past many national and provincial government programmes have failed at the point of delivery due to lack of capacity or involvement of local governments. As a reaction, The Department of Provincial and Local Government has introduced the Integrated Development Planning (IDP), a tool for reorganising local government and setting strategic frameworks for project delivery.

The level where electrification plans can be integrated with other development initiatives has to match with the existing institutional structure of the South African government to promote rural

development, which is the IDP process. The integration of energy into the IDP process has two major components:

- Energy planing into IDP - Considering that energy issues and income generation are high on the priority list of rural communities, it is quite relevant to develop local energy planning tools to assist districts in energy planning and decision-making. It will enable local communities to make informed choices of what is feasible and will help them express their needs towards ESKOM or the concessionaire in that area. Such a tool could be made available through the PIMS-Centre or other relevant local body.

- Making use of the implementation infrastructure of the concession programme- The concessionaires are established at the national level by DME, while the development planning through the IDP will take place at the district level. It seems therefore a priority to link the planners at the municipal level with the concessionaires. The concessionaire and the municipality could engage in the energy planning for each area and identify potential energy activities. Through such a process, concessionaires can be linked to income generation activities and assist in providing energy solutions to those initiatives.

In order to find out how energy actions can be integrated into the local IDP process, it was suggested at the workshop that a pilot project with a few interested municipalities could take place to identify the needs and key issues for such an action on the local level.

Action 5: *Capacity building to support the implementation of the Non-Grid Electrification Programme*

The Non-grid Electrification Programme is the single best opportunity for promoting the large-scale penetration of renewable energy technologies in South Africa. Because European parties are already deeply involved, stimulating this Programme is also a good opportunity to strengthen South African - European integration on renewable energy.

Given its experimental nature, there is likely be a lot of policy challenges for DME during the implementation phase of this programme. Policy flexibility on the side of DME is therefore an important component to meet its ambitious targets without jeopardising the needs of the end-users and the financial operations of the private companies. This flexibility should be enhanced within the involved implementation bodies, i.e. DME, NER and the concessionaires.

- *Improve monitoring and evaluation capacity at DME, NER*

The chances of addressing these policy challenges will be increased if proper monitoring and evaluation of the programme is conducted. It is therefore recommended that long term technical assistance to DME is provided during the implementation of the programme to strengthen the monitoring and evaluation capacity at DME and assist in finding creative solutions for the policy challenges. This technical assistance could also include a review of similar international initiatives in order to learn from other experiences with non-grid electrification in other countries.

- *Concessionaires*

The role of the concessionaires is in the first place is to operate a commercial rural energy service business in a commercial way within the margins of the NGEP. The low margins/high risk nature of their business combined with the constraints of commercial operations is likely to result in little space for the concessionaires to develop and test new practices to improve their services and try new technologies which in the long run would improve their energy services. In order to provide the flexibility within the NGEP to develop the most appropriate delivery mechanism, it is desirable to provide separate assistance to the concessionaires.

Assistance can be provided in two ways:

- Technical assistance to the concessionaires to expose them to other experiences with non-grid energy service delivery to poor rural households.
- Technical assistance to expose them to the latest technological developments on off-grid renewable energy, including new applications such as stand-alone small-scale wind turbines, small-scale biomass power generators and thermal energy providers.
- Financial assistance to enable the concessionaires to experiment with new delivery mechanisms and technologies which in the long term can improve energy service delivery in rural areas.

Apart from improving the performance of the South African programme, the improved monitoring and evaluation of the programme will make it easier for other countries to draw valuable lessons learned from this programme.

Other relevant actions

- *Conduct research on optimising South Africa's rural energy services*

Currently, the delivery of rural energy services is distributed over different providers (ESKOM, municipalities and concessionaires), which provides unclear situation on responsibilities. At the same time, as part of the Electricity Sector Restructuring, the formation of 6 Regional Electricity Distribution Companies is being considered. Apart from these developments in the electricity sector, natural gas is being introduced. These developments raise a number of questions, which are relevant for long-term energy service strategy in rural areas in South Africa. Research in the provision of rural energy services models as well as analysing the compatibility of the current models to meet the long term energy needs of rural provisions would provide useful inputs into the long term rural energy policy decision making.

- *Concessionaires should be responsible for all non-grid energy services in their concession area*

By setting up the concession system, there is now an implementation capacity in place to deliver energy services in rural areas. The concessionaires will in the first instance be very much focused on delivering energy services to rural households, i.e. for consumptive applications. At the same time, there is a need for establishing energy services for rural industries as well. Since concessionaires have already the infrastructure in place, and the level of risk of such activities is too high to allow competition, they should also be mandated to provide other off-grid energy services in their area.

- *Special risk mitigation measures for economic activities*

The government should try to put in place separate measures to facilitate the investments in renewable energy projects to economic activities in rural areas, likewise they had done it for households. During the workshop, a number of barriers were identified hindering the deployment of renewable energy for economic activities:

- lack of training & awareness,
- lack of funding,
- sectoral instead of holistic approach blocking development initiatives,
- high-risk,
- no IPP-framework,
- confusion on ESKOM task division.

One of the main barriers to economic activities is the lack of rural economic activities. This could be advantaged by integrating energy into the IDP process (see point above) with a special emphasis on involving local communities.

It was concluded that the concessionaires should be the main responsible for providing energy services to economic activities in rural areas (see also previous point). They would have access to finance to develop decentralised energy projects and could in turn sell the power to the project developer under a power purchase agreement. However, concessionaires would only get engaged if such ventures are commercially viable for them. Energy projects for economic activities require higher investments than household and hence are surrounded with more risk. They involve small-scale activities from companies which often have no financial track record and which face uncertain market prospects. Special support measures, similar to the ones provided to rural households, are therefore also required for off-grid renewable energy projects for economic activities. Such measures could include:

- subsidy on capital expenditures (similar to the one provided for households) to create a level playing field with grid extension,
- guarantee fund for the power purchase agreement,
- assistance to project developers: economic, financial, legal skills to set up commercial projects,
- integrate this into the IDP process (see point above),
- make concessionaires responsible for such activities (see point above).

- *Launch integrated PV follow up programme*

As part of the programme to improve the public image of PV, DME may wish to consider developing policies targeted at improving operation and maintenance of installed PV systems in the field. This operation and maintenance campaign could be targeted at all pilot and public PV projects which overlooked a clear operation and maintenance back up strategy in the project implementation, for example, the clinics and schools programmes, and the farmer project in the Transvaal. The idea is that before starting new PV project, the mess of old ones has to be cleaned up.

Such a programme could at the same time be combined with training local technicians, and raising awareness on the potential of PV among end-users, and train them on how to properly use and maintain PV systems. It could also be linked to the PV infrastructure that will be put up by the concessionaires. Stakeholders to be involved in this programme are the concessionaires, PV suppliers, ESKOM, Department of Trade & Industry (DTI), DME, Department of Housing (DoH).

4.3 Actions to promote demonstration and commercial projects

Different demonstration projects have been implemented or are in development. These include projects in the field of wind, biomass, solar thermal power and wave energy. Also grid-connected PV and low cost energy efficient housing are being considered. Being not commercial viable, these demonstration projects need financial support. This support could be given by the government or international co-operation. At present, several demonstration projects are already in further stages of development. In the development of a set-aside programme, special attention should be given to those projects. Opening a tendering procedure under the set-aside programme could easily kill these projects, although probably a lot of efforts have been invested already. One option would be to allow for demonstration elements within the set-aside programme.

The following actions can be distinguished:

Action 1*: Providing financial support*

- *Financing for renewable energy projects*

Financing for renewable energy projects is currently provided via export subsidies and ad hoc funding by the overseas development assistance (ODA) . Export subsidies are not considered the appropriate route to stimulate financing of renewable energy technologies in South Africa.

They do not favour optimal technology assessments, create unfair competition between companies from different EU member states and have a negative impact on developing a local manufacturing capacity in South Africa.

The other route, via ODA, is characterised by its ad hoc nature. Donors often shift priorities and co-ordination among them is lacking. There could be case for providing such funding on a more systematic basis by linking EU parties willing to invest in green energy abroad with project opportunities in South Africa. This may be formalised through the set-up of a renewable energy fund.

Although many foreign countries are hesitating to provide financial support on project level, South African stakeholders clearly expressed the view that providing financial support is essential for implementing the majority of renewable energy projects. Apart from existing export subsidies and the CDM, European governmental bodies should seriously look into the possibility of setting-up a renewable energy fund. This does not necessarily have to be restricted to South Africa, but could apply to the whole SADC-region.

- *Clean Development Mechanism of the UNFCCC*[4]

Upon entry into force and ratification of the Kyoto Protocol, the possibility will exist to sell CO_2 reduction credits from South Africa through the CDM. Considering its excellent fit with the objectives of this mechanism, renewable energy should play an important role in the CDM activities of both EU and South Africa. Special concern in this regard is required for off-grid renewable energy projects.

For off-grid renewable energy projects to be viable within the CDM, the transactions costs of their participation must not outweigh the value of Certified Emission Reductions (CERs) they generate. In order to keep transaction costs low, CDM eligibility rules should be fit for purpose and CER calculation procedures kept simple. This would be stimulated if the EU, EU member States and the Government of South Africa would adopt a special CDM window for off-grid renewable energy systems under the CDM.

Action 2*: Capacity building*

In order to institutionalise capacity building it is recommended to start a mutual South African - EU programme that could serve as a focal point and match-making platform for different kind of stakeholders. This focal point could also serve to inform about, and eventually to co-ordinate activities in South Africa conducted bilaterally by different EU countries.

Another part of this action could be to organise an educational programme comprising for example student exchange, centres of excellence and chairs for renewable energy.

The capacity building programme could include the following areas:

- *Building-up technological expertise*

The European Union is actively promoting the implementation of renewable energy. This resulted during the past years in many projects being developed and implemented throughout the Union. Parties involved in these projects have gained expertise and know-how that could be valuable in South Africa. Specific items, where one could think about are:

- Integrating renewable technologies in the grid
- Technical design aspects of mini-grids
- Wind measurements
- Local manufacturing of components

[4] United Nations Framework Convention on Climate Change

- *Building-up expertise on project development and implementation*

Due to the large amount of renewable energy projects being developed and implemented in Europe, there is large experience with conducting extensive feasibility studies, preparing bankable business plans, and implementing projects. This experience could be of valuable means for South African parties.

- *Building-up expertise on dissemination of knowledge and information*

In order to promote renewable energy technologies in specific countries or regions, demonstration projects have been implemented with a focus on gaining and disseminating knowledge and information. Apart from specific target groups, these demonstration projects were also used in order to get a broader public acquainted with specific technologies.

***Action 3**: Providing technology*

Europe has well-established renewable energy production facilities. In the field of wind energy, Europe can be regarded as the world market leader. Also biomass technologies are being manufactured in Europe at a large scale. Wave energy and solar thermal energy technologies are less mature, but there are a number of European manufacturers involved in developments in this field.

This means that Europe can provide technological hardware for projects in South Africa. These technologies have been exported already world-wide for years and have proved to be suitable for different climatological conditions. These conditions however change from region to region. Therefore it is recommended to develop joint research and development programmes, aimed basically at adapting EU technologies to (South) African conditions and to analyse possibilities for manufacturing in South Africa.

4.4 Other actions for South African - European co-operation

Some elements of an EU - South African action plan for grid-connected renewables were suggested by the participants. EU parties should see this collaboration as a starting point to access the SADC market.

- Disseminate successes and failures within the EU in matters of policy, regulation, market liberalisation, standards, project implementation, etc.
- Link EU parties willing to invest in green energy abroad with project opportunities in South Africa. This may be formalised through the set-up of a renewable energy fund.
- Organise an educational programme comprising for example student exchange, centres of excellence and chairs for renewable energy (I would suggest a small survey on existing initiatives to find out whether we should build on them or start something new).
- Develop joint research and development programmes, aimed basically at adapting EU technologies to (South) African conditions.
- Analyse possibilities for manufacturing in South Africa.
- Research successes and failures of renewables in South Africa by EU parties.