PROJECT BRIEF

1. IDENTIFIERS:

PROJECT NUMBER	1858 (PIMS)
PROJECT NAME	Renewable Energy-Based Rural Electrification in Lesotho
DURATION	Five years
IMPLEMENTING AGENCY	United Nations Development Programme
EXECUTING AGENCY	Government of Lesotho / Ministry of Natural Resources
REQUESTING COUNTRY	Lesotho
ELIGIBILITY	Lesotho ratified the UNFCCC on 7th February 1995
GEF FOCAL AREA	Climate Change
GEF PROGRAMMING FRAMEWORK	OP #6: Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs

2. Summary:

The project aims at reducing Lesotho's energy related CO_2 emissions by promoting renewable and low GHG technologies as a substitute for fossil fuels utilised in rural areas of the country. The activities proposed in the project are designed to remove barriers that hamper the wide-scale implementation of renewable energy technologies. The project will assist in the development of a renewable energy market in the remote rural areas of the country and facilitate the use of renewable energy for productive uses.

3. Costs and Financing		US Dollar
GEF	Project:	2,500,000
	PDF B:	220,000
	Subtotal GEF	**2,720,000**
Co-financing (Parallel)	PDF B Government (in kind)	17,000
	PDF B UNDP	10,000
	Government (in kind)	100,000
	Government (budget renewables)	183,000
	National Rural Electrification Fund	2,500,000
	Electrification access pilot project (PV)	816,500
	Department of Rural Water Supply	73,000
	WB (support Rural Electrification Unit)	546,000
	Private sector	10,000
	Co-financing total	**$4,255,500**
Total Project Financing		**$6,975,500**

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List of acronyms and abbreviations

AfDB	African Development Bank
ATES	Access to Electricity Study
DANCED	Danish co-operation for Environment and Development
DOE	Department of Energy
EAP	Energy Action Plan
EAPP	Electricity Access Pilot Projects
EMP	Electricity Master plan
EPF	Energy Policy Framework
FAO	Food and Agricultural Organisation
FINESSE	Financing Energy Services for Small Scale Energy Users
GEF	Global Environment Facility
GHG	Green House Gas
GOL	Government of Lesotho
IMTF	Interim Management Task Force
kW	kilo Watt
kWh	kilo Watt hour
LEC	Lesotho Electricity Corporation
LEMP	Lesotho Energy Master plan
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LMS	Lesotho Meteorological Services
MHP	Muela Hydropower Plant
MNR	Ministry of Natural Resources
NEMP	National Electricity Master plan
NGOs	Non-Governmental Organisations
NREB	National Rural Electrification Board
NREF	National Rural Electrification Fund
NREP	National Rural Electrification Programme
PRSP	Poverty Reduction Strategy Paper
PS	Principal Secretary
PSC	Project Steering Committee
PSPC	Power Sector Policy Committee
PV	Photovoltaics
RET	Renewable energy technology
REU	Rural Electrification Unit
REWG	Rural Electrification Working Group
RR	UNDP Country Resident Representative
SADC	Southern African Development Community
t	metric tonne (1000 kilograms)
UNDP	United Nations Development Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WB	World Bank

Exchange rate 1 US $ = 7 M (end 2003)

Contents

1. Background and context

1.1. Overview of rural electrification in Lesotho

1. The electricity supply in Lesotho began in 1969 with the establishment of the Lesotho Electricity Corporation (LEC) in terms of the Electricity Act of 1969. LEC was mandated by the Act for the generation, transmission, distribution and supply of electricity in the entire country. The national grid was established in the lowlands, linking major centres to the Eskom network in South Africa, and gradually expanded to reach other centres. Four mini-hydro plants, some of them with diesel back up, were developed at Mantsonyane (2MW), Semonkong (180kW), Tlokoeng (670kW) and Tsoelike (400kW).

2. The Department of Energy (DOE) was formed in 1985 in the Ministry of Natural Resources with the responsibility of policy formulation, energy planning and sector coordination. A number of Government ministries participate in energy sector issues, but primary responsibility for the sector lies with the DOE.

3. In 1986 the Lesotho Highlands Development Authority (LHDA) was established as implementing agency for the Lesotho Highlands Water Project (LHWP). As such, the LHDA was mandated to develop hydropower schemes as part of the LHWP, and constructed the 72MW 'Muela Hydropower Plant (MHP) which was commissioned in late 1998. LHDA also operates a 500kW mini-hydro plant at Katse dam to supply the local power requirements. The 1993 *Policy on the LHDA/LEC Interface* defines the precise responsibilities and roles of the two utilities.

4. In the early 1990s the GOL proposed an electrification target of 5% to be achieved by the year 2000 and commissioned the Electricity Master Plan (EMP) for the period 1994-2003. The EMP was released in 1996 and approved as the working document for the power sector in April 1997. The EMP envisaged increasing domestic connections in urban and rural areas from about 10,000 in April 1994 to 20,000 by the end of 2000 (5%), and to 40,000 by 2010 (13%).

5. The Power Sector Policy Committee (PSPC) was established in 1997 to formulate and implement policy for the electricity sector, and to coordinate power sector activities between LEC and LHDA. The *Power Sector Policy Statement*, which was formulated in 1998 and amended in October 2000, builds on the recommendations of the EMP, focusing on institutional reform of the sector, private sector participation in electricity service provision, the costing structure of electricity, and the establishment of a regulatory authority.

6. The privatization process for LEC began in 2001 with the appointment of an Interim Management Task Force (IMTF) to streamline operations and improve financial viability of the company. The IMTF produced a *Service Territory Study* (STS) report that proposes the service territory of a privatized LEC, and an *Access to Electricity Study* (ATES) report that identified existing and potential customers within and outside the future service territory of LEC. Rural electrification outside

the service territory is the responsibility of the GOL. The ATES report identified a number of pilot projects to test four rural electrification approaches outside the service territory.

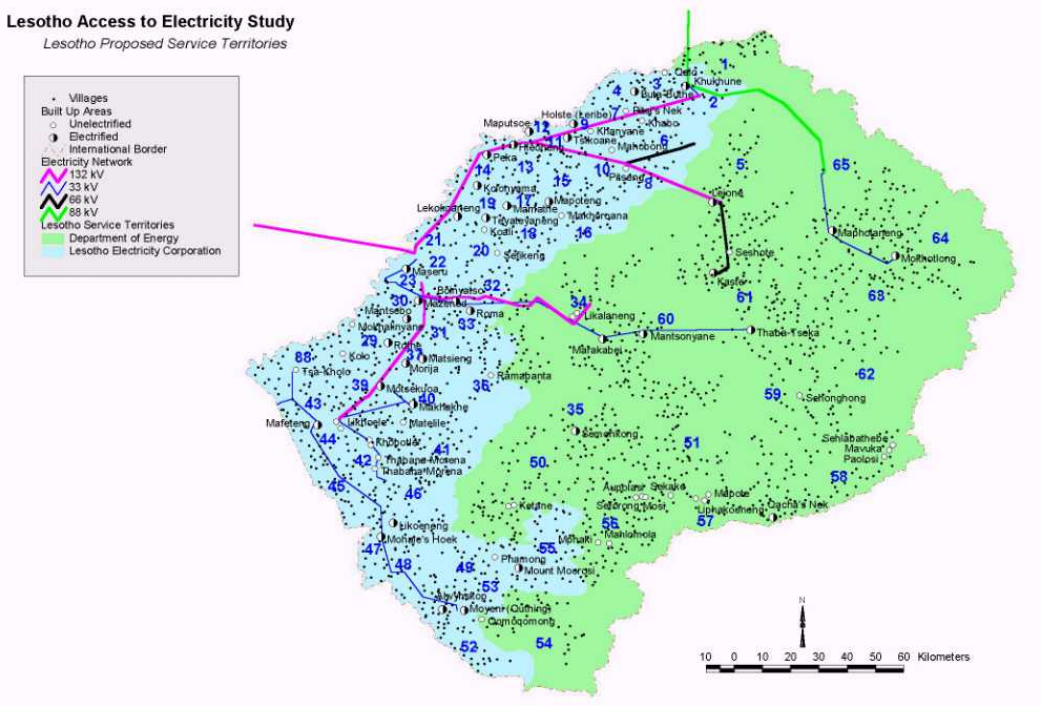

Figure 1 Proposed LEC service territory

7. A Sales Advisory Group (SAG) was appointed in late 2001 to develop a privatization strategy and make recommendations to the GOL on selling LEC through international competitive bidding. Following concerns that the outright privatization of LEC may compromise the GOL's economic and social objectives, it has been agreed with the World Bank (WB) that a public concession scheme will be implemented instead.

8. Lesotho's *Energy Policy Framework* (EPF) was released in June 2002, providing general energy policy direction, and to guide decisions and activities of the DOE and its interactions with other Government departments. The EPF builds on and complements national development planning activities. An *Energy Action Plan* (EAP) is being prepared (latest draft: June 2003) to provide specific energy sector targets in terms of the EPF.

9. In mid 2003, the DOE established a stakeholder-based Rural Electrification Working Group (REWG), to prepare for the implementation of rural electrification pilot projects and the formulation of NREP. Guided by facilitators, CORE International, the REWG prepared a report entitled "*Overall Action Plan for Rural Electrification in Lesotho – Phase I: Preparation and Implementation of RE Pilot Projects*". This report includes a list of major immediate and mid-term milestones and actions for rural electrification in Lesotho, as well as best practices from other parts of the world.

1.2. Government strategy / policy

10. Policy for the electricity industry envisages considerable institutional changes, both in relation to regulatory and policy bodies, as well as industry structure. With regard to the future of utilities it has been decided that:

    - LEC should be commercialised and privatised through a public concession scheme. The privatisation of LEC includes reducing its service territory to those areas considered financially viable.
    - New entrants into the industry will be encouraged. GOL has raised the options of retail competition (more a long-term objective), independent operators of isolated networks, and independent operators of grid extensions in rural areas. The LEC distribution assets outside its service territory will either be transferred to the relevant local government entities or outsourced under contract to appropriate operators.

11. The restructuring of the power sector will enable LEC to concentrate on improving its operations in a more restricted service area, and allow independent operators to service rural communities.

12. With regard to public institutions, GOL has proposed the establishment of three new institutions:

    - The Lesotho Electricity Authority to take responsibility for regulation of the sector, including licences, price controls and standards. The Lesotho Electricity Authority Act of 2002 provides for the establishment of an electricity regulator and the process of appointing LEA Board members and recruiting its chief executive has been initiated.
    - The National Rural Electrification Fund (NREF) to channel capital subsidy resources into rural electrification. The NREF was created in February 2004 by Cabinet decision. Preparations to capitalize the fund and spell out the operational details including its replenishment are very advanced. The draft operational regulations have been submitted to the minister in March 2004. It is expected that the fund will be operational in June 2004. Initially, the Fund will be resourced through connection fees collected by LEC and a surcharge/ levy on electricity sold through the grid.

    - The Rural Electrification Unit (REU) to facilitate, co-ordinate, and manage the rural electrification projects in the country. As part of Access Pilot Projects, the World Bank is supporting the establishment of this unit through provision of funds to cater for the REU Head and two Engineers. The Access Pilot projects, which will be funded through the World Bank, have been divided into two phases and each phase consists of the following projects:

Phase 1a			
District	**Pilot area**	**Technology**	**Budget (US$)**
Butha-Buthe	Qholaqhoe	Grid Extension	295 714
Maseru	Semonkong	Mini-grid rehabilitation	234 107
Mokhotlong	Linakaneng	Solar Home System	816 500
Quthing	Dilli-Dilli/Sixondo	Grid cross border	118 286
Qacha's Nek	Ha Sekake	Diesel mini-grid	141 286
TOTAL BUDGET		**1 605 893**	
Phase 1b			
Thaba-Tseka	Linakeng	Solar Home System	345 000
Thaba-Tseka	Sehonghong	Diesel mini-grid	252 343
Quthing	Mphaki	Diesel mini-grid	252 343
Qacha's Nek	Sehlabathebe	Grid cross border	335 143
TOTAL BUDGET		**1 184 829**	

Table 1 Electricity Access Pilot Projects

1.3. Prior / ongoing assistance

13. In 1984 the Government of Germany provided technical assistance to the Government of Lesotho. There were two primary reasons for assistance; firstly to establish the Department of Energy within the Ministry of Water, Energy and Mining (now Ministry of Natural Resources) and secondly to prepare a national energy policy which resulted in the development of a comprehensive, in terms of data base, Lesotho Energy Masterplan (LEMP). The Masterplan contains a national energy policy and strategies to translate policy into practical realisation. One of the strategies was the promotion of new and renewable sources of energy. This strategy led to further technical assistance by the Government of Germany in the area of renewable energy in early 1990's. The Energy Master plan was finalised in 1988, the main feature of the plan was self reliance and less dependence, especially on South Africa, on energy supply.

14. In the early 1990's there were positive developments, which included the introduction of democracy in South Africa, and the Southern African Development Co-ordination Conference (SADCC) changed to Southern African Development Community (SADC) with the new focus being on regional economic integration. In light of these developments a decision was made to review the LEMP and this led to the technical assistance by the Government of Denmark, whose implementation began in 1999 and ended in 2002. The five main outputs of the assistance were:

- **National Energy Policy Framework:** National Energy Policy Framework and the associated action plan to translate the strategies into practical implementation were prepared.
- **Implementation of energy planning strategies:** This part was essentially meant to implement small projects to test the practical implications of the proposed policies as outlined in the policy framework. Due to the time

constraint, this task was only conceptualised and never realised implementation.

- **Framework for Power Sector monitoring and Governance:** This component was essentially meant to provide backstopping activities and constant advice to the Director of the Department of Energy in relation to electricity projects monitoring and power sector governance.
- **Strengthening of LEC for efficient production, distribution and use of electricity:** This part was meant to assist the Lesotho Electricity Corporation (LEC) to improve efficiency and effectiveness in its operations. However, the assistance of Denmark did not reach conclusions since there was an introduction of World Bank (WB) assistance in restructuring the power sector. This led to the engagement of an Interim Management Task Force to manage LEC so that it is turned into a commercially viable institution.
- **Wind energy survey:** It is under this component, where wind energy assessment for electricity generation was done. Wind measurements, at heights of more than 10 metres, were initiated in three locations in the country. Assessment for wind energy potential was done for the three locations. The conclusions were that there is potential for wind electricity generation particularly for large scale applications for connection to the national electricity grid, particularly with one site " Letseng La Terai"

15. Specific to the power sector, GOL has over many years obtained assistance from international donor community for electrification schemes of various types. The Swedish and Norwegian Governments have among others supported the construction of main infrastructures such as transmission lines and substations since many years. Lately, the World Bank (WB) and African Development Bank (AfDB) are assisting the GOL in the process of restructuring the Lesotho Electricity Corporation (LEC) including finance of some rural electrification projects. Other important donor assistance were received from Caisse Francaise de Development, the German Government and others. More recently (2003), the United States Agency for International Development (USAID) has financed a study on "Rural Electrification Planning in Lesotho" that resulted in the establishment of the Rural Electrification Working Group (REWG) and the preparation of an action plan for implementation of rural electrification pilot projects.

16. Formal initiatives to promote and utilise renewable sources of energy including photovoltaic (PV) systems started in the late 70's with assistance from United States Agency for International Development (USAID), United Nations Educational Cultural and Scientific Organisation (UNESCO), the Food and Agricultural Organisation (FAO), the Governments of China and Germany. The initiatives here focussed on dissemination. During the assistance with the Government of Germany, in 1992, a study was commissioned to find out the constraints limiting the widespread adoption of renewable energy technologies including energy efficiency in buildings. A number of constraints were identified and included: high investment costs for renewable energy systems, poor workmanship in the installations and lack of awareness.

17. The study further confirmed that PV lighting, energy efficiency in buildings and solar water heating are needed technologies by the public. This led to the

continuation of the German assistance where the removal of the identified barriers in the promotion of PV lighting and energy efficiency in buildings was considered. This led to the preparation and the development of a video on PV and energy efficiency in buildings, demonstration PV units for lighting and TV in shops and inclusion of renewable energy technologies in the curriculum of secondary schools and technical and vocational schools.

18. Under the Southern African Development Community (SADC), a regional project was launched in some member states including Lesotho, The Project "Financing Services for Small Scale Energy Users (FINESSE)" which was aimed at identifying potential renewable energy technologies and preparing business plans for financing. The technologies identified for Lesotho were three and included: PV lighting in homes, energy efficiency in buildings and solar water heating. The greatest problem in the proposed business plans was the proposed delivery mode, especially institutional aspects, was not attractive.

19. Lessons and experiences include:
    - For the promotion of RETs, all stakeholders must have a benefit, either currently or in the future. For example DOE formed several co-ordinating committees for information sharing and enhancing efficiency in planning and implementation, however, virtually all the different committee and professional bodies like the Lesotho Solar Energy Society (LESES) have either collapsed or are not very active because there were no immediate benefits.
    - The Government has to concentrate on enhancing an enabling environment for implementation of projects by the private sector.
    - Most of the projects were donor driven or city driven and have collapsed. Therefore, it is very important that the projects are demand driven. This means that the intended beneficiaries, often the rural communities have to be empowered by way of providing education and skills about RETs so that they can effectively participate in the promotion of RETs.
    - The market for RETs, in particular PV industry has not reached maturity and consequently, financial support is essential for PV market infrastructure development.
    - Where dissemination initiatives require demonstration plants for use by the consumers, the plants should not be given free, without any financial contribution; otherwise the consumers do not value such plants. This has largely been true with the dissemination of biogas digesters in the country.

1.4. Barriers

20. The main barriers identified that hamper the large-scale utilisation of renewable energy-based technologies can be classified into four broad headings, namely:
    - institutional
    - economic, commercial and market
    - technical and information
    - education and training

21. Institutional barriers

- Lack of an effective infrastructure for delivering renewable energy-based energy services on a sustainable basis
- Fragmented institutional responsibilities and lack of integrated planning and implementation by various stakeholders including government, the research institutions, the academic institutions, the NGOs, community based organisations (CBOs) and the private sector with regard to the applications of renewable energy technologies. The involvement of community participation in the promotion of RETs is essential. Lack of community participation has led to PV components theft.
- Removal of institutional barriers remains one of the greatest challenges in the country.

22. Economic, commercial and market barriers
    - Limited private sector capacity supply, distribution, installation and maintenance of renewable energy systems. The situation is severe with maintenance since all the PV suppliers and installers are all in Maseru and not in rural areas where maintenance is required. In addition, ordinary retail shops do not sell PV components. Consequently, the consumers need to travel long distances to get the required maintenance services or even to replace a light. In some cases, the consumers prefer not to pursue the maintenance but rather stop using the PV technology. This is one of the greatest barriers in the utilisation of PV electricity.
    - Limited business skills, while there are some people with energy expertise the appropriate business skills to start energy enterprises are lacking
    - Lack of or very limited in-country experience with many of the relevant renewable energy systems options.
    - Lack of suitable financing arrangements for renewable energy companies and end users, and the need for training of in-country financial institutions to lend for renewable energy enterprises and projects. This is one of the greatest barriers to the development of the market of PV industry in the country. Appropriate financing mechanisms will be in place to remove the barrier.

23. Technical barriers
    - Poor workmanship in the installation, operation and maintenance of renewable energy technologies (RETs), including PV systems.

24. Information, education and training barriers
    - Lack of access to necessary information
    - Lack of public awareness of the technologies
    - Lack of trained manpower at all levels and in particular
    - Insufficient qualified personnel for maintenance for renewable energy systems including PV.

2. Rationale and justification

25. Almost 90% of energy consumption in the rural areas is sourced from indigenous biomass fuels consisting of shrubs, firewood, crop residues and cow-dung. Paraffin is mainly used for cooking, heating and lighting. Many rural people have

to travel long distances to get fuels such as paraffin, often at very high price. The declining number of trees in rural areas has resulted in rural people having to walk 5-10 kilometers a day to collect firewood. Other fuels such as liquefied petroleum gas (LPG) and coal play relatively minor role in rural areas. Finally, very few households in the rural areas use solar Photovoltaic (PV) systems or diesel/petrol generators.

26. The population of Lesotho is about 2.2 million persons, of which three-quarters live in rural areas. With an average of 6 persons per households, this leads to approximately 282,000 households residing in rural areas. At present only about 8% of households in Lesotho have access to electricity, with most of these being located in urban areas. It is estimated that only 1% of rural households have access to reliable electricity. The GOL objective is to increase the electrification targets from this current 8% to at least 35% by 2020.

27. The potential for grid connection in the next 5 years is approximately 10,000 households in the rural areas. Connected and potential for isolated diesel generator sets is about 1414 customers. The existing number of SHS stands at 1100. The national potential market is about 142,000 customers and it will not be possible to meet this market without the intervention of the GEF project. For more details on the potential market, see the separate report on this issue, which is attached as Annex C - Market for PV in Lesotho

28. The Vision 2020 and the Poverty Reduction Strategy Paper (PRSP) have identified community priority needs as employment creation, infrastructure development and food security and rural development. Availability of reliable and affordable energy supply is a prerequisite for the needs to be satisfied. To be specific electricity is an important energy carrier in this respect, see Table 2.

Community Priority Needs	Sectoral Intervention to respond to the challenges	Electricity (energy) contribution
1. Employment Creation	• Entrepreneurship development	• Energy (electricity) enhances income-generating activities such as small local tourism, knitting and sewing industry. • Existing local shops can now extend their operating hours beyond the daylight period.
2. Food Security and Rural Development	• Food security and Nutrition. • Soil fertility and crop Husbandry methods.	• Agricultural productivity might be enabled through irrigation. • Lighting for commercial production of birds (chicken). • Alternative energy options will enable increased use of animal dung and crop residues for soil fertility and conditioning while their use for energy purposes will decline.
3. Increasing access to quality basic education.	• Free basic education for all. • Increases access to quality Early Childhood Care Development (ECCD).	• Electricity availability at home and schools enables access to educational media and distance learning. • Good quality lighting enables home-based study. • Lighting in schools allows evening classes and study, and helps retain teachers, especially if their accommodation has electricity. • Availability of electricity services free children's and especially, girls' time from helping with survival activities such as fetching water and collecting firewood.
4. Promoting access to quality essential health care and social welfare	• Improving access to quality essential health care and social welfare services. • Strengthen health promotion and disease prevention.	• Electricity for refrigeration allows vaccination and medicine storage for prevention and treatment of diseases and infections • Enables access to health education media through information communication technology. • Cleaner energy technologies are expected to reduce energy-related health problems/diseases. • Safe disposal of used hypodermic syringes by incineration prevents re-use and potential further spread of HIV/AIDS. • Electricity in health centres enables night availability, helps to retain qualified staff and allows equipment use.
5. Safety and Security	• Improved working environment for police personnel.	• Provision of efficient lighting at police stations. • Communication can be enhanced in rural areas.
6. Water and Sanitation	• Improve supply of clean potable water supply to rural areas.	• Electricity can be used to pump ground water locally and thereby reducing time spent collecting it.

Table 2 Energy (electricity) contribution towards achieving community needs

29. Electricity is required for income generating activities namely small local tourism industry, knitting and sewing, local shops to extend operating hours beyond the daylight period. Good quality lighting is required at homes, for study purposes, and for schools, under the policy of universal primary education, which calls for increased access to Early Child Care Development. In terms of Health, reliable source of energy for vaccine and medicine refrigeration is needed. Communication is poor in most of the rural areas, especially in the mountainous places. One of the greatest barriers for communication networks to cover these areas has been reported as lack of electricity.

30. Renewable energy technologies (RETs), particularly PV systems have a formal history of about thirty years in Lesotho. Despite several initiatives in the

development and promotion of RETs, RETs are still not widely used in the country due to a number of barriers. Efforts to address the barriers have been implemented in the country. Positive progress has been recorded in addressing the issue of lack of awareness of RETs, poor workmanship in the installation of RETs and lack of qualified personnel for maintenance of RETs. Progress includes the design and implementation of dissemination strategies, the preparation of the code of practice for solar home systems, RETs have been introduced in the teaching programme of secondary schools. Despite the progress, the barriers as identified in section 1.4 still apply though they are not ranked high on the priority list. The issues of institutional set up and high initial investment costs for RETs continue to be the greatest barriers in the promotion and utilisation of these technologies and consequently they are of high priority.

31. The successful removal of the barriers will not be realised through national initiatives alone. The GEF project is expected to play a pivotal role in removing the barriers to wider adoption of renewable energy based rural electrification thus leading to the availability of electricity for needed service delivery to meet the urgent community needs in rural areas of the country.

32. Lesotho has excellent renewable energy resource base, ranging from extensive mini hydropower potential, small-scale wind potential to abundant solar radiation. The exploration of these energy sources using renewable energy technologies would make it possible to meet the basic energy needs of the rural population and thus improving their quality of life. Providing clean energy for basic services will give a tremendous improvement in the quality of life of the rural population. Clean energy resources will mainly replace paraffin currently used for lighting purposes and dry cell batteries for entertainment purposes. Local benefits are a reduction in the exposure to smoke and soot from paraffin and reduced expenditure on dry cell batteries.

33. Removal of the identified barriers to the use of renewable energy technologies will also provide the private sector with the necessary incentive to improve and expand their services. This will benefit customers in the whole country, not only in the rural areas or the target areas of the project.

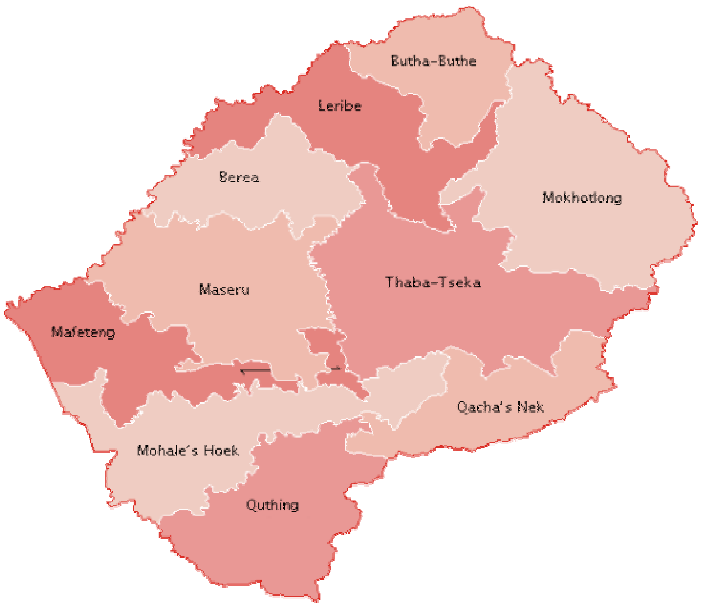

Figure 2 Administrative boundaries Lesotho

34. As mentioned earlier, the Access to Electricity Study report had identified existing and potential customers within and outside the future service territory of LEC. The main focus was on supply of reliable electricity on what the Ministry of Local Government has identified as "Rural Service Centres". These centres provide at least both economic and social services to a number of surrounding villages and are seen as growth centres, and the provision of reliable energy services is seen as a priority for stimulating their economic activities. Households energy and village development surveys were conducted in 29 selected un-electrified villages (including the rural service centres) outside the LEC's service territory and these villages were prioritised based on points allocated to various institutions found in the village and such institutions included hospital/clinic, police station, post office, schools, businesses, agricultural extension offices, local court and churches. Again, based on energy requirements per village and potential for economic development, energy supply options were recommended and they included the network/grid extension, diesel mini-grid, stand-alone solar home systems, cross border connection with Eskom South Africa, wind-diesel hybrid and hydro-diesel mini-grids.

35. One of the ongoing activities as described in section 1.2 is the Electricity Access Pilot Project (EAPP). The EAPP is an integral part of the current privatisation process of the electricity utility LEC. The only renewable energy based pilot of the EAPP will take place in the Mokhotlong district and will be limited to Solar Home Systems. The delivery model of the EAPP PV subproject has not yet been decided upon. Both the WB supported EAPP PV project and the UNDP-GEF project will be managed and coordinated by DoE thus making sure that the maximum synergies are being achieved. As the EAPP will focus its attention to the Mokhotlong district, it was decided that the best synergies can be achieved when the UNDP/GEF project would target the same district. Replication of the

activities in this district will be targeted for the Thaba-Tseka and Qacha's Nek districts.

36. The Mokhotlong district has at least eleven (11) un-electrified rural service centres and stand-alone solar home systems have been found appropriate for addressing the present and future energy needs. Other mountainous districts like Qacha's Nek and Thaba-Tseka have un-electrified rural service centres, which are suitable for electrifying through mini-grids.

37. The population of Mokhotlong district is 106 286 and 63% resides in rural areas. The average household size is 6 persons and there are 11 160 households in the rural areas. Due to the mountainous terrain, access to grid electricity is 1.2% and is mainly in town. It is estimated that only 500 rural customers can be connected to the rural grid network with the average grid connection costs of above M15 000 (US$2 143). The PV market potential in the district is 5637 customers for systems between 18kWp and 42kWp depending on income group levels, and does not include other PV technologies markets.

38. Compared to other two rural districts like Thaba-Tseka and Qacha's Nek, Mokhotlong district accounts for 12.4 percent of the country's rural poor and 14.6 percent of the urban poor while Thaba-Tseka accounts for 28.1 percent of the rural poor and 10.5 percent of the rural urban and Qacha's Nek contributes 6.1 percent of the poorest rural population, and 19.5 percent of the poorest urban population. The highest prevalence of rural poor is in Thaba-Tseka with 28.1 percent of all the rural poor. The highest prevalence of urban poverty is in Qacha's Nek with 19.5 percent of all urban poor in the country.

39. The global benefits of the project will result from the reduction of the use of paraffin for lighting in the Mokhotlong district by those customers targeted by the PV credit and cash sales component, the elimination of the use of paraffin for those household customers targeted by the proposed Sani Top wind/PV mini-grid, the elimination of the use of diesel generator sets by the productive users at Sani Top, as well as the replaced diesel generation capacity at Semonkong. Detailed calculations of the GHG emissions by the project activities can be found in Annex A - Incremental cost analysis and matrix of this proposal.

3. Objectives, outputs and activities

40. The *global objective* of the project is "*to reduce Lesotho's energy related CO_2 emissions by substituting fossil fuel (paraffin and diesel) with renewable energy sources (PV, wind and hydro) for household and productive uses through the provision of basic energy services to rural homes and community users*".

41. The *development objective* is "*to improve people's livelihoods by promoting the utilisation of renewable energy to provide basic electricity services to the rural areas in Lesotho starting in the Mokhotlong district, thus reducing the country's dependency on fossil fuels*".

42. These objectives would be achieved by project activities designed to remove barriers to the wide-scale utilisation of PV, mini hydro-diesel hybrids and wind-PV hybrids. The project will consider the institutional, financial and market instruments necessary to demonstrate the viability of using the private sector to participate in the process of sustainable development in rural areas through the delivery of basic energy services through PV and renewable energy based mini-grids.

43. The project consists of six components. Each of these components is composed of an immediate objective, specific outputs and a number of activities. By achieving these immediate objectives, the project will contribute towards the achievement of the global and development objectives. These components are:

    1. **delivery of renewable energy-based technology packages**: *To implement different delivery models for renewable energy-based rural electrification targeting different end-user groups and making use of different technology packages*
    2. **awareness raising**: *To increase awareness among the general public, decision-makers and rural customers on the potential role of renewable energy in meeting basic energy needs in rural areas*
    3. **private and public sector strengthening and training**: *To strengthen and support the public and private sector working in the renewable energy sector to provide better quality of service to the rural areas*
    4. **policy support and policy framework**: *To assist the development of policy and institutional arrangements needed for the widespread adoption of renewable energy sources for off-grid electricity services*
    5. **financial mechanisms**: *To assist with the implementation of appropriate financing mechanisms for the larger scale dissemination of renewable energy based technologies to rural customers*
    6. **learning and replication**: *To disseminate experience and lessons learned in order to promote replication throughout the country of rural electrification based on renewable energy technologies*

    The components as discussed above are related to the barriers identified (see page 10) as summarised in Table 3

Barrier	Component
Lack of an effective infrastructure for delivering renewable energy-based energy services on a sustainable basis	1, 4
Fragmented institutional responsibilities and Lack of integrated planning and implementation by various stakeholders including government, the research institutions, the academic institutions, the NGOs, community based organisations (CBOs) and the private sector with regard to the applications of renewable energy technologies.	1, 4
Limited private sector capacity supply, distribution, installation and maintenance of renewable energy systems.	3
Limited business skills, while there are some people with energy expertise the appropriate business skills to start energy enterprises are lacking	3
Lack of or very limited in-country experience with many of the relevant renewable energy systems options. Lack of suitable financing arrangements for renewable energy companies and end users, and the need for training of in-country financial institutions to lend for renewable energy enterprises and projects.	6 5
Poor workmanship in the installation of renewable energy technologies (RETs), including PV systems.	3
Lack of access to necessary information	2, 6
Lack of public awareness of the technologies	2, 6
Lack of trained manpower at all levels and in particular insufficient qualified personnel for maintenance for renewable energy systems including PV.	3

Table 3 Link between the barriers identified and the project components

44. The six components are to a large extent inter-dependant; hence all have to be addressed to remove the identified barriers. With this in mind the activities to be undertaken are planned as in Table 4

		year 1		year 2		year 3		year 4		year 5	
1	delivery of renewable energy based technology packages										
2	awareness raising										
3	private and public sector strengthening and training										
4	policy support and policy framework										
5	financial mechanisms										
6	learning and replication										

Table 4 Planning of the project activities over the five years

45. **Component 1: Delivery of renewable energy based technology packages**
The immediate objective is "*to implement different delivery models for renewable energy-based rural electrification targeting different end-user groups and making use of different technology packages*".

This component of the project will be executed in close collaboration with the Electrification Access Pilot Project (EAPP). The delivery models that will be implemented under the GEF project will focus on credit sales and cash sales.
Furthermore this component will demonstrate the potential to use mini hydropower plants to power local mini-grids by focusing on the existing hydro/diesel mini-grid at Semonkong and the identified hydro hybrid at Seforong, as well as the potential for wind energy through a wind/PV mini-grid using prepaid meters.
The EAPP will increase the customer base of the Semonkong mini-grid from the current 42 customers to 250 customers. Installing additional diesel generation capacity will enlarge the generating capacity. The project will investigate the potential to limit the additional diesel capacity needed by increasing the installed capacity of the hydro station. Based on the conclusions of the investigations, donors will be approached for the actual investments needed.
At the Sani Top location the GEF project will build on the foundations laid by the feasibility study carried out as part of the DANCED support to the GOL. The DANCED project investigated the potential for large-scale grid connected wind energy. For Sani Top it concluded that there is potential for small-scale wind electricity generation, but as it fell outside the scope of the project, DANCED was not able to implement it. The scope of the DANCED project was limited to the technical and economic viability of wind electricity generation. The current GEF project will demonstrate that wind generation is a viable option for certain locations in the country.

The total costs for component 1 are US $ 4,223,600. GEF is requested to contribute US$ 700,000 towards these costs. The total costs are as follows:

donor	description	amount
EAPP	PV project Mokhotlong district	$ 816,500
EAPP	expansion of Semonkong mini-grid	$ 234,000
DRWS	PV water pumping	$ 73,000
GEF		$ 700,000
NREF		$ 2,500,000
TOTAL		**$ 4,323,500**

Table 5 Cost breakdown component 1

The nine outputs of component 1 will be:

Output 1.1
In Mokhotlong district 1000 customers purchased PV-systems through a credit scheme or through cash sales

Activities:
- Design a delivery model that uses customer credit in collaboration with the PV industry and the financial sector.
- Implement the designed delivery model.

Output 1.2
At least three business centres are established in the Mokhotlong district using PV as their energy source

Activities
- Define roles and responsibilities of stakeholders involved, particularly communication institutions
- Design of the technical installation required
- Tender for equipment
- Install in the field

Output 1.3
Limited grant financing is provided to a small number of schemes proposed by the private sector to test various productive uses of renewable energy

Activities
- Develop in close consultation with local stakeholders and industry a competition to select several schemes to demonstrate productive uses of PV in Mokhotlong
- Support a small number of the best project proposals.

Output 1.4
An isolated hybrid mini-grid using wind and PV is installed at Sani Top serving at least 25 customers and two businesses

Activities:
- Update the existing information on current and expected energy use in Sani Top
- Design a mini-grid using PV and wind
- Prepare a tender for the installation of the mini-grid
- Implement the mini-grid

Output 1.5
The wind energy potential for small-scale power generation, in particularly hybrid mini-grids at selected sites that are favourable for hybrid mini-grids using wind is assessed

Activities:
- Assist LMS in the assessment of wind measurements
- Build capacity to interpret wind data for assessing the wind energy potential (Department of Energy, private sector and LMS)
- Evaluate wind regime and judge the feasibility of a wind mini-grid at the measurement location

Output 1.6
In Mokhotlong district three villages have been provided with PV water pumping systems. This output will be reached in close collaboration with the Department of Rural Water Supply.

Activities:

- Provide technical assistance to DRWS to install and operate water pumping systems powered by PV in line with the PV Code of Practise

Output 1.7
Feasibility study on the potential to increase the hydro component of the Semonkong hydro/diesel mini-grid

Activities:

- Investigate the current technical status of the hydro plant at Semonkong
- Investigate the technical possibilities to increase the generating capacity of the hydro plant
- Evaluate the technical options available and their economic potential

Output 1.8
The capacity of the hydro station at Semonkong is increased

Activities:

- Evaluate the outcome of the activities under output 1.7
- Find an appropriate financier for the expansion of the hydro plant
- Implement the recommended activities from the feasibility study

Output 1.9
The use of hydropower generation is included in the Seforong mini-grid

Activities:

- Assess the hydropower potential at the location of the Seforong mini-grid
- Integration of the hydropower in the tendering documents for the Seforong mini-grid

46. **Component 2**: **Awareness-raising**

The immediate objective of this component is "*to increase awareness among the general public, decision-makers and rural customers on the potential role of renewable energy in meeting basic energy needs in rural areas*".

The cost of component three is estimated to be US$ 250,000, of which GEF is requested to contribute $ 200,000.

donor	description	amount
GEF		$ 200,000
GOL	in kind	$ 50,000
TOTAL		**$ 250,000**

Table 6 Cost breakdown component 2

The three outputs of component two will be:

Output 2.1
Information and awareness packages have been developed and made available to the general public

The main focus is the development of information and awareness raising materials that address the merits and technical limitations of PV systems and that of management issues regarding mini-grids

Activities:

- Identify the type of information that is needed by the general public (facts as well as tone needed).
- Develop a recognisable layout/format of all information material.
- Prepare all information in the developed format.
- Disseminate the developed information materials.
- Develop materials to be used during demonstrations
- Train presenters for the demonstrations (know-how and media training)
- Engage specialised media company to develop TV and radio advertisements.

Output 2.2
Awareness programme for decision makers is developed and implemented

Activities:

- Identify key decision-makers that need to be targeted in this component
- Develop targeted awareness and information packages about renewable energy and mini-grid management for rural electrification purposes
- Organise field trips for identified key decision-makers to the project area to witness the implementation of the project

Output 2.3
A rural customer awareness programme is formulated and implemented

Activities:

- Identify the type of information that is needed by rural customers (facts, language as well as tone needed).
- Develop a recognisable layout/format of all information material.
- Prepare all information in the developed format.
- Disseminate the developed information materials.
- Develop materials to be used during demonstrations
- Train presenters for the demonstrations (know-how and media training)

47. **Component 3: Private and public sector strengthening and training**.
The immediate objective of this component is "*to strengthen and support the public and private sector working in the renewable energy sector to provide better quality of service to the rural areas*". The implementation of this component will be done through on-the-job training as appropriate, supported by theoretical / class room type of training. The main focus will be on the private sector and NGOs.

The cost of component three is estimated to be US$ 300,000. GEF is requested to fully fund this.

donor	description	amount
GEF		$ 300,000
TOTAL		**$ 300,000**

Table 7 Cost breakdown component 3

The three outputs of component 3 will be:

Output 3.1
Business development services in the renewable energy sector will be strengthened

Activities:
- Provide business planning and development services through one-on-one meetings with business to develop business plans, marketing plans, and promotional opportunities, making reference, as appropriate, to the resources and opportunities available for support.
- Assist local PV wholesalers and importers to develop stronger linkages with international companies;
- Make available, reassess; refine; and update the PV market data for the key product lines in order to support further business development.
- Carry out training on PV business "best" practice, including service warranties and maintenance contracting.

Output 3.2
Technical knowledge of renewable energy technologies is strengthened

Activities:
- Develop a variety of courses (short/long) for various target groups on financing for small-scale renewable energy systems; the correct sizing, installation, operation, repair and maintenance. The courses will cover all technologies promoted through this project including PV systems, Wind-PV and Hydro-Diesel Minigrids and other relevant topics tailored to the needs of the following groups:
  - NGOs, micro-finance institutions (MFI's); banking staff, and others;
  - Technicians and sales people;
  - Engineers; and
  - Vendors.
- Work with (local) training institutes to develop an appropriate curriculum for the training of PV technicians, including training in standards, international best practice, and codes of practice/conduct.

Output 3.3
The association of PV suppliers in Lesotho is operational (Lesotho Solar Energy Society, LESES)

Activities:
- Assist the local PV suppliers in re-activating the LESES.
- Involve the LESES as sounding board for the project implementation

48. **Component 4: Policy framework and support**

The immediate objective of component 4 is "*to assist the development of policy and institutional arrangements needed for the widespread adoption of renewable energy sources for off-grid electricity services*". The Government of Lesotho attaches high priority to providing rural locations in the country with basic energy services. The establishment of the National Rural Electrification Fund will be supported by this project. In particular this project will help the Government to ensure consistency between the adopted energy policy and other rural energy activities.

The cost of component four is estimated to be US$ 829,000. The contribution requested from GEF is US$ 100,000.

donor	description	amount
WB	assistance to the rural electrification unit	$ 546,000
GOL	in kind – rural electrification unit	$ 183,000
GEF		$ 100,000
TOTAL		**$ 829,000**

Table 8 Cost breakdown component 4

The two outputs of component 4 will be:

Output 4.1
A policy and implementation framework for renewable energy based rural electrification is defined and in place

Activities:

- Provide input to the Government in implementing the Lesotho Rural Electrification Fund to assure that renewable energy technologies are integrated in its activities
- Provide input to the Government in implementing the National Energy Master Plan to assure that renewable energy technologies are integrated in the plan
- Work in very close co-operation with the stakeholders involved to identify and formalise their respective roles

Output 4.2
Standards for renewable energy technologies and mini-grid are updated and enforced

Activities:

- Identify the current existing standards
- Review and if necessary update the current existing codes of practise for technicians regarding PV systems and mini-grids.
- Facilitate the formulation and adoption of national standards, code of practice and minimum requirements for PV systems and mini-grids (in collaboration with the Ministry of Trade, Industry, Marketing and Co-operatives and the Lesotho Electricity Authority).
- Make the standards and codes available and publicly known.

49. **Component 5: Financial mechanisms**
The immediate objective of this component is "*to assist with the implementation of appropriate financing mechanisms for the larger scale dissemination of renewable energy based technologies to rural customers"*

The cost of component five is estimated to be US$ 835,000. GEF is requested to contribute US $ 800,000 towards this.

donor	description	amount
private sector	in kind	$ 10,000
GOL	in kind	$ 25,000
GEF		$ 800,000
TOTAL		**$ 835,000**

Table 9 Cost breakdown component 5

The development of the financing mechanisms will be completed prior to CEO endorsement. Some additional funds will be requested from the GEF to complete the work started under the PDF B. These additional PDF B funds would be used to design financing schemes for end-users, dealers and financing institutions. The implementation of these schemes will happen after CEO endorsement under the full project. By CEO endorsement it is also expected that the final terms of operation of the NREF will be clear and publicly available.

The two outputs of component five will be:

Output 5.1
Financing schemes for end-users, dealers and financing institutions implemented

Activities:
- Implement an appropriate financing scheme for end-users
- Implement an appropriate financing scheme for PV dealers
- Implement an appropriate financing scheme for financing institutions focusing on established micro-finance schemes

Output 5.2
Sustainable long-term financial support schemes for renewable energy systems are implemented

Activities:
- Assist the government in identifying the role the NREF should play with respect to financing rural electrification.
- Assist with implementing the NREF and particularly the financing schemes developed under the NREF.

50. **Component 6: learning and replication**.
The immediate objective is "*to disseminate experience and lessons learned to promote replication throughout the country of rural electrification based on*

renewable energy technologies". The implementation of component 1 will be closely followed and lessons learned will be actively considered to develop an improved understanding on what conditions have to be in place for large scale dissemination of renewable energy-based technologies and mini-grids.

The cost of component six is estimated to be US$ 327,000, GEF is requested to contribute towards this with US $ 300,000.

donor	description	amount
UNDP	PDF B phase	$ 10,000
GOL	PDF B phase	$ 17,000
GEF		$ 300,000
TOTAL		**$ 327,000**

Table 10 Cost breakdown component 6

The three outputs of component six will be:

Output 6.1:
A programme for replication of the activities implemented under immediate objective 1 is prepared

Activities:
- Closely follow the implementation of component 1 and distil the necessary elements for up-scaling these activities beyond the target villages.
- Design a roll-out programme for renewable energy-based systems based on the activities in component 1 for the districts of Thaba-Tseka and Qacha's Nek.
- Design a roll-out programme throughout the country.

Output 6.2
Evaluation of the impact of renewable energy technologies on rural livelihoods

Activities:
- Review and adapt existing methodology for the evaluation and measurement of the impact of renewable energy-based energy services on the livelihoods and standards of living of the customers.
- Apply the most appropriate methodology to a representative sample of customers in the project area.
- Summarise the impact of renewable energy-based systems on customers based upon the project experiences.

Output 6.3
Support has been provided to disseminate the learning and replication experiences in the project area

Activities:
- Prepare publications on the lessons learned and results of the PV and mini-grid management initiative in the project area for distribution to other sites in Lesotho;

- Organise site visits to the project area for other donors/investors and private sector entrepreneurs interested in implementing a similar initiative nationally in other regions or internationally;
- Engage with other projects in the country, region and world to exchange lessons, experiences, and solutions encountered to perceived challenges in the renewable energy field; and
- Present the results achieved in the Mokhotlong district and the Semonkong mini-grid through presentations at national and international seminars and workshops.

The GEF budget for the entire programme is provided in Table 11. The detailed incremental cost analysis is provided in Annex A

Component description	Estimate GEF budget	
1. delivery of renewable energy based technology packages	US$	700,000
2. awareness raising	US$	200,000
3. private and public sector strengthening and training	US$	300,000
4. policy support and policy framework	US$	100,000
5. financial mechanisms	US$	800,000
6. learning and replication	US$	300,000
M&E	US$	100,000
Total	**US$**	**2,500,000**

Table 11 GEF project budget

Flexible programming: The proposed initiative will allow changes during the implementation according to market developments. However, it is necessary to remain within the programme boundaries presented here. Moreover, no additional financial resources will be made available by GEF to innovations and/or to address newly arisen barriers.

4. Risk and sustainability

51. The first level risk relates to the policy environment. The project is being designed in the wake of power sector restructuring. However, this risk is being minimised as GOL is committed to operating efficiency of the utilities, especially LEC, and sustainability of the electricity sector in general. In components 3, 4 and 5 the link with the emerging national policy on (renewable) rural electrification is looked into. Associated uncertainty is with the institutions envisaged to implement the Government policy on rural electrification. The active role the Department of Energy is playing in this respect will assure a positive outcome that will not jeopardise the role of this project.

52. The second level risk is associated with the high up-front investment cost of renewable energy technologies. This risk will be minimised by engaging the National Rural Electrification Fund in the execution of the project. The NREF is mandated to financially support the provision of rural electrification. Components 1, 2 and 5 will mitigate this risk. Financial institutes will be involved to develop credit schemes for customers that are not able to pay the full costs up-front. To

mitigate the risk that customers, even though financing packages are available, do not approach the participants in the project, a substantial component on awareness-raising is included in the project.

53. The third level of risk resides in the replication of the project activities in other areas of the country. The project cycle for the Mokhotlong district will provide "lessons learned" that will largely contribute towards mitigating this risk.

54. A fourth level of risk is that the project will become an institution on its own without proper embedding into the arena of other projects. To mitigate this risk the project has been "marketed" from the start as combining all forces working on the provision of rural electrification. It will follow an open approach towards information sharing. As there is already a good base of geographic information available in GIS format in Lesotho, the project will build upon this and facilitate the use of GIS to the maximum extend possible.

55. The fifth and last risk is related to the very high HIV/AIDS infection rates in Lesotho. This is not a risk unique to this project, but one that can be found in every activity implemented in the country. Although the Government of Lesotho is expending substantial time and effort to this problem on a national basis, very few effective risk mitigation activities can be made available under this programme other than programming additional financial resources for training and capacity building. This is necessary, as more people will need to be trained to ensure sufficient available and qualified personnel for the longer term.

56. It should be mentioned that providing the basic energy services to HIV/AIDS sufferers will certainly relieve their situation, but on the other hand early deaths resulting from HIV/AIDS will result in loss of income in already poor households that will have an immediate effect on their ability to pay for energy services.

57. In addition to the above listed activities to mitigate the identified risks, there will be permanent monitoring of risks and activities to mitigate these risks by the project management team. Instead of following a cast-in-stone project plan, the project management team will adhere to flexible programming to ensure that pitfalls in the programme design, planning and implementation are immediately dealt with in the most appropriate manner. In this respect the link with other ongoing activities in other SADC countries is very important. Risks encountered by these projects will be evaluated to judge their applicability to the Lesotho programme and if necessary mitigation tasks will be initiated.

58. The proposed project is viewed as a support initiative to the on going national efforts to effectively promote rural electrification and as such its management, planning and implementation will be an integral part of the sustainable national rural electrification programmes. GOL considers rural electrification essential to support income generating activities thus contribution to poverty alleviation. In this respect, the establishment of NREF is a positive step. According to the NREF regulations, NREF will provide early stage funding and enterprise development services to entrepreneurs, helping build successful business that supply clean energy technologies and services to rural and peri-urban areas in the country. The project will stimulate market for RETs which will be sustained due to different

components in the project, especially component 3, on private and public sector strengthening and training.

5. Stakeholders participation and implementation arrangements

59. Participation of the stakeholders involved is seen as crucial for the success of the programme. Without proper consultation and involvement, the success of the programme will be jeopardised. During the PDF-B implementation, individual stakeholders were consulted and in addition, a stakeholders' workshop was convened on 20th -22nd August 2003. This workshop helped in identifying additional stakeholders and in defining their respective roles in barrier removal. The key stakeholders include: Rural communities, NGOs, Local Authorities, Energy Regulators, Department of Energy, Financial Institutions, Solar providers/dealers, Technical institutions, Media institutions and professional associations.

Implementation arrangements

60. The proposed GEF/UNDP supported project will be executed within the guidelines of UNDP National Executing (NEX) modality. NEX in principle creates a platform for Government flexibility to ensure that UNDP supported projects are executed in consistent with national development priorities. In particular, NEX enhances integration, thus increased prospects for sustainability, of UNDP supported projects into the overall activities of the executing agency. The Department of Energy (DOE) of the Ministry of Natural Resources will serve as overall Executing Agency for the project. DOE is responsible for overall national energy policy, coordination and monitoring of energy programmes and projects. DOE is fully responsible for the planning and implementation of rural electrification in Lesotho.

61. The proposed project is viewed as a support initiative to the national efforts to effectively promote rural electrification and as such its management, planning and implementation will be part of the activities of the Rural Electrification Unit (REU) whose Chief will report directly to the Department of Energy. In order for this integration to be practically realised, the Chief of REU is ideal to be the project manger. The project manager will report to the Director of DOE for the primary purpose of managing the project within the context of approved project document and any other authorised project reports. The Technical staff, and other DOE staff, of the REU will be responsible for technical input to the project.

62. In addition, the existing Rural Electrification Working Group (REWG), which composes of members from a spectrum of stakeholders including private, NGOs, Consumers and Government, and whose main responsibility is to advise on issues of rural electrification, will include the project in its project portfolio. REWG will advise the Director of Energy on policy issues relating to rural electrification and will include the proposed project as well. The REWG will replace the usual Project Steering Committee (PSC). There are prospects that REWG, in integrating the project into its portfolio, will require expanded membership. The Energy and

Environment Unit of UNDP is an example. The Director of DOE will report rural electrification progress to Principal Secretary (PS) of the Ministry of Natural Resources (MNR). Regarding the rural communities, the Ministry of Local Government, NGOs and consumers are part of the REWG to ensure that rural electrification programmes and projects, including the proposed project, respond to the community needs and that mechanisms are in place to empower the communities to effectively participate in their programmes and projects. The organisational structure is reflected in Figure 3.

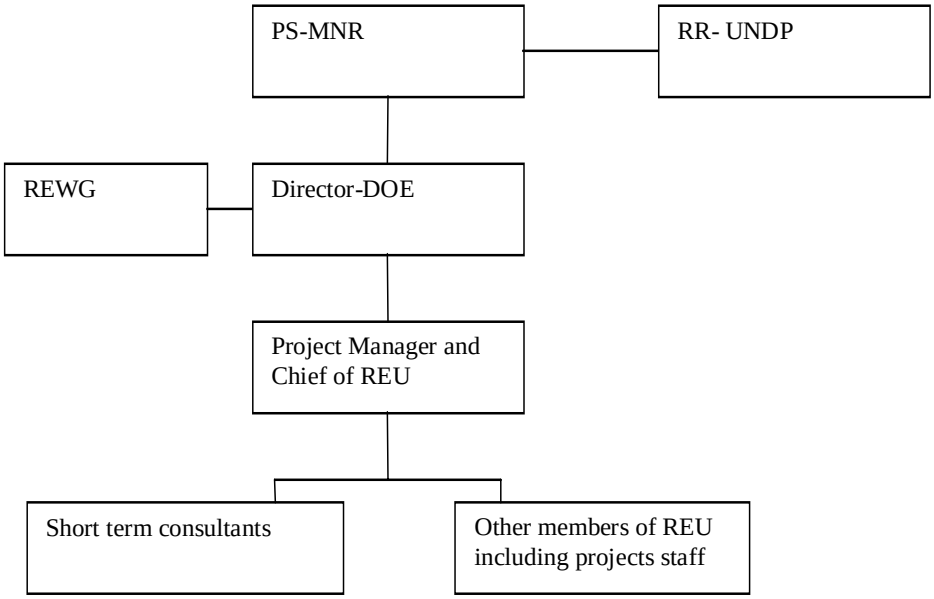

Figure 3 Proposed implementation arrangements

6. Incremental costs and project financing

63. This project is designed to remove barriers to the introduction of renewable energy technology-based systems to meet the basic energy needs of rural communities in the Mokhotlong district and to increase the use of hydropower at existing and proposed mini-grids. It will adopt a market transformation approach to the PV and wind market in Mokhotlong, and is consistent with the terms of GEF Operational Program 6. To the extent that it helps stimulate greater sales of PV's and wind technology to households and institutions, it will also help reduce both the incidence of respiratory and eye problems attributable to kerosene soot and the risk of hut fires. The proposed project activities would not take place in the absence of UNDP and GEF support, making the project activities largely incremental.

64. A detailed assessment of incremental costs is presented in Annex A - Incremental cost analysis and matrix. According to the available information on the current energy consumption, a household uses approximately 7.5 litres of paraffin per month for lighting purposes, costing approximately M 25.50 (US $ 3.65 / month).

In addition to this, a household in rural areas spends approximately M 36.00 on dry cell batteries to power radios and torches. In the case of Hi-Fi or TV appliances, a monthly battery charging rate of about M 20.00 has to be paid by the household.

65. For the targeted 1000 PV systems in the Mokhotlong district, the estimated CO_2 emissions reduction as a result of substituting paraffin based lighting with electrical lighting, amounts to 4500 tonnes over a 20 years' period. This is based on an average of nearly 6 litres paraffin savings per month per customer. CO_2 reduction per litre of paraffin has been taken as 3.2 kg. (source: IPCC draft Guidelines for National Greenhouse Gas Inventories, Volume 3. UN energy Statistics Yearbook 1992)

66. For the hybrid wind/PV mini-grid at Sani Top, 30 households will save the consumption of nearly 6 litres of paraffin per month, while two of the three businesses that will be connected (a general dealer and a tourist accommodation) will each save the use of 3 kW Lister diesel generator for 3 hours every evening. The household customers will reduce their carbon emissions by 130 tonnes of CO_2 over a 20 years' time horizon, while the two businesses will save a similar amount. This total emissions reduction for the Sani Top mini-grid will add to 260 tonnes of CO_2.

67. The replacement of one planned diesel generator of 100 kW at the Semonkong mini-grid by expanded hydro capacity will reduce the GHG emissions by 15,000 tonnes of CO_2. The project activities as such will eliminate nearly 20,000 tonnes of CO_2 over a 20 years' time horizon.

68. Spin-offs of the direct project activities are additional sales of PV systems in the Thaba-Tseka and Qacha's Nek districts and the implementation of the Seforong mini-grid using mini hydropower will contribute to an additional 16,000 tonnes of CO_2 emissions reduction.

69. The total CO_2 emission reductions that can be directly attributed to the project are 36,000 tonnes of CO_2 over the 20 year lifetime of the equipment. This results in a cost of US$ 69/ ton of CO_2 (2,500,000/ 36,000).

70. Because this project is not requesting a subsidy per W of renewable energy capacity installed, the incremental costs associated with this project are considered to be the costs of the activities designed to remove the primary barriers to rural electrification and stimulate the renewable energy market in Mokhotlong district and Lesotho in general. It will focus primarily on stimulating cash sales, experimenting various credit mechanisms which might be used in future projects to expand the market further.

71. The budget for the entire project is provided in the table below. The detailed incremental cost analysis is provided in Annex A

Component description	Estimate project budget			
	GEF		Co-funding	
1. delivery of renewable energy based technology packages	US$	700,000	US$	3,389,500
2. awareness raising	US$	200,000	US$	50,000
3. private and public sector strengthening and training	US$	300,000	US$	0
4. policy support and policy framework	US$	100,000	US$	729,000
5. financial mechanisms	US$	800,000	US$	35,000
6. learning and replication	US$	200,000	US$	27,000
M&E	US$	100,000	US$	25,000
Total	**US$**	**2,500,000**	**US$**	**4,255,500**

Table 12 Total project budget

7. Monitoring, evaluation and dissemination

7.1. UNDP monitoring

72. The project will be monitored and evaluated according to standard UNDP rules for nationally executed projects. For each of the six components, a monitoring plan will be prepared during project inception phase. A project planning matrix has been developed and is part of the submission (annex B). As part of the project inception, the project planning matrix will be revised, specifically the detailed indicators will be revisited and adapted, including measures to track the major external project risks. These indicators will draw upon all sources of information, including those of other donors active in the energy field in Lesotho. Appropriate and specific performance benchmarks will be established prior to project implementation to effectively monitor project progress and to make crucial management decisions. An annual reporting cycle will be established for this project that will provide progress reports to be shared by all participants in the project.

73. Following UNDP's change to results based management; the country office has developed a new format for work plans. The format emphasises achievements (benchmarks and milestones) as well as cost per output/result. This format will allow for a critical assessment of program performance as it shows, at a glance, what activities are to take place, when, the cost for each activity, the responsible agent for implementation, progress at the end of every quarter, and to facilitate the preparation of the work plans for the subsequent quarters.

74. In addition to normal Government monitoring, UNDP will have the monitoring and reporting obligation for the program. In this connection, additional monitoring and evaluation missions will be undertaken by UNDP when this is judged to be required, as for example when there is a need for an intermediate assessment of progress or impact before a decision is taken as to the continuation of any given activity. This will be done in collaboration with the executing agency as well as with the implementing partners.

7.2. Annual reviews

75. Annual review meetings involving key stakeholders will be held to review the status of implementation of the programme. The purpose of the review meetings is to assess the progress made and to take decisions on recommendations to improve the design and implementation of the programme in order to achieve the expected outputs. The annual review is to be based on the Annual Programme Report.

7.3. UNDP Evaluation

76. Two independent external evaluations will be carried out. One mid-term evaluation after 2½ to 3 years of project implementation and one evaluation will be carried out towards the end of the programme after 5 years of implementation. The mid-term evaluation will assist the executing and implementing agencies in receiving detailed feedback on the project operations that can be used to steer and/or re-direct the project activities in case necessary. The final evaluation will assist programme stakeholders to draw lessons learned for use in improving the quality of future development interventions with similar activities. UNDP regulations have no formal requirements for a final evaluation, so it should be needs-based. The evaluation should be done in collaboration with other development partners. An amount of US $ 50,000 from GEF has been specifically earmarked for these two external evaluations.

    Evaluating the impact of RE technologies on rural livelihoods will be included in the terms of the independent evaluations.

7.4. GEF specific monitoring and evaluation

77. The impact of the proposed project activities in terms of reductions in the emissions of green house gasses (expressed in CO_2 equivalents) is of immediate interest to the GEF, as these reductions are their main mandate. The GEF would like to achieve the reductions in GHG emissions through the removal or lowering of barriers towards the large-scale implementation of renewable energy technologies. Associated aspects as market development for renewable energy technologies, improve quality of live of the rural population and increase opportunities for businesses are considered important as they contribute towards the sustainability of the project and thus the (continued) reduction in GHG emissions. In order to properly and practically monitor these impacts it will be necessary that baselines be established prior to introducing and disseminating PV and other renewable energy technologies. During the PDF B phase a literature scan and an analysis of existing datasets and documentation has been carried out. The data collected during this phase have been used to develop the project baseline. At the start of the project the data used for the baseline need to be verified through an appropriate activity.

78. Based on the information gathered during the PDF B phase, augmented by any other information source, it will be necessary to identify a number of measurable indicators that can be used for monitoring of the impacts. The impact monitoring should be done on an annual basis by the project implementation team and the data collected and analysed should serve as a management tool for the team to

steer and/or redirect the project's implementation. It is proposed that the indicators as displayed in Table 13 will be used.

Impact to be monitored	Indicator to be used	Means of verification
CO_2 emission reduction	litres of paraffin used operational PV systems	end-user survey dealer survey
Increased PV market activity	umber of PV businesses active	market survey dealer survey
Increased income generating	number of businesses	end-user survey
increased number of mini-grids managed in sustainable way	number of mini-grids	energy regulator

Table 13 Impact monitoring indicators and means of verification

79. Please note that the baseline methodologies and monitoring and evaluation plans as they are being used as part of the Clean Development Mechanism (CDM) project development circle could be used to further fine-tune the impact monitoring scheme as in Table 13. An amount of US $ 50,000 from GEF has been specially earmarked for these GEF specific monitoring and evaluation activities.

7.5. Monitoring environmental impacts

80. Waste generated due to the use of PV systems can be separated in discarded PV panels and balance of system components like batteries, regulators, lights, etc. For the panels the main materials are silicon for the solar cells and aluminium for the frames. Both are not toxic. The frames are relatively easy to remove and qualify for recycling.

81. Of the Balance of System components, the batteries pose the highest risk for the environment since they contain lead and sulphur-acid, or other toxic material. There are more batteries than solar panels, since batteries have to be replaced several times during the lifetime of the panels. Batteries may be easily recycled, but no obligation exists that the suppliers of new batteries have to take care of the recycling of the old ones. Moreover, no recycling capacity exists inside Lesotho. All recycling of batteries have to be taken care of in South Africa. The project will give specific attention to the issue of recycling of batteries and will investigate the potential environmental issues concerning the disposal of CFLs.

82. The environmental impact of mainly the batteries will be closely monitored under the proposed initiative and measures for collection and recycling will be included in the operation and maintenance procedures that will be designed and implemented under the programme.

8. Legal context

83. This programme document shall be the instrument referred to as such in Article 1 of the Standard Basic Assistance Agreement between the Government of Lesotho and United Nations Development Programme. The host country-executing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the

Government co-operating agency described in that Agreement. As support to the executing agency, the UNDP country office will provide support services for some of the activities of the project as identified and agreed upon by all parties, especially in the following areas:

- Identification and recruitment of the required personnel/experts to undertake specific activities under the project;
- Identification and facilitation of training services
- Procurement of goods and services

84. The country office will be provided a fee directly from UNDP/GEF headquarters in New York for the provision of all the identified and agreed upon services. This fee will be in addition to the proposed GEF project budget and will be negotiated separately between UNDP/GEF headquarters and UNDP Lesotho.

85. The following types of revisions may be made to this Programme Document with the signature of UNDP Resident Representative only, provided he/she is assured that the other signatories of the programme document have no objection to the proposed changes:

- Revisions in, or in addition to, any of the annexes of this project document
- Revision which do not involve significant changes in the immediate outcomes, outputs or activities of the programme, but are caused by the re-arrangement of inputs already agreed upon or by cost increases due to inflation; and
- Mandatory annual revisions, which re-phase the delivery of agreed programme inputs, or reflect increased expenditure or other costs due to inflation or take into account agency expenditure flexibility.

9. Annexes

Annex A - Incremental costs
Annex B - Project Planning matrix
Annex C - Market for PV in Lesotho
*Annex D - UNDP budget **
*Annex E1 - STAP review **
*Annex E2 - Response to STAP review **
Annex F - Endorsement letter
Annex G - Co-financing letters

** Annexes D, E1 and E2 can only be prepared after the project document has been cleared internally by UNDP*

Annex A - Incremental cost analysis and matrix

Project activity	Baseline	Alternative	Increment
Component 1: delivery of renewable energy-based technology packages: To implement different delivery models for renewable energy-based rural electrification targeting different end-user groups and making use of different technology packages	Cash sales of PV systems through the private sector as is currently the case will continue at the current very low level Very limited applications of PV for productive uses The EAPP will install 710 SHS in the Mokhotlong district The community in Sani Top will continue to rely on fossil fuels for their energy services Three villages will be provided with pumped water The mini-grid at Semonkong will be expanded from the current 42 customers to 250 customers by installing additional diesel generation capacity The mini-grid at Seforong will be implemented without a hydro component	1000 customers will be targeted for purchase of a PV system through cash sales or a credit scheme Establishment of small-scale productive uses through the provision of “solar-containers” A hybrid wind/PV mini-grid will be established at Sani Top Wind energy potential for rural areas assessed Three villages will be provided with PV pumped water The mini-grid at Semonkong is expanded from the current 42 customers to 250 customers by installing additional hydro capacity and additional diesel capacity The hydro-potential at Seforong is identified and a hybrid mini-grid is implemented	Increased application of renewable energy-based rural electrification Increased application of renewable energy for productive uses. Potential of small-scale wind applications in the rural areas is known Water pumping in the rural areas is increasingly done using PV The Semonkong mini-grid will be expanded using both the hydro resource and additional diesel capacity The Seforong mini-grid is implemented using hydropower.

	Cost: US $ 816,500 (EAPP PV) US $ 234,000 (EAPP Semonkong) US $ 73,000 (RWS) total US $ 1,123,500	Cost: US $ 816,500 (EAPP) US $ 234,000 (EAPP Semonkong) US $ 600,000 (GEF) US $ 73,000 (RWS) US $ 2,500,000 (NREF) total US $ 4,223,500	Incremental cost: US $ 600,000 (GEF) US $ 2,500,000 (NREF) total US $ 3,100,000

Project activity	Baseline	Alternative	Increment
Component 2: awareness raising: to increase awareness among the general public, decision-makers and rural customers on the potential role of renewable energy in meeting basic energy needs in rural areas	Consumers are not fully aware of the potential of utilising renewable energy-based technologies as an alternative for paraffin, candles and dry cell batteries to obtain safe, efficient and reliable lighting / electricity services in the rural areas Decision makers are not fully sensitised with regard to the role that PV and hybrid mini-grids can play in rural electrification	Formulate a programme utilising multi-media, organise general awareness campaigns and demonstrations of PV and hybrid mini-grid applications	Renewable energy dissemination programme
	Cost: US $ 0	Cost: US $ 300,000 (GEF) US $ 50,000 (GOL in kind) total US $ 350,000	Incremental cost: US $ 300.000 (GEF) US $ 50,000 (GOL in kind total US $ 350,000

Project activity	Baseline	Alternative	Increment
Component 3. to strengthen and support the public and private sector working in the renewable energy sector to provide better quality of service to the rural areas	Local companies have limited capacity for quality interventions regarding PV systems and renewables linked mini-grids A limited number of companies will be able to expand their operations, but the market growth will be minimal	Develop an appropriate curriculum to increase the capacity of the local companies to deliver quality products Assist the private sector in developing business skills, prepare business plans and access loans to expand the market	Local companies are able to deliver higher quality products and services Private sector companies have better business skills and thus able to expand their operations
	Cost: US $ 0	Cost: US $ 400,000 (GEF)	Incremental cost: US $ 400.000 (GEF)
Component 4: policy support and policy framework: To assist in the development of policy and institutional arrangements needed for the widespread adoption of renewable energy sources for off-grid electricity services	Renewable energy-based rural electrification will not be an integrated activity in the National Rural Electrification Fund No standards for PV and mini-grids are in place and enforced	Assistance to the integration of renewable energy-based rural electrification in the activities of the NREF Standards for PV and mini-grids are in place	Far more attention to the specific role renewable energy-based rural electrification in Lesotho High standards for the implemented projects on renewable energy-based rural electrification projects implemented
	Cost: US $ 183,000 (GOL in kind) US $ 546,000 (WB) total US $ 729,000	Cost: US $ 183,000 (GOL in kind) US $ 546,000 (WB)) US $ 200,000 (GEF) total US $ 929,000	Incremental cost: US $ 200,000 (GEF)

Project activity	Baseline	Alternative	Increment
Component 5. financial mechanisms: To assist with the implementation of appropriate financing mechanisms for the larger scale dissemination of renewable energy based technologies to rural customers	Despite some interest and previous initiatives, very little actual lending for investments in the PV market occurs. As the market slowly expands, the lack of financing to PV customers and industry will become a major bottleneck to its expansion Long-term financial support schemes for renewable energy-based rural electrification are not attended to in the rural electrification schemes	To design, test and evaluate viable financing options / mechanisms for disseminating renewable energy-based rural energy services Integration of implementation strategies for subsidy schemes into the National Rural Electrification Master Plan	Valuable experience on setting up appropriate financing schemes for rural energy service provision in Lesotho is obtained Longer term financing in the form of subsidy schemes for renewable energy-based rural electrification has been designed and integrated into the operations of the National Rural Electrification Fund
	Cost: US $ 10,000 (private sector in kind)	Cost: US $ 10,000 (private sector in kind) US $ 400,000 (GEF) US $ 25,000 (GOL in kind) total US $ 435,000	Incremental cost: US $ 400,000 (GEF) US $ 25,000 (GOL in kind) total US $ 425,000

Project activity	Baseline	Alternative	Increment
Component 6. learning and replication: To disseminate experience and lessons learned to promote replication of rural electrification based on renewable energy technologies throughout the country	No structured learning and dissemination of activities in the baseline Limited ability to learn from projects both within and outside the country	Closely follow the implementation of component 1 and initiate a national programme to replicate the use of PV and hybrid mini-grids to generate and supply electricity to off-grid rural customers Evaluate the impact of the project interventions Closely follow the implementation of similar projects in other SADC countries and learn from their experiences	Recommendations for the inclusion of renewable energy based rural electrification in the operational activities of the NREF Improved understanding of the impact of rural electrification on the quality of life of the communities in rural areas Lessons learned documented and a dissemination programme for such is in place
	Cost: US $ 10,000 (UNDP PDF B) US $ 17,000 (GOL PDF B)	Cost: US $ 10,000 (UNDP PDF B) US $ 17,000 (GOL PDF B) US $ 500,000 (GEF) total US $ 527,000	Incremental cost: US $ 500,000 (GEF)

Project activity	Baseline	Alternative	Increment
Component: Monitoring and evaluation	No monitoring of the impact on CO_2 emissions reductions and the impact on the quality of life of the rural population of Lesotho will occur	To design a baseline, indicators and means of verification of the impacts on CO_2 emissions reduction, the PV market development, income generating activities and hybrid mini-grids	Impacts of the proposed interventions have been measured, analysed and serve as a management tool for the project management team
	Cost: US $ 0	Cost: US $ 100,000 (GEF) US $ 25,000 (GOL in kind) total US $ 125,000	Incremental cost: US $ 100,000 (GEF) US $ 25,000 (GOL in kind) total US $ 125,000
TOTAL costs	Cost: US $ 1,050,500 (EAPP) US $ 73,000 (RWS) US $ 200,000 (GOL) US $ 10,000 (UNDP) US $ 10,000 (private sector) total US $ 1,343,500	Cost: US $ 1,050,500 (EAPP) US $ 73,000 (RWS) US $ 2,500,000 (GEF) US $ 2,500,000 (NREF) US $ 300,000 (GOL) US $ 10,000 (UNDP) US $ 10,000 (private sector) total US $ 6,443,500	Incremental cost: US $ 2,500,000 (GEF) US $ 2,500,000 (NREF) US $ 100,000 (GOL) total US $ 5,100,000

Global environmental benefits	An estimated 3300 tonnes of CO_2 emissions avoided over the 20 years in Lesotho due to anticipated baseline activities	Over 20 years in Mokhotlong district 10,000 tonnes of CO_2 emissions avoided Due to the implementation of microhydro at mini-grids, a CO_2 emissions reduction of 30,000 tonnes	Nation-wide approximately 35,000 tonnes of CO_2 will be reduced over a 20 years time horizon
Domestic benefits	PV market continues to grow very slowly. The hydro resources of the country are not fully exploited Most rural households will continue being exposed to smoke and soot due to the use paraffin for lighting,	The market for PV will grow at a much faster rate The hydro potential of the country will be better utilised Significant reduction of the exposure to paraffin smoke and soot in the project areas and in the country as a whole	In the target areas a reduction of the consumption of 1.5 million litres of paraffin achieved Additionally approximately 280000 litres of paraffin are saved nation-wide Approximate savings of 8.8 million litres of diesel due to replacement by hydro capacity Significant reduction in the exposure to indoor air pollution from paraffin

Annex B - Project Planning Matrix

strategy	indicators	means of verification	critical assumption
Global objective: To reduce Lesotho's energy related CO_2 emissions by substituting fossil fuel (paraffin and diesel) with renewable energy sources (PV, wind and hydro) for household and productive uses through the provision of basic energy services to rural homes and community users	Consumption of paraffin reduced by 80 % in the households using renewable energy based systems for lighting	Energy use survey	
	Incidence of paraffin related respiratory and eye diseases reduced by 10 % over 5 years within those households targeted by the project	Medical survey	
	Small scale renewable energy-based business activities increased by 50 % compared to the baseline	Dealer survey	
	Consumption of diesel for generating electricity reduced by 80% in the households and businesses targeted by the wind/PV and hydro/diesel mini-grid pilots	Energy use survey	
Development objective: to improve people's livelihoods by promoting the utilisation of renewable energy to provide basic electricity services to the rural areas in Lesotho starting in the Mokhotlong district, thus reducing the country's dependency on fossil fuels	The number of customers reached by renewable energy-based electricity services in the Mokhotlong district reaches 1760 in year 5 of the project, as compared to 735 in the baseline	Dealer survey EAPP files Project files	Paraffin prices will not significantly drop EAPP will be implemented as planned
	The hydro component of the Semonkong hydro/diesel mini-grid is expanded	Site visit	The feasibility study that will be carried out under the project concludes the expansion of the hydro capacity at Semonkong is feasible

strategy	indicators	means of verification	critical assumption
Immediate objective 1: To implement different delivery models for renewable energy-based rural electrification targeting different end-user groups and making use of different technology packages	The number of household PV systems in the district will be 2035 as compared with 1035 in the baseline scenario	Project implementation and progress report	End users are able and willing to adopt new technologies and ready to use the proposed delivery model (cash and credit sales) to purchase PV systems
	A hybrid mini-grid using PV and wind is established at Sani Top		
	The Semonkong mini-grid is equipped with additional hydro generation equipment		
Output 1.1 In Mokhotlong district 1000 customers purchased PV-systems through a credit scheme or through cash sales	1000 PV systems sold in Mokhotlong district	Data from PV dealers	Private sector is willing to engage in offering credit schemes to rural customers
Output 1.2 At least three businesscentres are established in the Mokhotlong district using PV as their energy source	Three businesscentres established using PV	Project files	Rural households are interested to use the services of the businesscentres
Output 1.3 Limited grant financing is provided to a small number of schemes proposed by the private sector to test various productive uses of renewable energy	At least 5 grants provided to companies by the end of the project	Project files	Private sector is willing to participate in the development of productive use applications of PV
	At least 1 product for productive use applications is commercialised by the end of the project	Dealer survey	
Output 1.4 An isolated hybrid mini-grid using wind and PV is installed at Sani Top serving at least 25 customers and two businesses	25 domestic customers and two businesses connected to a hybrid mini-grid at Sani Top	Project files	End-users are able and willing to adopt new technologies

Output 1.5 The wind energy potential for small-scale power generation, in particularly hybrid mini-grids at selected sites that are favourable for hybrid mini-grids using wind is assessed	Capacity built in the Department of Energy and LMS to interpret wind data for assessing the wind energy potential	Report on capacity building activities done Collected data and site evaluation	Funds for wind measurement equipment will be provided for in the annual budget of LMS
Output 1.6 In Mokhotlong district three villages have been provided with PV water pumping systems	Three systems installed and in operation in line with the PV Code of Practise	Project files	
Output 1.7 Feasibility study on the potential to increase the hydro component of the Semonkong hydro/diesel mini-grid	Report on the feasibility of increasing the installed hydro capacity	Project files	
Output 1.8 The capacity of the hydro station at Semonkong is increased	The installed capacity at the Semonkong hydro station is increased with an additional 180 kW	Project files	The feasibility study that is carried out under output 2.1 concludes the expansion of the hydro capacity at Semonkong is technically feasible and economical viable
Output 1.9 The use of hydropower generation is included in the Seforong mini-grid	The mini-grid at Seforong has a hydropower component	Project files	

strategy	indicators	means of verification	critical assumption
Immediate objective 2: To increase awareness among the general public, decision makers and rural customers on the potential role of renewable energy in meeting basic energy needs in rural areas	Doubling of the number of people using renewable energy technologies as compared with the baseline scenario	Energy consumption report	
Output 2.1 Information and awareness packages have been developed and made available to the general public	Information and awareness packages in the form of brochures, leaflets, demonstrations, road shows, TV/radio announcements	Copies of these packages are readily available	Willingness of market parties, national, district and local government to act as an outlet for the distribution of the packages
Output 2.2 Awareness programme for decision makers is developed and implemented	At least 25 key decision makers have visited the target area and have been exposed to the activities of the project	Reports prepared on these visits	Willingness of high-level decision makers to undertake multi-day trips to remote rural areas.
Output 3.3 A rural customer awareness programme is formulated and implemented	At least 1000 persons attending information meetings in the rural areas	Reports on information meetings	Rural customers are interested to participate in information meetings

strategy	indicators	means of verification	critical assumption
Immediate objective 3: To strengthen and support the public and private sector working in the renewable energy sector to provide better quality of service to the rural areas	Number of businesses dealing with renewable energy systems increased by 50% by the end of the project	Dealer survey	Market actors are willing to co-operate and businesses are eager to expand and/or include renewable energy technologies in their business
	Level of end-user satisfaction with installation and after sales increased by 50% by the end of the project	End-user survey	
Output 3.1 Business development services in the renewable energy sector will be strengthened	At least 50% of all renewable energy dealers/companies active in Lesotho participated in at least one capacity building activity offered by the project	Project files (attendance register capacity building activities)	Willingness of private sector to invest time in training
Output 3.2 Technical knowledge of renewable energy technologies is strengthened	Several technical training courses offered to vendors, dealers, technicians, etc. which are completed by 75% of the participants	Project files	
Output 3.3 The association of PV suppliers in Lesotho is operational (Lesotho Solar Energy Society, LESES)	75% of all PV businesses are member of the association	Membership register of LESES	Private sector is willing to co-operate in the PV association

strategy	indicators	means of verification	critical assumption
Immediate objective 4: To assist the development of policy and institutional arrangements needed for the widespread adoption of renewable energy sources for off-grid electricity services			Willingness of NREF to incorporate renewable energy based electricity into their operations
Output 4.1 A policy and implementation framework for renewable energy based rural electrification is defined and in place	By the end of the project renewable energy features prominently in the National Rural Electrification Master Plan as an option for meeting energy needs in rural areas	National Rural Electrification Master Plan	
Output 4.2 Standards for renewable energy technologies and mini-grids are updated and enforced	80% of suppliers of PV committed to the PV code of practice	List of companies that agreed to adhere to the code of practice	Private sector willing to improve quality of services by adhering to PV code of practice
	Standards publicly available	Project files	Industry is willing to co-operate to develop these standards

strategy	indicators	means of verification	critical assumption
Immediate objective 5: To assist with the implementation of appropriate financing mechanisms for the larger scale utilisation of renewable energy based technologies to rural customers	50% of all major PV dealers offer at least one financing option for rural customers	Data from dealers and financial institutions compiled in project documentation	Willingness of financial sector to get involved in financing renewable / PV energy systems
Output 5.1 A financing scheme to reach rural customers has been designed and implemented	At least two financing schemes are operational in order to deliver PV systems to rural customers	Data from financial sector	
Output 5.2 Sustainable long-term financial support schemes for renewable energy systems are developed and implemented	Design and implementation strategies for financial support schemes documented and integrated in the National Electrification Master Plan	Fiscal policy	

strategy	indicators	means of verification	critical assumption
Immediate objective 6: To disseminate experiences and lessons learned in order to promote replication throughout the country of rural electrification based on renewable energy technologies			
Output 6.1 A programme for replication of the activities implemented under immediate objective 1 is prepared	After year 4 of the project, 50 PV systems will be sold annually in the Thaba-Tseka and Qacha's Nek districts	Sales figures	Successful implementation of the activities of component 1 Willingness of rural customers in Thaba-Tseka and Qacha's Nek to use PV
	After year 4 of the project, the planned mini-grid at Seforong will be implemented using hydropower	Resource assessment completed Hydropower included in the tendering documents	
Output 6.2 Evaluation of the impact of renewable energy technologies on rural livelihoods	Baseline survey and annual data updates provided throughout the project-life	Evaluation report	Willingness / ability of rural customers to provide necessary socio-economic information to assess impact
Output 6.3 Support has been provided to disseminate the learning and replication experiences in the project area	Experiences from this project will be shared with all actors involved in rural electrification in Lesotho	Project files	Actors involved in rural electrification in Lesotho are willing to learn from the project experiences
	The experiences from this project will be shared with at least four countries in the SADC region before the end of the project	Project files	Willingness of actors in other countries to actively share information on their renewable energy based rural electrification activities.

Annex C - Market for PV in Lesotho

Rational and objectives

Almost 90% per cent of energy consumption in the rural areas is sourced from indigenous biomass fuels consisting of shrubs, firewood, crop residues and cow-dung. Paraffin is mainly used for cooking, heating and lighting. Many rural people have to travel long distances to get fuels such as paraffin, often at very high price. The declining number of trees in rural areas has resulted in rural people having to walk 5-10 kilometers a day to collect firewood. Other fuels such as liquefied petroleum gas (LPG) and coal play relatively minor role in rural areas. Finally, very few households in the rural areas use solar Photovoltaic (PV) systems or diesel/petrol generators.

PV market potential in rural areas

The market for electricity in Lesotho is characterized by the country's geography and in particular the small, largely rural, and sparsely distributed population of about 2.2 million. Of the estimated 370 000 households, only about 37 267 are connected to a formal electricity supply.

The table 1 below, using basic assumptions shows that the potential number of households that are likely to be serviced through stand-alone PV systems when PV is compared to other options.

Table 1: Total Potential Market for Solar Home Systems

Number	Parameter	Assumption
2 233 266	Total Population	From Electricity Market and Economic Analysis Report.
372 000	Total households	76% of population is "rural"
282 880	Rural Households	6 people per household
2 829	Rural HH Already Connected	1% of rural population connected to grid
10 000	Potential for Grid Connection in 5-10 years	At least 2 000 connections per year (additional 4% will be connected to the grid in 5 years)
1 414	Connected and potential for isolated generator sets	At least 0.5% of rural HH could connect more cost effectively to isolated gensets in the next 5 years
1 100	Existing PV connections	
267 537	Total Number of Potential PV SHS	

In the following sections, this base market is screened using simple models to estimate what the actual *cash* market is based on estimated spending power of rural populations. The *average* rural income is less than $400 per year, of which approximately 40% is used for energy (mostly wood and paraffin). In Lesotho several realities suggest that, if products were available and awareness was increased, a small sustainable demand would develop. For example, the market for consumer goods such

as cassette players and radios is increasing. If PV is the most effective method to power such items, it will be utilised by off-grid people.

The table below breaks potential markets into 4 groups based on the country income and energy expenditure. This breakdown is fairly arbitrary; owing to the lack of data. However it does provide a useful indicator to possible purchasing trends, and an indicator for what might happen as the market develops. Note that the models below are based on *cash,* not financed systems.

Rural Household Income Groupings

Income Group	Approximate Percentage	Characteristics
"Elite" (has roots in village/rural area, seeking to make investment)	<1%	Investors and business people in small towns. Returnees from overseas setting up businesses. Incomes over $4 700 p.a.
Upper-middle income (village)	3-9%	Business & NGO employees and management. Expected HH incomes range between $1600-4700 p.a.
Middle income (agricultural, village dweller)	15-20%	Traders and farmers. HH income between $800-1600 p.a. Some access to remittances.
Low income & subsistence	>70%	Casual workers, farmers, street vendors, etc. HH incomes below $400.

Using the above classifications, it is possible to break the purchasing groups into the following categories of systems:

Table 2: Rural Household Income and Interest in PV Systems

HH Income ($/annum)	Relative Percentage of Population	Most Likely Interest in PV System Size
<$400	<70-80%	No System
$800-1600	15-20%	One Light System and a radio (12 Wp)
1600-4700	3-9%	2 light & radio system (20 Wp)
>4700	<1%	4 light system or higher (40 Wp or more)

It can be readily demonstrated that such stand-alone PV systems provide lower cost service --- and better quality service --- than existing off-grid solutions. Annualized PV costs for families that require decent lighting and regular radio or music system power are slightly lower for equivalent service from dry cells and kerosene (see table below).

Compared Expenditures of 2 Basic Lighting/Power Systems

Main energy source	Annualized energy costs US$/year
Lamp paraffin	$160
Lantern/a system and a radio	$150[1]

[1] A lantern prices are taken from Kenya. Compared to local prices, systems costs are twice the ones in Kenya or South Africa.

By breaking the market for solar into several groups, and by making assumptions about purchasing power, a rough picture of the demand for Solar Home Systems can be made, as shown below. Several scenarios are presented, including "optimistic", baseline and "conservative".

Table 3: Estimated Market Demand for Solar Home Systems in Lesotho (3 Cases)

Scenario 1: Baseline						
System Description	**Average Size**	**Cost**	**% of Population**	**No HH**	**Size of Market**	**Cash Value**
	Wp	$			kWp	1000's/$
No System	0	0	80	214,030	0	0
One Light & Radio	11	319	11	29,429	324	9,388
2 lights and radio	20	456	8	21,403	428	9,760
4 light system, colour TV and radio or higher	40	794	1	2,675	107	2,124
			100	**267,537**	**859**	**21,272**
Scenario 2: Optimistic						
No System	0	0	77	206,004	-	-
One Light & Radio	11	319	12	32,104	353	10,241
2 light and radio system	20	456	9	24,078	482	10,980
4 light system, colour TV and radio or higher	40	794	2	5,351	214	4,248
			100	**267,537**	**1,049**	**25,470**
Scenario 3: Conservative						
No System	0	0	90	240,783	-	-
One Light & Radio	11	319	4.5	12,039	132	3,840
2 light and radio system	20	456	5.0	13,377	268	6,100
4 light system, colour TV and radio or higher	40	794	0.5	1,338	54	1,062
			100	**267,537**	**454**	**11,002**

As can be seen from these calculations, the potential reachable cash market for SHS is between 454 kWp and 1.049 MWp. This represents a value between 11 and 25 million dollars worth of PV equipment sales. In terms of households the national market potential is 14175 consumers. This figure constitutes the sum of all the three options, excluding the No system, under all the scenarios. This does not include the potential finance market *or* the market for other PV technologies such as water pumping, vaccine fridges, small rural businesses and communications systems.

Other Potential PV Product Markets:

Micro-PV Systems: These are 1-5 Wp systems that could power very small lights or radios. Although the technology development in this field is at an early stage, these low cost products have a good market. They would meet the needs of the rural poor for radio power systems.

PV Pumps: PV for water pumping has been an important market in Lesotho. So there is a good experience in using PV as a water pumping source, particularly for community water supply.

School Lighting & Radio Education: There are at least 1287 primary and 184 secondary schools in the country that are un-electrified. The primary schools can benefit from solar for powering small radios that are used for radio learning programmes. On the other hand the rural secondary schools can have access to educational devices such as microscopes, computers and photocopying machines.

Health Clinics: Vaccine refrigeration and lighting for both health clinics and veterinary centres has been a growing market. The vaccine refrigeration in the health centres in rural areas use mainly LPGas and most cases it is difficult to transport. Moreover, the PV installations in most rural clinics need maintenance and upgrading to cater for growing energy needs.

Churches: Churches require lighting and audio systems for their normal day-to-day operation. They also are able to raise their own support from community, and can be seen, to some degree as non-donor dependant markets. There are some churches off-grid, many of which already use generator sets for their power requirements.

Small Off-Grid café's and Businesses: There are currently 101 000 small scale and medium enterprises in the country, and only 1790 had electricity in January 2003. There is growing demand for power in off-grid rural trading centres, and this opens up opportunities for PV systems.