



Global Environment Facility

Leonard Good
Chief Executive Officer
and Chairman

1818 H Street, NW
Washington, DC 20433 USA
Tel: 202.473.3202
Fax: 202.522.3240/3245
Email: lgood@TheGEF.org

November 16, 2005

Dear Council Member,

UNEP, as the Implementing Agency for the project, ***Zambia: Renewable Energy-based Electricity Generation for Isolated Mini-grids***, has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with UNEP procedures.

The Secretariat has reviewed the project document. It is consistent with the proposal approved by the Council in May 2004, and the proposed project remains consistent with the Instrument and GEF policies and procedures. The attached explanation prepared by the UNEP satisfactorily details how Council's comments and those of the STAP have been addressed. I am, therefore, endorsing the project document.

We have today posted the proposed project document on the GEF website at www.theGEF.org. If you do not have access to the Web, you may request the local field office of the World Bank or UNDP to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,

cc: Alternate, Implementing Agencies, STAP



United Nations Environment Programme

برنامج الأمم المتحدة للبيئة • 联合国环境规划署
PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT • PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE
ПРОГРАММА ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО ОКРУЖАЮЩЕЙ СРЕДЕ

DIVISION OF GEF COORDINATION

P.O. Box 30552, Nairobi, Kenya • Tel:[254 20] 624166• Fax:[254 20] 624041/42•
E-mail: Ahmed.Djoghlaif@unep.org@unep.org • Http: www.unep.org/unep/gef/

TELEFAX TRANSMISSION

4To:	Patricia Blissquest Acting Assistant Chief Executive Officer GEF Secretariat Washington, D.C. 20433, <u>USA</u>	Date: 28 September 2005
	(1 202) 522 3240/3245 ATTN: GEF Programme Coordination	
From:	Mr. Ahmed Djoghlaif Director Division of GEF Coordination	
Subject	CC: OP6: Renewable Energy Based Electricity Generation for Isolated Minigrids	Page 1 of 1

Dear All.

Attached please find the Project Document following an extended appraisal period during which comments from Council and GEF Secretariat were addressed through consultation with partners in the project, technical and financial experts. A detailed Annex C3 is provided in the Executive Summary and the Project Document responding to comments.

In brief, the initial funding of the biomass and hydro minigrids will be firmly controlled by UNIDO in collaboration with ZESCO under a Build Operate Transfer mechanism, and the much smaller PV mini-grid investment is to be an IPP concession. Transfer to the Development Bank of Zambia will be made possible so that they can act as a neutral body to direct the funds in support of replication. DBZ has a minority government ownership (non-political) and a board of governors (including private sector) that ensure transparent operation under Bank of Zambia supervision. Development Bank of Zambia extends technical assistance to business using funding from the European Union Development Branch and their rules and procedures are described in the new ANNEX 11. Since the reflows from the initial investments are relatively small, feasibility studies will comprise the bulk of support for replication.

**UNITED NATIONS ENVIRONMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY (GEF)**

PROJECT DOCUMENT

SECTION 1 – PROJECT IDENTIFICATION

1.1 Title of Sub-Programme:	Africa Region	
1.2 Title of Project:	Renewable Energy Based Electricity Generation for Isolated Mini-Grids	
1.3 Project Number:	PMS: IMIS:	
1.4 Geographical Scope:	Zambia	
1.5 Implementation:	External: UNIDO	
1.6 Duration of the Project:	5 years	
	Commencing:	November 2005
	Completion:	October 2010
1.7 Total Cost:		US\$ (million)
GEF financing:	Full Project	US \$ 2.950
Co-financing	Government of Zambia	US \$ 1.256
	Private Sector Investors	US \$ 2.750
	UNIDO	US \$ 0.500
	UNEP	US \$ 0.050
	Subtotal Co-Financing	US \$ 4.556
Total Cost of Full Size Project		US\$ 7.506¹

1.8 Project Summary

The main objective of this project is to help reduce the global green house gas (GHG) emission by promoting renewable energy based mini-grids for rural electrification in Zambia. Although Zambia has abundant hydropower, which is estimated at 6000 MW (currently installed capacity is about 1700 MW), only 50% of the urban population has access to electricity, and only 2% of the rural population has been connected to the national power grid. In keeping with the New Partnership for African Development (NEPAD) Zambia plans to provide commercial energy services to 15% of the population by the year 2010. The large land span and sparse population in Zambia have made it difficult to extend the national power grid to far-flung rural areas. The baseline trend is that supply of power in many of remote rural areas is predominately serviced by diesel generators, facing high imported diesel fuel cost with consequent environmental impact. Thus, Zambia presents an ideal opportunity for GEF to intervene and promote the use of abundant renewable energy resources -

¹ GEF financing for PDF-B was US\$ 325,000 provided directly to UNIDO by GEF. Total project cost including GEF financing for the PDF-B is US\$ 7.831 million

biomass, solar, and mini-hydro, that are indigenously available to facilitate the rural electrification and promote linked productive use activities.

The project, which primarily aims at removing the key barriers and reducing implementation costs of renewable energy to accomplish this goal, would adopt a holistic approach by including two main components - technical assistance and business model demonstrations. The technical assistance component would engage activities for barrier removal including strengthening of the enabling environment in terms of policy instruments, capacity building, institutional strengthening and information dissemination to support the wide spread replication and sustainability after the GEF intervention. Increased power supply and reliable energy services in the rural areas will promote income generation activities, which is a key element in the Zambian Government’s efforts to eliminate/reduce poverty in the rural areas. The business model component would aim at setting up of three pilot mini-grids to commercially demonstrate the technical and financial viabilities of using renewable energy technologies for electricity generation as well as for providing reliable energy services under the respective applicable business models. The project would support development and implementation of detailed environment management plan for each business model to ensure compliance with the national environmental guidelines and ecological sustainability of mini-grids. In particular, under the Biomass mini-grid, the project would promote environmentally sustainable forestry management and develop mandatory certification standards. The project will also focus on enhancing local manufacturing capacity and maintenance services for renewable energy technologies in Zambia.

Department of Energy (DOE) under the Ministry of Energy and Water Development, Government of Zambia is the national counterpart agency with overall ownership and responsibility for guiding the implementation of the project at the national level. Development Bank of Zambia (DBZ) - a national level financial and banking institution is the designated agency for the introduction of business models to support their wide spread replication and sustainable development in Zambia. The project will introduce new and innovative financial and institutional structures to encourage private investments and support economically viable energy markets in the rural areas. As a result, a robust market and strong institutional and financial capacity at the national level for supporting renewable energy investment projects and markets will emerge in Zambia. This would make Zambia’s economy less reliant on imported fossil fuels to meet its growing energy needs in the rural areas, and in the process, also help in reducing overall GHGs emissions through wide-spread use of renewable energy technologies in the country as well as in the Africa region.

SIGNATURES :

For: UNIDO

For: UNEP, Nairobi

.....
Mr. Abel J.J. Rwendeire
Managing Director
Programme Development and Technical
Cooperation Division

.....
Mr. David Hastie
Chief,
Budget and Financial Management Service

Date:

Date:

SECTION 2 - BACKGROUND AND PROJECT IMPLEMENTATION
UNITED NATIONS ENVIRONMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY

PROPOSAL FOR FULL PROJECT GRANT

Region / Countries: Zambia
Project Title: Renewable Energy Based Electricity Generation for Isolated Mini-Grids
Focal Area: Climate Change
Implementing Agency: UNEP
Executing Agency: UNIDO
National Counterparts: Department of Energy, Ministry of Energy and Water Development, Government of Zambia²
Development Bank of Zambia³
Total Project Cost: US \$ 7.831 million
(GEF grant US \$ 2.950 million, PDF B Grant US \$ 0.325 million, and US \$ 4.556 million co-financing)

Brief Description:

A number of barriers including financial, institutional, technical, information and human resource constrain the increased use of renewable energy sources in the rural areas of Zambia. Although Zambia has huge hydro potential and exports electricity to the region, only 2% of the rural population has access to grid. The country has ambitious plans for rural electrification, and since electricity is seen as necessary to support economic growth in the rural areas, electrification based on diesel and fossil fuels is widely used. The main objective of the project is to demonstrate, through the pilot mini-grids, the technical and financial viability of using renewable energy resources for rural electrification to potential investors, financing institutions, the utility, equipment suppliers, energy service providers, and government planning and regulatory officers. The demonstrations will achieve acceptance by these stakeholders that renewable energy alternatives are viable and appropriate for rural electrification in Zambia.

The PDF-B phase identified, evaluated and designed activities to reduce/remove barriers and demonstrate business models encouraging investment and incentive based management within the local institutions and physical conditions in Zambia. The project therefore would promote lower life cycle cost renewable energy solutions and promotes private sector engagement through IPP or Build Operate Transfer. Greenhouse gas emissions will be reduced through mini-hydro, PV and biomass gasification technologies for remote mini-grids. The replication potential of these renewable technologies in Zambia and the region is at least an order of magnitude considering the existing and potential mini-grids in Southern and Eastern African regions.

The project will implement three mini-grids based on biomass gasification, solar PV and small hydro technologies, and strive at making these pilots commercially viable and sustainable.

²Department of Energy (DOE) under the Ministry of Energy and Water Development, Government of Zambia is the national counterpart agency with overall responsibility for guiding the implementation of the project at the national level.

³Development Bank of Zambia (DBZ) is a national level financial and banking institution with mandate to fund developmental projects. DBZ has shown strong ownership to manage innovative funding mechanisms for promoting investments in renewable energy-based rural electrification in Zambia.

The biomass gasification business model will overcome perceived and real technical risks. ZESCO and the private sector were briefed on the economics and viability of an integrated approach to biomass management and the technology, and a study trip was undertaken to India to see some of these technologies working on commercial basis in the field. Until the UNIDO/GEF intervention, ZESCO was unwilling to consider biomass technology. Having visited the 1 MW system in Coimbatore India, they are now anxious to initiate the project in order to introduce the technology and replicate it in up to ten other locations served by diesel based electricity generation. Based on discussions with ZESCO and private investors, a Build Operate Transfer model has been recommended to introduce this new technology. The biomass supply business model will be supervised jointly by the Department of Energy, Ministry of Forests and UNIDO. Since the biomass gasification process produces activated carbon or charcoal as a by-product, the local charcoal industry as well as the associated communities would be benefited by actively involving them in the project as biomass gatherers and charcoal re-distributors. The resultant ash could also be used successfully on the acidic soils of the region to improve the crop productivity and reduce slash and burn practices.

Since local forests will provide biomass needed for the biomass mini-grid on power generation at Kaputa, to begin with, the project will introduce mandatory certification standards for sustainable forestry management at Kaputa in collaboration with the Forest Stewardship Council (FSC)⁴, and then replicate this experience in the rest of the country in a phased manner.

The PV business model will be a Renewable Energy Service Company focused on a fishing village with high willingness to pay for the services due to fishing income. The 36 kw solar PV mini-grid will demonstrate an alternate model to solar home systems. The concept of a PV mini-grid for income generation activities is new, and associates with the fishing villages as a replication market in Africa. Distribution losses are reduced due to relatively tight clustering of houses. The shared generation capacity averages the individual peak loads and allows for central backup generation reducing battery costs. A small PV lantern component will displace kerosene use on the fishing boats. Given the specific needs of local fishermen, the use of Light Emitting Diodes (LEDs) technology to reduce the implementation costs of solar mini-grid has been adopted under the project.

The mini-hydro demonstration has the least technical risk but highest likelihood of broad replication. The mini-hydro (0.5 to 1MW) is small relative to most Zambia installations to date, and is an instance where the UNIDO/GEF has catalysed a public/private partnership to electrify this remote area and displace diesel powered milling operations and generation capacity.

The three technologies present a variety of risks from the more generally accepted mini-hydro, to the economic challenge of PV, to the technical risk of biomass gasification⁵. Similarly the pilot mini-grid business models will demonstrate the IPP and BOT business models for utilizing each of the three renewable energy sources in rural electrification so that efficiencies in deployment and financing can be achieved. Further replication will be supported through a public/private⁶ project financing mechanism. A revolving fund is proposed to share early risks for future renewable energy projects sustained within the national development bank. Further finance would be leveraged through this effort and subject to losses and additional contributions could become a long-term program at DBZ.

⁴ Forestry Stewardship Council (FSC) was founded in Bonn in 1993 to promote environmentally appropriate, socially beneficial and economically viable management of forests world over.

⁵ Experience gained and lessons learned in various parts of the world on commercial adoption of biomass gasification technologies to local conditions will be very useful for the successful implementation of pilot biomass gasification plant at Kaputa and subsequent larger investments in Zambia as well as in the region.

⁶ Consultations held with key stakeholders and investors revealed their willingness to invest in renewable energy technologies based mini-grids in Zambia provided they get the Power Purchase Agreements finalized with ZESCO on agreed terms.

The project will contribute to a legal, institutional, and policy framework that provides a favorable environment for commercial deployment of renewable energy based mini-grids in rural areas of Zambia. National and local capacity for commercial deployment of renewable energy based mini-grids in rural areas of Zambia is expected to sustain further expansion of the market for these technologies. The project will coordinate closely with other ongoing rural electrification programmes and projects for ensuring synergies and avoiding duplication. While this project focuses on the specific issues mentioned above, more general activities will be supported under the World Bank rural electrification programme and bilateral aided renewable energy projects.

For the GEF, UNEP is the Implementing Agency, which will oversee the successful achievement of the project objectives, while UNIDO will execute the project activities. Department of Energy (DOE) under the Ministry of Energy and Water Development, Government of Zambia is the national counterpart agency with overall responsibility for guiding the implementation of the project at the national level. It will closely coordinate with UNEP and UNIDO for the timely execution of the project activities. Initial discussions with multi/bilateral partners indicated that the funding as well as technical support from them is likely come into play as well. Ongoing consultations with private agencies to join hands in the implementation of the project have started yielding results as a number of companies have shown a keen interest to invest and collaborate on setting up of renewable energy technologies based mini-grids in Zambia.

LIST OF ACRONYMS/ABBREVIATIONS

AEG	Advisory Expert Group
BOO	Build-Own-Operate
BOT	Build-Operate-Transfer
CD	Certified Deposit
CEC	Copperbelt Energy Corporation
CEEEZ	Centre for Energy, Environment and Engineering of Zambia
COMESA	Common Market for Eastern and Southern Africa
DBZ	Development Bank of Zambia
DOE	Department of Energy
EIA	Environmental Impact Assessment
ERB	Energy Regulation Board
ESCO	Energy Services Company
FSC	Forestry Stewardship Council
GEF	Global Environmental Facility
GHGs	Green House Gases
ICT	Information and Communication Technology
ICTP	Industrial, Commercial, and Trade Policy
IPP	Independent Power Producer
ISO	Independent System Operator
JICA	Japanese International Co-operation Agency
KGRTC	Kafue Gorge Regional Training Center
KNBC	Kariba North Bank Company
kWh	Kilo-Watt hour
LEDs	Light Emitting Diodes
LHPC	Lunsemfwa Hydro Power Company
LRMC	Long Run Marginal Cost
MCTI	Ministry of Commerce, Trade and Industry
MEWD	Ministry of Energy and Water Development
MFNP	Ministry of Finance and National Planning
MOE	Ministry of Education
MOH	Ministry of Health
MTENR	Ministry of Tourism, Environment and Natural Resources
NEP	National Energy Policy
NEPAD	New Partnership for African Development
NGO	Non-Governmental Organization
NISRI	National Institute for Science and Industrial Research
NRSE	New and Renewable Sources of Energy
PDF	Project Preparation and Development Facility
OPPI	Office for Promoting Private Power Investment (used on Page
PPA	Power Purchase Agreement
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic
RE	Renewable Energy
REA	Rural Electrification Authority
REF	Rural Electrification Fund
RET	Renewable Energy Technology
REMP	Rural Electrification Master Plan
RRMF	Risk and Replication Management Fund
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SHEMP	Smallholder Enterprise and Marketing Program
SHS	Solar Home Systems
SIDA	Swedish International Development Agency

SSI	Small Scale Industry
TDAU	Technology Development and Advisory Unit
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
TNDP	Transitional National Development Plan
USAID	United States Agency for International Development
UNEP	United Nations Environmental Program
UNICEF	United Nations Children’s Fund
UNIDO	United Nations Industrial Development Organization
UNZA	University of Zambia
UNF	United Nations Foundation
VAT	Value Added Tax
WB	The World Bank
ZABS	Zambia Bureau of Standards
ZACCI	Zambia Chamber of Commerce and Industry
ZAM	Zambia Manufacturing Association
ZAMSIF	Zambia Social Investment Fund
ZCCM	Zambia Consolidated Copper Mines
ZESCO	National Utility Company, previous called Zambia Electricity Supply
Company	
ZNFU	Zambia National Farmers Union
ZPA	Zambia Privatization Agency

Currency conversion used: **1 USD = 4,800 Kwacha**

TABLE OF CONTENTS

	Page No.
1. BACKGROUND AND CONTEXT	11
1.1 Country Context	11
1.2 Energy Scenario in Zambia	17
2. BARRIERS TO RENEWABLE ENERGY DEPLOYMENT IN ZAMBIA	21
2.1 Policy and Institutional Barriers	21
2.2 Financial Barriers	22
2.3 Technical Barriers	23
2.4 Information Barriers	23
2.5 Human Resource Barriers	23
3. PROJECT RATIONALE AND OBJECTIVES	24
3.1 Rationale for Promoting Renewable Energy Based Mini-Grids in Zambia	24
3.2 Project Objectives	25
3.3 Baseline	26
3.4 Alternative Project	26
3.5 Replication Strategies and Relevance to GEF's Operational Program	28
3.6 Global Activities	30
3.7 Project Design	31
4. PROJECT ACTIVITIES AND EXPECTED RESULTS	37
4.1 Activity 1: Designing and Establishing Legal, Institutional, and Policy Framework	38
4.2 Activity 2: Building National and Local Capacity	39
4.3 Activity 3: Setting up Innovative Project Financing	41
4.4 Activity 4: Implementing Pilot Mini-Grids	42
4.5 Activity 5: Project Management, Coordination and Monitoring	43
5. RISKS AND SUSTAINABILITY	45
5.1 Sustainability	45
5.2 Replicability	46
5.3 Risk Assessment	47
6. STAKEHOLDER PARTICIPATION	50
6.1 Key Stakeholders	50
6.2 Public Involvement	51
7. IMPLEMENTATION PLAN	51
7.1 Project Implementation Arrangement	51
7.2 Project Schedule	52
8. INCREMENTAL COSTS AND PROJECT FINANCING	52
8.1 Incremental Costs	52
8.2 Global and Local Environmental Benefits	53
8.3 Project Financing	54
9. MONITORING, EVALUATION & DISSEMINATION	56

FIGURES :

Figure 1: Primary Energy Consumption in Zambia	18
Figure 2: Power Generation and Transmission in Zambia	18
Figure 3: Business Models – Pilot Mini-Grid Sites in Zambia	27

TABLES:

Table 1: Isolated Diesel-Based Electricity Generation Sites in Zambia	19
Table 2: Estimated Growing Stock and Annual Growing Rate by Forest	20
Table 3: Potential Risks and Mitigation Type Measures	49

LIST OF ANNEXES

ANNEX 1:	A: Budget in UNEP Format
	B: Budget by Project Component Activity
	C: UNEP/GEF REPORT ON PLANNED PROJECT CO-FINANCE AND ACTUAL CO-FINANCE RECEIVED
ANNEX 2:	Timetable and Work plan
ANNEX 3:	Format for Cash Advance Statement
ANNEX 4:	A: Format for Quarterly Project Expenditure
	B: Format of Quarterly Reporting on Unliquidated Obligations
ANNEX 5:	A: Format for Half-yearly Progress Report to UNEP
	B: Format for Inventory of Outputs/Services
	C: Format for Inventory of Non-Expendable Equipment
ANNEX 6:	Format for Terminal Report
ANNEX 7:	Format for Self-evaluation Fact Sheet
ANNEX 8:	A: Incremental Cost Matrix
	B: Logical Framework Planning Matrix
	C1: STAP Roster Review
	C2: Response to STAP Roster Review
	C3: Response to GEF Sec Review for CEO endorsement and Work Program and GEF Council Comments
	D: GEF Operational Focal Point Endorsement
	D1: DOE, DBZ and ZESCO Letters
ANNEX 9:	Other Supporting Documents
	E: Technical Details on Biomass Mini-grid
	F: Technical Details on Mini-Hydro Mini-grid
	G: Technical Details on Solar Mini-grid
	H: Organizational Chart
	I: M & E Plan

	J:	UNIDO – World Bank Road Map
	K:	Financial and Technical Details
ANNEX 10	L:	Terms of Reference Project Coordinator and Technical Expert
	M:	Terms of Reference for the Project Steering Committee
ANNEX 11		Operational Guidelines for the Risk and Replication Fund

1. BACKGROUNDS AND CONTEXT

1.1 Country Context

1. Zambia is a land locked country, bordering with Democratic Republic of Congo and Tanzania in the north, Malawi and Mozambique in the east, Zimbabwe, Botswana, and Namibia in the south, and Angola in the west. It has a land size 40% larger than France, but with only 10 million people. About 64% of the population resides in the rural areas while the remaining 36% reside in urban areas. The country is generally flat with tropical lowland in the north, cooler high plateau in the south, and arid grassland in the west.

2. Due to the large number of rivers and streams in the country, as exemplified by the Victoria Fall at the border with Zimbabwe, Zambia has abundant supply of hydropower. Zambia's hydropower potential is estimated to be 6,000 MW, excluding the mini-hydropower. Currently, hydropower provides more than 94% of the 1,170 MW total power consumption in Zambia (1,600-1,700 MW installed capacity). In fact, Zambia has excess hydropower (about 20% of the total power produced), which is exported to neighboring countries. Location wise, Zambia is strategically positioned in linking the Southern Africa Power Pool (SAPP) with East Africa. Existing power export is made through interconnections with Zimbabwe (on to South Africa) and Democratic Republic of Congo. The contemplated Zambia-Tanzania -Kenya interconnection will link SAPP with East Africa and beyond and thus open a new market for power export.

3. Despite the abundant hydropower resources, only 44% of the urban population has access to electricity. ZESCO's coverage in rural areas is even less. Currently, only 2% of the rural dwellers have electricity supply, mainly because the extension of power grid to many widespread rural areas is very expensive and is cross-subsidized by a uniform electricity tariff. Low capital cost diesel generation is often used but due to the high cost of importing and transporting diesel,⁷ the generators run for short periods, and electrification is not reaching people quickly. Overall, only 17% of the country's population has access to electricity, which is seen as an impediment to economic development

4. The production and export of copper used to be the main economic base for Zambia. Since the collapse of world's copper market due to the use of optic fibers for telecommunication, Zambian economy has shown a downward trend. As electricity supply is critical to the economic development and majority of country's population (about 64%) live in the rural areas, rural electrification has been accorded high priority by the Zambian Government.

5. Zambia has abundant renewable resources in the rural areas, which can be harnessed on a sustainable basis. The utilization of these indigenous renewable energy resources (i.e. mini-hydro, solar, and biomass resources) would be a very effective and sustainable alternative for the rural electrification on a decentralized basis. If ZESCO levels the playing field for renewable energy technologies (RETs), they would save dramatically on diesel costs and could more easily meet the growing energy needs in the rural areas and also reduce GHG emissions. In an IPP market, the lower cost of RETs would make them a preferred choice; where local industries are active, productive uses will result in a willingness to pay the cost of energy production as a niche commercial market.

6. Zambia has already restructured its energy sector and privatization is being pursued in phases. The modern concepts such as Independent Power Producers (IPPs) and Energy Service Companies (ESCOs) are already being implemented. The large hydropower sector has been opened to private investment and several projects are under negotiation. Given the low power grid access and the abundant availability of renewable energy resources in the rural areas, the options to enhance national energy security in Zambia would invariably include integrated energy policy planning, strengthening

⁷ Diesel cost varies between 3000-4800 Kwacha per liter (Zambian national currency). Currently exchange rate is about 4800 Kwacha: 1 US \$.

of key institutions, diversifying the energy supply by including locally-available renewable resources, and actively involving local communities and private sector focusing mainly on the income generation activities.

1.1.1 National Energy Policies and Institutions

National Policies

7. The development of the national energy policies and strategy in Zambia includes three milestones: (a) the Government's promulgation of a National Energy Policy (1994); (b) an Energy Regulation Act (of 1995 as amended in 2003) under which the Energy Regulation Board (ERB) was established; and (c) a new Electricity Act (of 1995 as amended in 2003) which permitted private sector investment in the power sector. The National Energy Policy (NEP)- continues to be the key document to guide the energy sector development. Its major focus is to promote socio-economic development by an optimum supply and utilization of energy, especially in indigenous forms, while maintaining a safe and healthy environment. It encourages the use of renewable energy sources, and accords priority to rural electrification programme.

8. The Zambian Government created a Rural Electrification Fund in 1994 with the objective to raise funds for rural electrification. This fund was created by dedicating a percentage of the sales tax on electricity consumption, which changed to a direct 3% levy on all electricity consumption in 1995. The Zambian Government, in May 1999, came out with a "Framework and Package of Incentives for Private Sector Participation in Hydropower Generation and Transmission Development". An Office for Promoting Private Power Investment (OPPPI)⁸ has been set up under the Ministry of Energy and Water Development (MEWD) to implement the framework.

9. To tackle poverty problems in the country, the Zambian Government has developed a Poverty Reduction Strategy Paper (PRSP), which outlines national policies and developmental priorities to alleviate poverty. One of the key focus areas in the PRSP is to pursue rural electrification to uplift the living standards in rural areas. The Ministry of Commerce, Trade, and Industry has also come out with a national-level Industrial, Commercial and Trade Policy (ICTP) in 1994. The main objective of ICTP is to encourage the diffusion of industries into rural areas by giving appropriate incentives to enterprises located in such areas. Unfortunately the referred incentives are not elaborated beyond the general statement.

10. Driven by the NEP, PRSP, and ICTP, the Government has developed a draft National Rural Electrification Master Plan (NREMP) that would focus on identifying various options for rural electrification for implementation by the Rural Electrification Authority (REA)⁹ that has been set up in 2003 to facilitate the enhanced rural access to electricity. REA is committed to be proactive by formulating viable and competitive project proposals, and to attain sustainable socio-economic benefit of reliable energy services in the rural areas. One of the elements of NREMP is to integrate new and renewable sources of energy to provide reliable electricity services to the rural communities in far-flung areas. The goal is to increase the rural electricity access from the current 2% rural population to

⁸ According to OPPPI and World Bank reports, a study has recently been completed on the solicitation strategy and documents for a number of projects which are envisaged to be developed by the private sector on a BOO (Build-Own-Operate) basis.

⁹ In November 2002, the Government recognized the limitations of current institutional organization and financing mechanism, were acting as key barriers to increased access to electricity in the rural areas. A roadmap and timeframe was drawn for the passage of Rural Electrification Bill aiming at direct channeling of the Rural Electrification Levy into the Rural Electrification Fund Account and establishment of an autonomous Rural Electrification Agency. A Bill to set up the Rural Electrification Authority (REA) was passed in the Parliament in November 2003 [to facilitate the access of rural communities to electricity and reliable energy services.](#)

15% by 2010.

11. The Ministry of Energy and Water Development (MEWD) has been administering the Rural Electrification Fund since 1995. Due to other more pressing financial needs in the country, the Ministry of Finance and National Planning (MFNP) has not been releasing the funds consistently for the original purpose. One of the key reasons for setting up REA is to prevent this fund diversion and attracting additional financing from external sources, particularly from multi/bilateral cooperating partners for rural electrification.

12. The proposed full project is in line with the national policies and priorities, and will contribute to the extensive use of renewable energy technologies to continue as a key element in Zambian Government's rural electrification programme beyond the GEF's intervention.

National Institutions

13. In Zambia, the Ministry of Energy and Water Development (MEWD) is responsible for the overall energy supply and utilization in the country. Under MEWD, the Department of Energy conducts the energy planning and formulates the national energy policies, including development and dissemination of new and renewable energy technologies. MEWD is the national counterpart department to coordinate with UNEP and UNIDO for the execution of the proposed full project.

14. ZESCO, the national electricity utility company, generates and distributes more than 90% of the electricity in the country and is currently the implementation agency for the national rural electrification programme. Kariba North Bank Company (KNBC) has been reintegrated with ZESCO. Copperbelt Energy Corporation (CEC), and Lunsemfwa Hydro Power Company (LHPC) produce and distribute the balance. In 2001, the Government outlined steps for the divestiture of Government's interest in ZESCO. The steps included: (i) Zambia Privatization Agency (ZPA) undertaking the necessary studies to enable the operations and management of ZESCO to be carried out by a private sector operator, (ii) identification and establishment of suitable modalities for peri-urban and rural electrification, and (iii) regulatory capacity building. However, given its past experience in dealing with privatization¹⁰ of other enterprises, the Government is now focusing¹¹ on the commercialization of ZESCO's operations instead of privatization.

15. The Energy Regulation Board (ERB), which was set up in 1997 to oversee the regulatory functions for the energy sector, has also made several recommendations to restructure the power sector. Some of the ERB's key recommendations include establishment of new power generation companies, separation of ZESCO's generation assets and investments by the existing transmission companies, such as CEC, and the new transmission companies in building transmission lines and networks to augment ZESCO's transmission assets. ZESCO's National Control Center and regional control centers would be taken to form an Independent System Operator (ISO) to manage the entire interconnected network. ZESCO's power distribution/supply system would also be separated into several regional companies, each covering a specified geographical area. These distribution companies will have concessions for their respective areas. Developers may build distribution lines and networks within the areas. If the power sector restructuring is approved and proceeds as planned, it will encourage the private sector investment in the power sector including renewable energy technologies. However, these recommendations will be considered later on only after the current National Energy Policy Review process is over.

¹⁰ This is mainly because of purely commercial interests conflict with national development goals. The untimely closure of these units made the government to revise its economic liberalization policies by exempting certain state owned enterprises "strategic" to national interests from the privatization process. ZESCO is one of these "strategic" state owned enterprises.

¹¹ Government of Zambia and the World Bank have jointly agreed on a roadmap for commercialization of ZESCO, which is currently under implementation.

16. ZESCO charges a uniform electricity tariff for the entire nation. As ZESCO has already recovered the capital investment in many of the large hydropower projects, the tariffs set are very low in the 1-3 ¢/kWh range. Users with very large electricity consumption usually negotiate lower rates with ZESCO, as their utilization is often high voltage power without the distribution costs. But these negotiated lower rates have to be reviewed and approved by ERB for their reasonableness. The privately owned power generation/distribution companies are not subject to uniform tariff. The ERB intervenes only if the customers of these companies submit complaints on the electricity rates charged.

17. The Rural Electrification Authority (REA), a statutory body created under an Act of the Parliament No. 20 in 2003, has been set up in order to enhance the access of rural poor to electricity and reliable energy services. REA is committed to be proactive by formulating viable and competitive project proposals, and to attain sustainable socio-economic benefit for rural communities. In seeking the best results, the REA places special emphasis on adopting multi-sectoral approaches to the implementation of rural electrification projects, particularly those serving critical sectors of economy such as Agriculture, Education, Health, Tourism, Mining and Water. This will entail an increased collaboration between the REA, the client sectors and other relevant key stakeholders. REA efforts are not only focused on accelerated economic development of the rural areas, but also aim at overall poverty reduction.

18. For the GEF activities, the Ministry of Tourism, Environment and Natural Resources (MTENR) is the national focal point, which coordinates all GEF activities with other ministries including MEWD. Under MTENR, the Department of Environment has special interest in climate change issues and promotes related clean technologies by mobilizing international bilateral and multilateral funding resources and the Department of Forestry is responsible for managing the forest resources. The inter-ministerial efforts on rural electrification are coordinated through the Rural Electrification Committee (REC). The REC comprises of MEWD, Ministry of Local Government and Housing, MFNP, ZESCO, National Energy Council, and the Engineering Institution of Zambia.

19. Even though the Zambian Government has revised its privatization policy for ZESCO, overall it encourages private investments. It has established two institutions to facilitate small private enterprises. As mentioned earlier, the first one is the Office for Promoting Private Power Investment¹² (OPPPI) under the MEWD to attract private investments in the power sector, and second one is Small Enterprises Development Board set up under the Ministry of Commerce, Trade and Industry (MOCI).

20. For building national capacity on new technologies, the Zambian Government has established the Technical Education Vocational and Entrepreneurship Training Authority (TEVETA). Also, several public research institutes, such as Technology Development and Advisory Unit (TDAU) under the University of Zambia and National Institute for Science and Industrial Research (NISIR), have been actively involved in renewable energy technology research and training. But the research and training activities are mostly related to the mini-hydro and solar PV technologies.

21. There are quite a few companies in Zambia engaged in the design, manufacturing, assembling, installing, and servicing renewable energy based power generation facilities, but they are mostly related to mini-hydro and PV. Some of the renewable energy equipment manufacturing and supply companies in Zambia are Solar World, Suntech Appropriate Technology, Electrical Maintenance Lusaka, BP Zambia, Solaris Africa, Hazida Communications, Powerlink Solar Equipment, Siemens Zambia, Assimex Agency Import, Solar City, and Sun Solar Systems and Supplies. Some of key companies for installation and maintenance of renewable energy technologies systems are Behrens, Electrical Techniques, and Hold Trade Engineering Zambia. Few operational energy service

¹² OPPPI has so far received a total of 21 inquiries from potential IPPs interested in the development of small / mini hydropower projects / schemes in the country.

companies include Nyimba Energy Service Company, Chipata Energy Service Company, and Concord Investments. Multi/bilateral agencies have supported promotion of renewable energy technologies to a great extent in the country.

1.1.2 Linkages to Other On-going Projects and Programs

22. At present, in Zambia as well as in the African region, a number of renewable energy-based projects and activities funded by GEF and other agencies are under implementation. The proposed RE Mini-grids project in Zambia has been designed to complement activities of other ongoing projects/programmes, and to build synergies with them. Lessons learned from other important climate change projects¹³ will be taken into account while implementing the project activities to avoid duplication, and establish close linkages with the ongoing initiatives to make full use of their results, complement their activities and to develop synergies to maximize the impact.

23. A brief description of the important energy projects, which are ongoing in Zambia as well as in the region, and have relevance to the proposed project, is as follows:

24. GEF has funded two PDF-B projects for UNIDO namely: (a) Renewable energy (RE) based electricity generation for isolated mini-grids; and (b) Renewable energy promotion through Information and Communication Technology (ICT) introduction in off-grid rural communities in Zambia and Malawi. While the first PDF-B project on RE mini-grids has been successfully implemented, and has resulted into the proposed project brief, the second PDF-B project which is a regional project on linking RE with ICT, has just started.

25. The proposed RE mini-grids project will incorporate results from field studies to be undertaken under the second PDF-B project, link up with social and productive activities, and would strive to achieve synergies by exchanging information on the project activities on regular basis. In both projects, UNEP is the IA for GEF funding.

26. GEF has approved a PDF-B project in Zambia for the World Bank on “Increasing Access to Electricity and ICT Services (IAES)”. The IAES project’s development objective is to facilitate a significant improvement in the quality of life of rural households as well as the incomes/jobs generated by rural enterprises by increasing the access of households, enterprises and social facilities to electricity and ICT services. It proposes about \$ 5 million of GEF co-financing for institutional solar PV systems for social services and renewable energy-based stand-alone grids.

27. The proposed RE mini-grids project will link up with World Bank PDF-B activities expected to lead to a large (about \$50+ million) project which includes (a) investments in main grid extensions, renewable energy-based mini-grids, and solar PV systems; and, (b) various technical assistance and capacity building efforts, aimed at enhancement of the legal and regulatory framework for electricity and telecoms; initial operation of rural electrification and communications institutions; an indicative national master plan for expanded electricity access; renewable energy training and capacity building; and cost-shared business development services to qualified private sector. A roadmap for ensuring close coordination between the UNEP/UNIDO and WB projects has been drawn in consultations with WB team, which is placed at Annex K. The UNIDO project size has been reduced by about 25%, and will focus on technologies that could be introduced into the World Bank programme.

28. GEF funded an UNEP implemented Enabling Activity Project - National Communications to the UNFCCC for Zambia in 1997. This project provided assistance to the Government of Zambia to comply with the provisions of the UNFCCC.

¹³ Experience gained and lessons learned from the GEF funded UNEP/UNIDO’s renewable energy project for Isla de la Juventud in Cuba will also be taken into account while implementing RETs based businessmodels in Zambia.

29. The proposed RE mini-grids project has benefited from the information already made available under the first national communication report, especially from the details given on GHGs emission sources and abatement options, and would strive to achieve synergies by exchanging information on the project activities on regular basis.

30. UNEP/UNF and E+Co are executing the African Rural Energy Enterprise Development (AREED) project in Africa. The Centre for Energy, Environment & Engineering Zambia Ltd (CEEEZ) is a non-governmental organisation collaborating with Government and various institutions, and investigates, analyzes and makes useful conclusions and policy recommendations on energy, environment and engineering concerns, and also carries out studies, research and development, consultancy and training in those areas. CEEEZ represents AREED in Zambia. GEF has approved funding for a global/ multi-country expansion PDF-B – Global Renewable Energy Enterprise Development (REED). The project provides "patient" seed capital and enterprise development/assistance services to small rural enterprises engaging in providing energy services based on renewable energy. Enterprises' services are for both household systems and productive uses (income generating activities). It removes key barriers preventing new or existing small and medium-size enterprises from expanding their services with renewable energy.

31. The proposed RE mini-grids project will incorporate results from the REED project, link up with social and productive activities through energy enterprise development, and would strive to achieve synergies by exchanging information on the project activities on regular basis. In particular, the E+Co has been asked to assist in training the DBZ and CEEEZ would provide training for small and medium enterprises (SMEs) like the fishing lanterns activity or the biomass gathering enterprises.

32. Partners for Africa is a regional networking project, which is looking at implementation of renewable energy technologies and renewable energy market opportunities in Africa.

33. The proposed RE mini-grids project will link up with regional network of institutions working on developing renewable energy markets and would strive to achieve synergies by exchanging information on the project activities on regular basis.

34. The Swedish International Development Authority (SIDA) has implemented a project called "Providing Solar Photovoltaics Electricity through Energy Service Companies (ESCO) in Rural Areas of Zambia" in 1999. The project provided upfront costs for the equipment and technical support to ESCOs for meeting the electricity needs of 400 households for lighting and radio/TV through solar PV systems in three districts (Nyimba, Chipata and Lundazi) of the Eastern Province.

35. The proposed RE mini-grids project has incorporated results from SIDA project, looked at the critical issues that need to be taken into account while planning for pilot mini-grids, and incorporated them into the project design. The project would strive to achieve synergies with SIDA initiatives by exchanging information on the project activities on regular basis.

36. UNEP is implementing a global programme — Global Network of Energy for Sustainable Development (GNESD), which aims at enhancing national capacities to develop policy and planning efforts that integrate solutions to energy, environment and development problems. Renewable energy technologies and systems are an integral part of this global network, which also covers institutions in Zambia and other countries in the region.

37. The proposed RE mini-grids project will link up with GNESD network of institutions working on developing capacities in renewable energy technologies, and would strive to achieve synergies by exchanging information on the project activities on regular basis.

1.1.3 Past Experiences of Renewable Energy Technologies in Zambia

38. Zambia already has experience in renewable energy technologies, and Ministries of Energy, Health and Education have closely been involved in the implementation of a number of renewable energy technologies based energy and social projects¹⁴ funded by various multi/bilateral agencies.

39. The major PV solar experience in Zambia was a pilot project in 1999 called “Providing Solar Photovoltaics Electricity through Energy Service Companies (ESCO) in Rural Areas of Zambia” as mentioned earlier. It provides 400 households with electricity for lighting and radio/TV in each of the three districts (Nyimba, Chipata and Lundazi). An ESCO provides the day-to-day maintenance, service, fault repair, and troubleshooting based on a monthly fee charged to each customer for the Solar Home Systems (SHS) used, which include the PV panels, power converter, and storage battery. In the past, many solar PV projects failed due to lack of technical support. In this SIDA funded project, the Energy and Environment Resource Center (EERC) of University of Zambia (UNZA) provides the technical training for the ESCOs’ operating and maintenance staff. As a result, most of the 400 SHS are still in operation. EERC itself also has a PV unit to provide electricity for its laboratory. DOE and SIDA have now an expansion plan to install 20,000 more SHS over the next ten years.

40. Other solar PV experiences in Zambia include a project undertaken by the Ministry of Health (MOH) with funding from the European Union, UNICEF and Japanese International Co-operation Agency (JICA) to provide medical refrigeration and lighting to about 200 rural health centers and a project by Ministry of Education (MOE) under the World Bank funding (through Zambia Social Investment Fund, ZAMSIF) to provide electricity for teachers’ houses in 80 schools. Overall, the number of PV units installed in Zambia has increased from 6 in 1993 to over 750 in 2001.

41. Although the Government has evaluated the development potential of small hydropower for many years, Zambia has now only six mini-hydro or micro-hydro stations with capacities ranging from 750 kW to 20 MW. ZESCO owns four of them and LHPC owns the other two. Currently, ZESCO is planning to build a 3.5 MW mini-hydro plant at Chikata in the Northwestern Province to replace an existing diesel generation station.

1.2 Energy Scenario in Zambia

1.2.1 Primary Energy Supply in Zambia

42. The primary sources of energy consumption in Zambia are hydro, coal, petroleum, and wood. The relative share of use for these primary energies is given in Figure 1¹⁵, which shows wood, (used mainly as fuel for home cooking), is the main source of energy, particularly in rural areas. Wood is used directly as fuel and also converted to charcoal, which is also extensively used in urban centers. The petroleum fuel consumed in the country is all imported. Despite the fact that Zambia has a large coal reserve exceeding 80 million tonnes, coal accounts for only 2% of the national total energy consumption, that is mostly in industry.

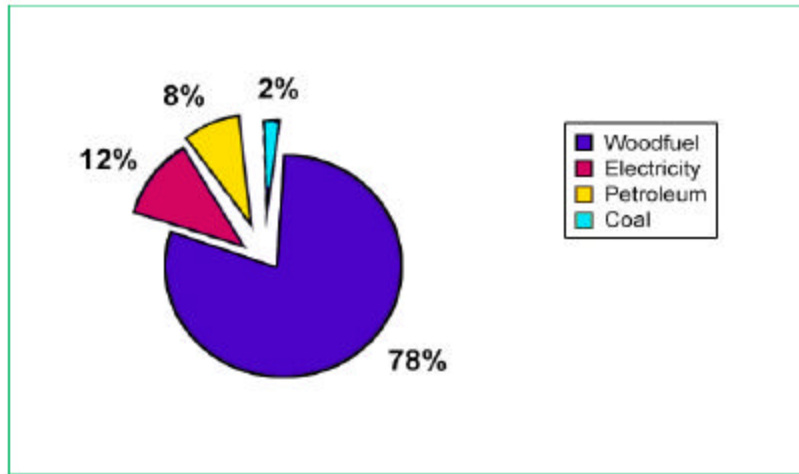
43. As mentioned earlier, Zambia is blessed with immense hydro potential, and the country power consumption about 1,170 MW is almost exclusively (>94%) supplied by hydropower. The remaining electricity supply is generated mostly by diesel engines, particularly at remote locations. The major hydropower schemes are Kafue Gorge (900 MW), Kariba North (600 MW), and Victoria Falls (108 MW). The copper mines consume about 70% of the electricity. Zambia has six hydropower stations that have over the years been classified as small. ZESCO runs four of these hydropower stations and the rest are run by ZCCM. There are 10 small hydropower stations, which total to 62 MW. About 13

¹⁴ Most of the renewable energy projects so far have focused on use of solar PV and mini hydro technologies for providing energy services or linking on education or health institutions

¹⁵ Department of Energy 2000 Energy Bulletin Statistics, Ministry of Energy and Water Development, Govt. of Zambia Printer, Lusaka, Zambia

small hydropower sites have also been identified by various studies on rivers such as Zambesi, Lunga, Kabompo, Chambeshi and Manshya with power generation potential ranging from 10 kW to 20 MW.

Figure 1
Primary Energy Consumption in Zambia

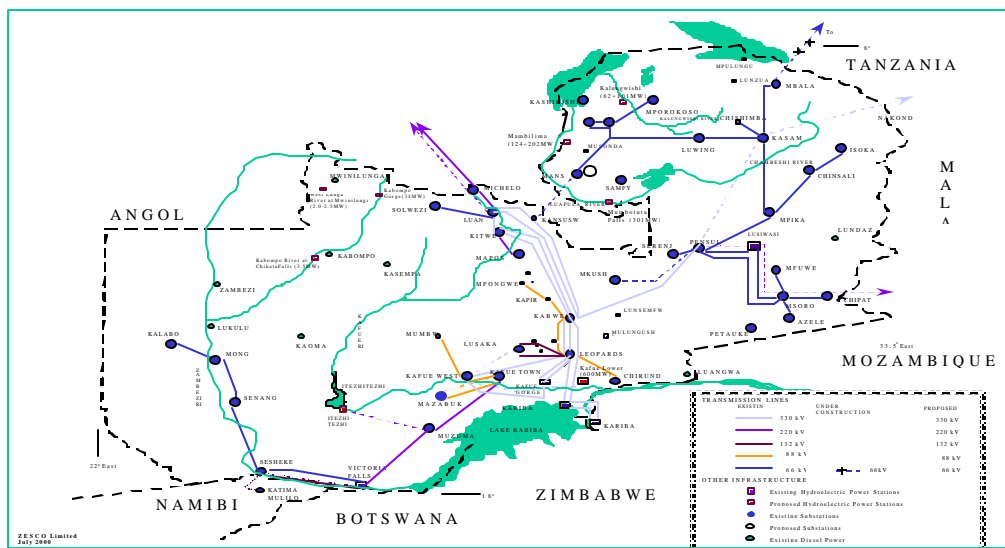


Source: Annual Report of Department of Energy, Government of Zambia 2002.

1.2.2 Power Supply and Rural Electrification in Zambia

44. Currently, ZESCO provides electricity to far-flung rural areas mainly through the use of diesel power generation stations. There are ten such stations throughout the country with a total aggregate capacity of 9 MW. In each location, the power produced from the station is distributed to the consumers through a local mini-grid. In addition, many private enterprises and communities in Zambia also have captive diesel generators to meet their own power demands. The power generation stations and transmission systems in Zambia are shown in Figure 2.

Figure 2
Power Generation and Transmission in Zambia



Source: Annual Report of ZESCO 2002.

45. Some of the key isolated diesel-based electricity generation sites in Zambia are as under:

Table 1
Isolated diesel-based electricity generation sites in Zambia

Site	Location – distance to the nearest grid line	Diesel genset capacity	Population, households
1. Mwinilunga	241 km west of Solwezi	1.16 MW	23,138
2. Kasempa	184km south of Solwezi	1.06 MW	9,140
3. Kaoma	181 km E of Mongu	2.4 MW	30,915
4. Kabompo	355 km SW of Solwezi	1.16 MW	13,654
5. Zambezi	515 km SW of Solwezi	0.795 MW	12,483
6. Kaputa	152 km NE of Chiengi	0.5 MW	9,686
7. Lukulu	370 km N of Mongu	0.577 MW	13,212
8. Mufumbwe	246 km SW of Solwezi	0.76 MW	7,563
9. Luangwa	331 km east of Lusaka	0.27 MW	3,817
10. Minga (Petauke district)	30 km west of Petauke	245 KVA	47,957
11. Mulobezi (Sesheke district)	100 km to the line 210 km from Livingstone	335 KVA	16,275
12. Kalungwishi Sugar Estates (Kasama district)	6 km east of the line 40 km north of Kasama	185 KVA	36,067

Source: Annual Reports of Department of Energy and Energy Regulation Board, 2002.

46. As a part of Government's efforts to accelerate rural electrification, a Rural Electrification Authority (REA) has been set up to enhance the access of rural poor to electricity and energy services. REA would mainly focus on the implementation of the rural electrification options outlined under the National Rural Electrification Master Plan (NREMP) that has been developed by the Department of Energy jointly with other key stakeholders and funding agencies.

1.2.3 Renewable Energy Sources in Zambia

Mini-Hydro

47. The power generation in Zambia so far focused on building large hydropower stations. Mini-hydropower from many suitable locations in Zambia is largely untapped. The mini-hydropower

potential, estimated from the heads and flows at applicable locations in various river basins is about 15-30 MW. More details on mini hydro potential – province wise are given in Annex F.

Solar

48. Zambia is located just south of the equator and has ample sunshine to produce power by the use of photovoltaic (PV). The annual solar radiation in Zambia is amongst the highest in the world. The radiation is fairly uniform across the country, varying in the range of 6,600-7,700 MJ/m² (5.27- 6.09 kWh/m²)¹⁶. More details on solar energy potential - province wise are given in Annex G.

Biomass

49. Land in Zambia is very fertile, and has large supply of biomass in terms of both agricultural wastes and forest residues. The biomass resources from agricultural residues are estimated to be 3.8 million tonnes / year based on the crop production ¹⁷. The biomass resources from wood processing wastes are estimated to be 1.2 million tonnes / year. More than 60% of the Zambia land is forest (446,000 km²), which contains 4,202 million m³ growing stocks as shown in Table 2, with an annual composite growing rate of 17.4 m³/hectare (of various forest types). There could be additional biomass resources if the forestland is properly managed for this purpose. Rural population pressures on biomass include fuel for cooking and slash and burn agriculture. Slash and burn practices have become unsustainable, and there are programmes by the International Centre for Research in Agroforestry and SIDA to introduce alternatives. Suitably managed biomass resources can be gasified to produce fuel gas, which in turn, can be fed to gas engines to produce power. Potential power generation from the total biomass available (surplus) has been estimated at 500 MW in Zambia. However, there would be a need to put in place a mandatory forest certification to ensure sustainable forestry management at Kaputa, and then gradually extend the experience to rest of the country wherever biomass will be used for power generation and allied forestry activities. More details on biomass potential - province wise are given in Annex E.

Table 2
Estimated Growing Stocks and Annual Growing Rate by Forest Types

Category	Growing Stock (10 ⁶ m ³)	Annual Growing Rate (m ³ /ha)
Forest reserves	779	12.2
Open forest areas	2,798	22.4
National Parks	544	1.6
Trees outside forest	81	3.3

Source: Annual Report of the Department of Forestry, Government of Zambia 2002.

Wind and Geothermal

50. Zambia has limited wind energy resources as it does not have any significant geographic features that accelerate wind and the country is landlocked. Mean annual wind speeds are relatively low in Zambia, and inadequate for wind electric systems (JICA reports). The meteorology department has been carrying out wind speed measurements at 34 monitoring stations. The wind speeds vary between 0.1 and 3.5 m/s with an annual average of 2.5 m/s measured at 10m from the ground level. The University of Zambia has evaluated and determined that these low wind speeds are not sufficient for

¹⁶ Jain, P.C., “Solar Radiation over Zambia”, International Center for Theoretical Physics, Report No. IC/83/213 (1983)

¹⁷ Agricultural Statistics Bulletin, 2001, Department of Planning and Cooperatives Development, Government of Zambia, Lusaka.

power generation and the wind resources are adequate only for water pumping. Due to the low wind resource, the wind energy industry has also been non-existent in Zambia.

51. Zambia has quite a few hot springs spread over the country. Most of them have low water temperatures (< 95 °C) and thus are not suitable for power generation. In late 1980s, a 200 kW geothermal power plant was built at Kapishya under a bilateral funding from Italy but this plant has never been operational due to lack of distribution infrastructure and thus was shut down. Government has handed over this project to ZESCO to revive it. Overall, the potential of geothermal resources in Zambia for power generation has not been tapped yet, and more field studies are required to estimate the potential of geothermal source of energy for Zambia.

2. BARRIERS TO RENEWABLE ENERGY DEPLOYMENT IN ZAMBIA

52. Although Zambia has some experience in the implementation of renewable energy projects funded by bilateral agencies, there are a number of generic barriers to renewable energy development and widespread adoption in the country. Extensive successful experience to deploy renewable energy technologies on commercial basis to meet rural energy needs is still missing. In general, the deployment of renewable energy systems has been slow in Zambia due to a variety of reasons, some of which act as key barriers not only for Zambia but also in the region.

53. The PDF-B phase identified a number of barriers that hinder the development of renewable energy sources for rural electrification and linked productive use activities. These barriers are inter-related and would require an inter-disciplinary and holistic approach to overcome through close and active participation of key stakeholders such as planners, experts, electric utility, investors and local communities. The proposed full project is designed to remove these barriers by technology demonstration in pilot projects, policy change, capacity building, institution changes, and information dissemination so that these technologies can be commercially viable in Zambia.

54. The barriers can be divided into policy/institutional, financial, technical, and information, and human resource areas as described individually below.

2.1 *Policy and Institutional Barriers*

55. Although the government has accorded priority to the use of renewable energy for rural electrification, there are several policy and institutional barriers that limit the spread of renewable energy technologies. In the absence of a level playing field in terms of policies and institutional mechanisms, renewable energy based mini-grids cannot compete effectively with conventional projects in the rural areas.

56. Some of the key institutional and policy barriers identified during the PDF-B phase are as follows:

- The renewable energy agenda and policies are scattered in many government ministries and agencies. Effective coordination among them is lacking, and an effective mechanism is urgently required for inter-agency coordination.
- The energy policies do not envisage specific direct incentives (such as import duty and VAT exemption, tax credit for the generation, higher power purchase price stipulated by the government, and government's low-interest loans for both the generation projects and equipment manufacturing) or indirect incentives (such as imposing carbon emission tax) to entice the required investments in renewable energy sector. In May 1999, the Department of Energy published "Framework and Package of Incentives for Private Sector Participation in Hydropower Generation and Transmission Development". But this was for large-scale private power projects only. The Government also has passed the "Investment Act" to provide tax advantages for investments in Zambia. But this is applicable to all types of investment and the

tax advantages targeted at promotion of renewable energy systems are non-existent or very limited.

- The national policies have not addressed the capacity building issues concerning renewable energy technologies in terms of components adaptation and manufacturing, undertaking necessary research and development, provision of training and dissemination of information.
- Some of the institutions or offices established to facilitate private investments or encourage small power sector enterprises, such as OPPPI and Small Enterprises Development Board mentioned earlier are under staffed, low budgeted or never formalized to take a front line role.
- There is a lack of integrated development plans at the provincial and district-level to harness the potential of renewable energy-based electricity generation to support income generation activities and consequent poverty reduction.
- Absence of any institutional experience in dealing with power purchase agreements for production, distribution and sale of electricity from renewable energy technologies limits the private sector's ability to invest in renewable energy based mini-grids; and
- Complete absence of commercial and service networks and market linkages for providing maintenance and logistic support to renewable energy technologies and systems at the national/local level act as a key barrier for wide-spread replication

2.2 Financial Barriers

57. Given the high inflation rates, declining value of national currency and overall deficit budget scenario in Zambia, financial barriers have been identified as the key obstacles to the private sector investments in renewable energy based mini-grids for rural electrification.

58. Some of the significant financial barriers identified during the PDF phase are as follows:

- Due to the huge borrowing by the government to cope with the large national budget deficit, Zambia has very high interest rate of 40-50% if the investment loans are to be paid back on local currency. For loans to be paid back on foreign currency, the interest rate is lower in the 12-13% range. These high interest rates make private investments not very attractive in the renewable energy sector.
- Zambian currency, Kwacha has devaluated rapidly in the past few years. It has finally stabilized in last 6 months. But it will take some time to overcome the lack of confidence of investors in the currency, and overall economic environment is not very conducive for attracting new investments.
- The uniform low electricity tariff has led most people in Zambia to expect low cost electricity services. This makes it difficult to recognize and accept the actual costs of generation and distribution of renewable energy based mini-grids, which tend to be higher because of the small generation capacity and upfront higher costs of the technologies.
- Some of the renewable energy technologies, such as biomass gasification and PV, are still in the earlier stage of commercialization and thus have higher capital costs. As their performance and the rate of return are not yet fully proven, particularly under the Zambian conditions, the investors shy away from investing in these technologies.
- There is no clear and dedicated financing mechanism within the national financial institutions to support renewable energy projects. There is also virtually no or very little capacity within these financial institutions to appraise new renewable energy projects for funding.
- Due to the long distance and usually bad road conditions to reach the far-flung rural areas, the installation, service and maintenance of renewable energy facilities will be more difficult and costly.
- As Zambia is a land locked country, trading and shipping goods in and out of the country are more difficult and costly.
- Due to wide spread poverty, people in the rural areas are not in a position to afford the high costs of renewable based electricity until their income levels rise, after the electricity becomes available to promote economic activities.

2.3 Technical Barriers

59. In Zambia, there are a number of technical barriers that need to be addressed on priority in order to enhance the credibility of renewable energy technologies in the local industry, and to build national capacity to manufacture, build, operate and maintain new renewable energy based mini-grids.

60. Some of the key technical barriers identified in Zambia during the PDF phase are as follows:

- Norms and standards in terms of renewable energy performance, manufacture, installation and maintenance are weak and/or non-existent.
- Local manufacturing capacity and/or assembly of renewable energy technology components are currently lacking, although the knowledge, skills and expertise to operate renewable energy systems are available in Zambia.
- There is a limited technical capacity to design, install, operate, manage and maintain renewable energy based mini-grids.

2.4 Information Barriers

61. Given the low connectivity and literacy levels, prevalent poverty and sparsely populated rural areas, information barriers have been identified as important barriers to renewable energy development in Zambia. Some of key information barriers identified during the PDF-B phase are as follows:

- There is no sufficient statistical data available on the renewable energy resources in terms of locations, sizes, and other characteristics to better define project opportunities for investors.
- A central information-clearing house on renewable technologies does not exist. Instead, the information is scattered among various institutions and ministries.
- There is lack of information on comprehensive evaluation of renewable systems already installed in the country. Many potential investors and equipment suppliers are not fully informed about the relevant government policies and programmes.
- Awareness level among public as well as decision-makers about the potential of renewable energy resources for providing electricity and energy services is low.
- The electricity supply is considered as a social welfare service in Zambia. With the low electricity tariffs charged by ZESCO as mentioned above, some people prefer to wait for the government to extend the national grid to them, rather than having a mini-grid operated by an investor, and paying the investor at the commercial electricity rate. Local consumers need to be sensitized on commercial viability of reliable energy services.

2.5 Human Resource Barriers

62. Although Zambia has skilled and trained manpower in the energy sector, a number of significant human resource barriers, which may have impact on dissemination and replication of investment projects for new renewable energy based mini-grids, were identified during the PDF-B. The barriers identified are as follows:

- The local capabilities in Zambia for the design, manufacturing, assembling, installing, and servicing renewable energy based power generation facilities are limited mostly to mini-hydro and solar PV systems.
- There are very few training facilities in Zambia in the field of renewable energy for officials, utilities, developers and service providers. Training facilities offered so far do not reflect local priorities
- The research and training for renewable energy in Zambia are limited to the mini-hydro and PV technologies. Also, the training is limited to service providers. Training facilities need to be expanded to cover new technologies such as biomass gasification technology, and the

training also needs to extend to government officials and planners, financing institutes, and utilities.

3. PROJECT RATIONALE AND OBJECTIVES

3.1 *Rationale for Promoting Renewable Energy Based Mini-Grids in Zambia*

63. The country context, the overall energy scenario, low penetration of power grid in the rural areas and present alternative to generate electricity through diesel gensets clearly present an ideal opportunity for GEF to intervene, which would use the abundant renewable energy resources available indigenously namely biomass, solar, and mini-hydro to provide a sustainable solution for the rural electrification in Zambia. The widespread use of renewable energy resulted would curtail the GHG emissions in Zambia to meet the major objective of GEF's Climate Change programme

64. Detailed feasibility and field studies carried out during the PDF-B phase identified, evaluated and designed appropriately adapted activities to reduce/remove the financial, institutional, technical, information and human resource barriers hampering the increased use of renewable energy based mini-grids, and promote investment projects in the renewable energy sector in Zambia. Although the full project activities will focus on addressing the barriers and promoting investment projects for renewable energy based mini-grids at three locations, replication activities will be designed for implementation of similar projects in the rest of the country as well as in the region. Special efforts will be made to achieve a win-win situation by supporting renewable energy technologies on commercial basis, thereby ensuring reduction in their implementation costs, enhancement in investments and improving sustainability for the renewable energy development in Zambia. At every stage of project implementation, local communities (especially women groups) will be involved closely to ensure the sustainability and local ownership of the project.

65. The project seeks to achieve a win-win situation by supporting renewable energy technologies based mini-grids on commercial basis, thereby ensuring reduction in implementation costs, enhancement in investments in rural electrification and improving enabling environment to ensure the sustainability of renewable energy technologies based rural energy projects in Zambia.

66. The Government of Zambia has ratified the UNFCCC on 28 May 1993, and actively supports renewable energy development and private investments for rural electrification in the country.

Relevant GEF Operational Programme

67. The proposed project in Zambia is consistent with the GEF Climate Change Operational Programme OP 6 "Promoting the adoption of renewable energy by removing barriers and reducing implementation costs."

68. The project constitutes a part of the Zambian Government overall plans and strategies to increase the share of renewable energies in the country's energy mix with a view to improve sustainability and energy security in the rural areas. It also supports the objective of NEPAD to provide sustainable and reliable energy services to rural communities in Zambia to enhance their quality of life. Furthermore, the project takes into account the suggested principles for GEF assistance for mini-grids.

Productive uses of renewable energy

69. Given the country context and innovative features, the project addresses many strategic priorities. However, the proposed project is more in line with CC strategic priority on productive uses of renewable energy. The project will pave the way for renewable energy linked income generation activities in Zambia. The project focuses on rural electrification for productive use activities and social benefits, with applications of renewable energy in agriculture, education, health,

telecommunications and local enterprise development (i.e. cold storage facilities for fish products). The other key priorities of the GEF Business Plan are as follows:

70. **Increased financing availability:** One of the key components of the project strategy would be to promote private sector investment in renewable energy mini-grids, enterprises and intermediaries, using leveraged private finance (with contingent loans to share early costs and risks, i.e. the “Risk and Replication Management Fund”).

71. **Power sector policy frameworks:** Once appropriate policy, institutional and legal agreements including power purchase mechanisms are in place, broader replication will be supported. The project starts from a baseline of diesel based electricity generation in remote areas, and therefore has capacity to implement the proposed project.

3.2 Project Objectives

72. The main objective of this project is to address key barriers to the deployment of renewable energy based mini-grids for rural electrification in Zambia. The RETs alternative will displace diesel generation in the baseline thus achieving GHG emission reductions, and also provide a platform for RETs to move into un-electrified rural areas.

73. In line with the national priorities, this project will help Zambia to improve its energy security, reduce environmental risks such as over-dependence on traditional fuels (i.e. wood and charcoal), and use a more sustainable approach to meet local electricity needs. The project, which primarily aims at removing the key barriers and reducing implementation costs of renewable energy to accomplish this goal, would adopt a holistic approach by including two main components – technical assistance and business models. The technical assistance component would engage activities for barrier removal including strengthening of the enabling environment in terms of policy instruments, capacity building, institutional strengthening and information dissemination to support the wide spread replication and sustainability after the GEF intervention. The increased power supply and reliable energy services in the rural areas will promote income generation activities, which is a key element in Zambian Government’s efforts to eliminate/reduce poverty in the rural areas. The project would aim at setting up of three pilot mini-grids to commercially demonstrate the technical and financial viabilities of using renewable energy technologies for electricity generation as well as for providing reliable energy services under the respective applicable business models.

74. The project has the following immediate objectives:

- To demonstrate, through the pilot mini-grids, the technical and financial viability of using renewable energy resources for rural electrification to potential investors, financing institutions, the utility, equipment suppliers, energy service providers, and government planning and regulatory officers:
 - Biomass gasification technology demonstration will overcome perceived and real technical risks;
 - Solar PV mini-grid will demonstrate an alternate model to solar home systems; and
 - Mini-hydro demonstration has the least technical risk but highest likelihood of broad replication especially considering the follow-on WB project.
- To demonstrate, through the pilot mini-grids, the IPP and BOT business models for utilizing each of the three renewable energy sources in rural electrification;
- To set up a public/private project financing mechanism to entice investors. A revolving fund is proposed to share upfront risks for future renewable energy projects;
- To establish a legal, institutional, and policy framework to provide favorable environment for commercial deployment of renewable energy based mini-grids in rural areas of Zambia; and
- To build national and local capacity for commercial deployment of renewable energy based mini-grids in rural areas of Zambia.

3.3 Baseline

75. As many rural areas in Zambia have difficulty to access grid power, the lowest capital cost solution currently available for the electricity supply to promote their economic development and meeting the social objective is to use the conventional diesel generators. Under this baseline condition, these rural communities would continue to use of diesel generators despite the associated high generation cost (due to the high imported diesel fuel cost) and emissions of harmful pollutants. For ZESCO serviced areas, there is cross subsidization since the residents are currently too poor to afford the extremely high cost of generation from the diesel generators. Although the national electric utility has plans to feed isolated rural areas through fossil fuel based electricity generation, it has also started exploring¹⁸ the potential and opportunities being offered by renewable energy technologies to meet the growing rural needs for electricity and energy services.

76. Use of renewable energy technologies for industrial applications including process heat is also a key issue in Zambia. Several industrial activities like fishing and agro-based production in the rural areas have been adversely affected because the lack of reliable electricity supply or high fuel cost has made the storage, production and transport of their merchandises very expensive to reach the market. Without any external assistance, baseline energy scenario in the rural areas of Zambia would continue to be characterized by over-dependence on traditional fuel for cooking and mini-grids based on fossil fuels, under-utilization of industrial capacity, low employment opportunities and higher emissions of greenhouse gases.

3.4 Alternative Project

77. The alternative solution, as proposed in this full project, is to use and harness vast potential offered by abundant renewable energy resources available locally - mini-hydro, biomass, and solar energy to generate and supply the electricity required for the rural communities on a decentralized basis. The renewable energy based mini-grids presently constitute the most promising option to provide electricity to isolated rural locations not connected to the Zambia nation grid.

78. The three pilot mini-grids identified during the PDF-B phase activities and recommended for the proposed full project are designed to demonstrate the applicable business models for using the three types of renewable energy resources (mini-hydro, biomass, and solar energy) with proven potential for rural areas for future commercial deployment¹⁹.

79. The proposed project in Zambia will have two main components: a) Technical Assistance (TA) and b) Business Models (BM).

80. Some of the key barriers identified during the PDF-B phase activities will be adequately addressed through TA targeted at the specific problems and issues facing the renewable energy sector in Zambia.

81. TA will include, among others, activities to address barriers – institutional, technical and financial, developing standardized project development agreements, power purchase agreements, support to investment projects, and the identification of selection criteria for replication projects; developing project appraisal guidelines with particular emphasis on the business models, Government

¹⁸ ZESCO, the national electricity utility joined with UNIDO during the PDF phase to carry out field studies to select the potential sites for setting up of renewable energy based mini-grids in the country.

¹⁹ As regards the three business models (demonstration projects), the financial analysis revealed that when compared with base line diesel based electricity cost of production which comes to 25-30 cents / kWh, the mini-hydro project will produce electricity at 3-5.2 cents / kWh, the biomass gasifier system at 19 -20 cents / kWh, and the solar photovoltaic (PV) at \$1.04 per kWh. The price of diesel as delivered to Kaputa and regulated by the government, is used for the baseline estimate although for smaller more remote installations like where the PV mini-grid is proposed, the true cost could be higher

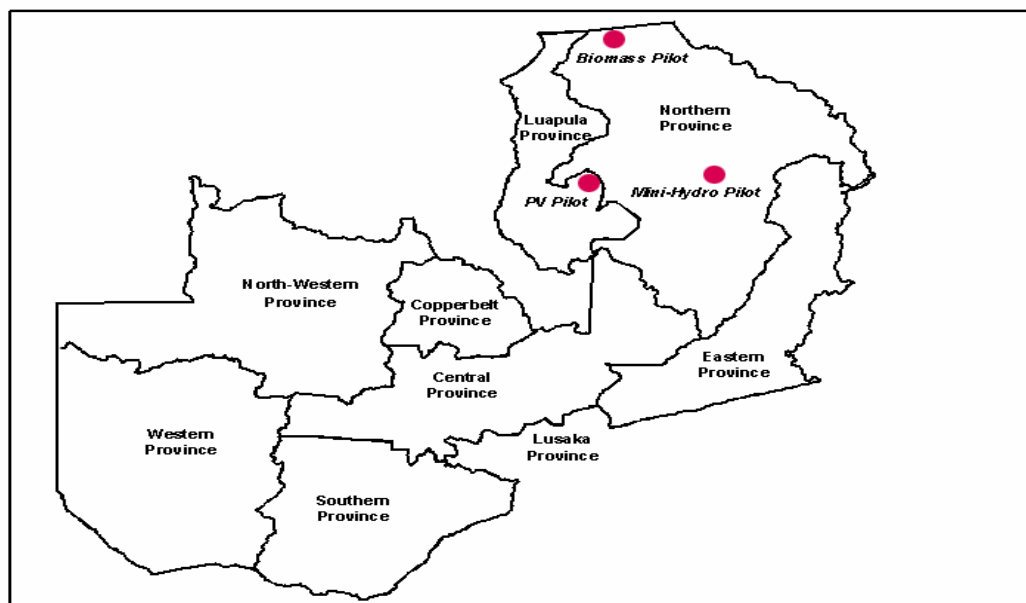
support agreements, policy dialogue with the Government (Ministry for Energy and Water Development, Ministry of Finance and National Planning, Ministry of Tourism, Environment and Natural Resources, in close co-operation with the Ministries for Industry, Agriculture and Health), and other national actors (Energy Regulation Board, ZESCO), capacity building, training and information dissemination initiatives, for addressing generic barriers related to wide-spread adoption of the proposed business models. Gender issues will be mainstreamed into the various project activities to ensure active involvement of women during the implementation phase.

82. Based on the details available from the field visits, the overall benefits and the national priority, the following sites were selected for setting-up of business cum investment models in Zambia under the proposed project:

- A 1,000 kW mini-hydro business model at Shiwang’andu in Chinsali District;
- A 1,000 kW biomass gasification business model in Kaputa District; and
- A 36 kW PV business model at Chinsanka in Samfya District (also included in this model is the demonstrated use of solar lanterns in luring fish during the night fishing)

83. Active participation of the private sector along with the national electricity utility will be a pre-requisite for the successful implementation of the proposed business models. Figure 3 shows the locations of the proposed pilot mini-grid projects.

Figure 3
BUSINESS MODELS - PILOT MINI-GRID SITES IN ZAMBIA



84. To implement the biomass energy based mini-grid at Kaputa in a sustainable manner, it will be necessary to support and develop sustainable forestry activities in and around Kaputa. Thus the forestry management will form an integral part of the biomass energy based mini-grid. In collaboration with the Forest Stewardship Council (FSC)²⁰, the project will provide the basis for evolving mandatory forest certification to ensure sustainable forestry management at Kaputa.

²⁰ Forestry Stewardship Council (FSC) was founded in 1993 to promote environmentally appropriate, socially beneficial and economically viable management of forests. FSC operates through a network of regional offices and national initiatives, coordinated by an international centre based in Bonn, Germany. FSC develops international, national and local forest certification standards based on recognised principles and criteria of forest stewardship.

3.5 *Replication Strategies and Relevance to GEF's Operational Programme*

85. Successful implementation of replication strategies will be the key to wide spread dissemination of renewable energy technologies in Zambia. The ultimate success of this project will mainly depend on the demonstration of the technical and commercial viability of renewable energy based rural electrification (business models based on biomass gasifier, solar PV and mini hydro technologies) to meet the electricity and energy needs of the rural areas, and their wide-spread replication in the region. The project would specifically aim at setting up a sustainable financial mechanism for attracting private investments to business models, supporting feasibility studies for prospective investments, and would facilitate technological transfer to establish commercial renewable energy technologies based business models for electricity generation in Zambia. The project is expected to have a wide replication potential for renewable energy systems throughout the Africa region. Diesel mini-grids are a common feature in many African countries. The potential for managed biomass harvesting is also quite common. Remote fishing villages are seen on Lake Victoria, and many other areas with commonality of clustered dwellings as a source of cash income. Abundant hydro resources are also found in the region.

86. Since the PV mini-grid is a new model, information on the capital cost savings and performance will be documented for dissemination to others. The biomass gasification technology is very new to Africa and the monitoring of performance, costs and environmental impact will be necessary to manage operations. The biomass management system and advantages to the local population will be key features for dissemination. UNIDO organized a Round Table Meeting on Biomass Gasification Technology in conjunction with the Indian Institute of Sciences at Bangalore (India) in December 2003, which was attended by experts from 14 countries including Zambia. A similar regional meeting²¹ would be held in the region in December 2005 to disseminate information on biomass gasification technologies to key stakeholders. A small working model will be used for touring technology transfer purposes. The mini-hydro demonstration will be documented and disseminated in the region.

87. To sustain and replicate renewable energy based mini-grids for rural electrification in Zambia, the project will address issues such as policy change, capacity building of institutions, networking, and information dissemination as mentioned earlier. All the business models for the three pilot projects will include investments from private sector. This is designed to facilitate the future commercial deployment of renewable energy based technologies.

88. As 64% of the Zambian population is in the rural areas, the potential replication of the pilot mini-grids and their benefits in rural areas of Zambia are very high. With the replication, the volume demand for these generation facilities will increase to enable a reduction of the implementation costs²². This will fulfill the main objective of GEF Operational Program No. 6: promoting the adoption of renewable energy by removing barriers and reducing implementation costs.

89. Introduction of new renewable energy technologies on a commercial basis to the rural areas in Zambia will be an important first step towards the country and region-wide replication. This project would enhance the credibility of biomass gasifiers, solar PV and mini hydro based mini-grids, and the key role these technologies can play in facilitating rural electrification.

²¹ UNEP and UNIDO would jointly organize a Round Table Meeting on Biomass Gasification Technology in the region in conjunction with the Indian Institute of Sciences at Bangalore (India) in December 2005. The proposed round table would aim at bringing experts, planners and institutions from various African countries including Zambia to discuss the key issues involving wide spread use of renewable energy technologies for promoting rural electrification in the rural areas of Africa. The opportunity will be also used to showcase a biomass gasifier functional model (1kW), and to bring private investors on board who have shown interest in committing investments for three business models in Zambia.

²² It is expected that successful implementation of demonstration mini-grid projects would lead to substantive reduction (savings could be in the range of 30 to 40%) in the implementations costs of subsequent business models on account of experience gained, enhanced local manufacturing capacity, availability of trained personnel and better financial management.

90. The experience with power production from the forestry biomass using gasifier technology at Kaputa will be replicated else where in the country where agro residues are available on a sustainable basis or small forestry plantations can be raised and managed for power generation. The gasifier technology for generation of electricity from forestry biomass or agricultural residues could also be adopted in the sugar industry, where surplus bagasse may be available for additional captive power generation or for supplying to the grid. There are a number of industries (using boilers) that need process heat with capacities up to 20 tonnes of steam. Some of them are located in northern and central provinces where biomass is an abundant resource, and hence replication of gasifier systems can easily facilitate the supply of process heat.

91. It is realistic to envision vast replication potential of this project to other African countries as they have many similarities with the Zambian situation in the rural areas. National markets are small, technology and equipments are inefficient, and there is over dependence on imported fuel. Hence, local mini-grid power systems based on renewable energy technologies could easily be replicated in these countries. Zambia is fully integrated into SADC, COMESA and NEPAD under the African Union - regional organizations that would facilitate technology transfer and information sharing in the region.

92. At the policy level, it is expected that this project will help in creating a supportive and enabling environment for the entrepreneurial sector, especially for small businesses in order to fulfill the replication potential described above. Elements of such support may include developing business models for power generation through mini-grids based on renewable energy technologies for Zambia and other countries in the region, reduction in costs of renewable energy mini-grid projects by technology transfer and augmenting local manufacturing capacities, and helping to build the demand and capacity for the servicing and maintenance of renewable energy technologies.

93. The strategy that will be implemented to ensure replicability would comprise of an advisory expert group within the project management structure of the project, with the following specific responsibilities:

- Working closely with the national departments and agencies such as REA, ZESCO and DOE, provide single window technical advisory services, including technical feasibility study, fuel supply availability, and technical trouble shooting service, to potential developers.
- Promote renewable energy based mini-grids and associated development under each business model in Zambia and the region, at every stage of the implementation process.
- Develop mechanisms for effective country experience in biomass, solar and mini hydro technologies based mini-grids and ensure successful dissemination across the region.
- Plan capacity building activities for the potential investors, financiers, government officials, and general public to have an increased awareness and confidence level in new renewable technologies.
- Involve local communities and women groups closely during the implementation phase to ensure the sustainability and local ownership of the project.
- Implement workshops, seminars, and study tours to the successful demonstration projects for the key officials and stakeholders of other African countries, as well as project developers and potential investors.
- Provide information on financing sources and potential renewable energy mini-grid projects to potential investors within and outside Zambia.
- Provide competent advisory services to conduct financial feasibility studies, prepare agreements and contracts, and arrange project-financing package to potential investors.
- Provide the basis for mandatory forest certification to ensure sustainable forestry management at Kaputa, and gradually extend it to rest of the country wherever biomass from forests will be used for power generation.

- Seek bilateral and multilateral financing and international IPP investment for local biomass power and facilitate a strong relationship between the financial sector and the project development sector, and
- Facilitate enactment of policies, rules and procedures that would help in attracting investments on renewable energy technologies for power generation, and ensure their commercial viability through PPAs and ESCOs.

94. A Risk and Replication Management Fund (RRMF) being proposed under the project would present interest free loans to promote private investments in business models and be managed by the Development Bank of Zambia (DBZ). Detailed discussions held with the senior officials of the DBZ brought out need to frame procedures and rules for the management of RRM Funds, disbursement of interest free loans, repayment of the loans after a grace period by the investors and penal clauses for charging interest if loans are not returned on time as agreed with the investors. The DBZ will manage the funds on the same general terms as industry standards elsewhere with typical management fees subject to transaction costs. A steering committee will be set up to oversee the functioning of RRMF. The steering committee, which will have members drawn from DOE, ERB and UNIDO, would lay down the rules and procedures for administering the RRMF by DBZ. While UNIDO and UNEP will facilitate administration of the fund during the project, capacity will be built such that the steering committee would be able to select new beneficiaries and direct the ongoing fund management. While DBZ carries this function for Zambia generally, specific guidelines would be produced for renewable energy activities. Given the strong ownership and interest shown by GOZ and DBZ in setting up of RRMF, risk of not finding consensual design for the fund is almost negligible. However, any savings or un-utilised funds will be returned to GEF.

95. UNEP will facilitate networking of the proposed project with similar projects/initiatives being implemented in the region, and will create the necessary synergy among them. The project will use these projects as a channel to communicate and co-ordinate with other countries in the region into the replication process. By interacting with the above mentioned and future projects, the replication potential would increase enormously, and consequently, overlap and duplication of efforts will be avoided. Specific agreement will be reached with each of the ongoing projects to create appropriate channels of exchanging information and results.

96. The proposed RE mini-grids project for Zambia presents a unique opportunity to build a strong network and partnership among the government authorities, the private sector, the agricultural sector, local communities, entrepreneurs, equipment manufacturers and technology/service providers in Zambia. The project components have been designed to ensure that the necessary and sufficient conditions exist to make the replication projects successful. Project activities are mainly designed to put in place institutional mechanisms for long-term sustainability of business models by addressing key barriers. It is expected that this project will lead to reduction in transaction costs and dissemination of information to different categories of potential renewable energy (i.e. biomass, solar and mini-hydro) investors. The project is expected to act as a catalyst to bring together various stakeholders on a common platform, and to expedite development of renewable energy technologies in Zambia.

3.6 Global Objective

97. The global objective of the project will be to reduce greenhouse gas emissions by supporting renewable energy based mini-grids for rural electrification. The proposed project in Zambia will demonstrate the technical and financial viability of renewable energy based mini-grids under investment business models, and will aim at removing the barriers to their development and wide replication. In particular, it will demonstrate the viability of new institutional and financial practices that would enable the private enterprises/companies to become power producers and energy service providers, and link reliable energy services with the productive use activities to enhance the employment opportunities in the rural areas of Zambia.

3.7 *Project Design*

98. The proposed project will aim at removing the barriers to the deployment of renewable energy technologies for rural electrification and promote investment projects in Zambia. As mentioned earlier, the project will implement technical assistance activities for capacity building, technology transfer, financial packaging and strengthening of institutional and policy mechanisms, and setting up initial investments as business models to demonstrate commercial viability of renewable energy based mini-grids to provide electricity and energy services in the rural areas of Zambia. The design would accommodate the expected World Bank OP6 project by reducing the effort and focusing more narrowly on relatively rapid demonstration of three technologies that could be adopted by the World Bank project.

99. On the basis of field data collected, resource availability, local demand for energy services and techno-economic feasibility studies including environment impact assessment studies carried out during the PDF-B phase, mini hydro, biomass gasification and solar PV technologies based mini-grids have emerged as most appropriate renewable energy technologies to meet the growing energy needs in the rural areas of Zambia, and there is also strong public and private interest to invest in and operate renewable energy based business models.

Selection of Sites and Technologies

100. The sites for setting-up of business models (renewable energy based mini-grids) were identified by the criteria developed during the national stakeholders workshop conducted as a start-up activity during the PDF-B phase implementation. Some of the key characteristics included in the criteria developed for site selection are as follows:

- Far-flung and inaccessible areas that cannot be reached economically through grid extension in the foreseeable future
- Areas with renewable energy resource potential for rural electricity generation
- Demand for rural electricity in areas that can pay at cost for the electricity service to be provided (agro-processing, rural industrial activities, public sector activities, existing demand centers serviced by expensive diesel-based electricity)
- Areas with reasonable population densities or concentration
- Willingness of the local stakeholders to participate in the pilot project and pay for electricity services
- Availability of financing especially in areas where the community, private investors, public/private partners
- Local institutional capacity for implementation and operation
- Areas where the development of rural mini-grids would have less potential for adverse environmental impacts.

101. The field visits were undertaken to the selected sites for evaluating local basic conditions as well as local community development demands. Each pre-selected site was evaluated as per the following local condition parameters compiled in the form of a questionnaire:

- (i) *Geographic*: location, distance to distribution and transmission lines, size of project area; wooded surface area; volume and flow rate of water resources, weather conditions (rainfall, wind factor, seasonal temperature variations), distribution of soil uses;
- (ii) *Socio-cultural*: population; age structure; number of households; technical capacity of the population; existence of leaders; active institutions; local organizations;
- (iii) *Economic and financial*: main economic activities (agriculture, livestock, forestry, artistry, and fishing); low-productivity economic activities; more dynamic economic activities; financing capacity; and

(iv) *Residential situation*: type of housing (family, complexes); main household activities (cooking, bread baking, brewing, water heating, lighting and pumping).

102. Abundant availability of biomass, solar and mini hydro resources, which can be harnessed on sustainable and commercial basis, influenced the final selection of technologies and sites in Zambia. Low availability of wind potential and lack of reliable information on geothermal potential ruled out their applicability as viable business model options. In all, initially 15 sites were selected all over the country, which were narrowed down to nine sites (three sites for each renewable energy technology – solar, biomass and mini-hydro). Out of the nine sites, three sites (one for each technology) were eventually selected and agreed with the national counterparts as these sites presented win win option at every level of implementation.

103. The following sites were selected for setting-up of business cum investment models in Zambia under the proposed project:

- Mini-hydro based business model at Shiwang’andu in Chinsali District;
- Biomass gasification business model in the Kaputa District; and
- Solar PV based Business model at Chinsanka in Samfya District.

104. Technology design for each business model was identified after going through very rigorous selection criteria, which among others included national priority, technical and commercial viability, environmental impacts and the GEF criteria.

105. A rapid environmental assessment study conducted for each site showed that there are no unacceptable environmental impacts, and with proper management plans in place, these projects can meet the environmental regulations in Zambia. Building on the field studies already undertaken during the PDF B phase, a comprehensive environmental management plan will be prepared for each of the demonstration mini-grid project, resources allocated, and regular monitoring will be undertaken to ensure its implementation. Further, to successfully implement the biomass gasification model in a sustainable manner, it will be necessary to support and develop sustainable forestry activities in and around Kaputa project area. Thus the forestry management will form an integral part of the biomass model in order to support sustainable forest harvesting²³ (only tops and lops, and fallen branches) to produce the quantity of biomass required to feed the gasifier systems for power generation.

106. Discussed below are the design and rationale for the each pilot project and the business model it intends to demonstrate.

Mini-Hydro Based Business Model at Shiwang’andu Estate

Rationale

107. Currently, at the Shiwang’andu Estate which was identified as most suitable site during the PDF-B phase activities for setting up of a business model using mini hydro based mini-grid, diesel generators are being used to generate power for:

- A metal/wood workshop (30 kW)
- A hammer mill for grinding animal feeds (12.5 kW)
- The tourist lodges at Shiwa House and Kapishya Springs (100 kW)

108. The estate has additional need of electricity to:

²³ As mentioned earlier, to begin with, special efforts will be made to introduce mandatory forest certification at Kaputa to ensure sustainable forestry management.

- Provide irrigation for coffee and sugar can plantation cultivated by the Estate and nearby farmers
- Process the coffee produced
- Expand the hammer mill to grind grains as well.

109. The local community also has needs for electricity for

- Supply power required by a hospital and a health centre nearby: The hospital is currently using a combination of diesel engine and PV to pump and treat its own water from the lake.
- Supply power to 100 residential homes: Some of these homes currently use dry cells to operate radio, TV, and other electrically operated goods.

110. The total electricity required in the immediate future by the Shiwang'andu Estate is 500 kW. But when needs of surrounding unelectrified rural areas and demand growth are taken into account, the estimated expanded requirement is significantly higher. The estate proprietor has a potential hydro resource within his property, and has expressed a strong interest to deploy it for the power supply.

Proposed Intervention

111. The hydropower resource in the Shiwang'andu Estate will be harvested from Manshya River when it flows from Shiwa Lake to join Chambeshi River. The pilot project will be based on the run-of-river design, i.e. no dam to be built. It comprises a power station with a diversion weir. A tailrace canal will lead the water back into the river. The effective diversion of flow will be for less than 400 meters. The project includes necessary distribution system to deliver the power to the users. As the capital cost difference between the 500 kW and 1,000 kW capacities is only 15%, this pilot mini-grid is designed for the 1,000 kW output.

112. The major difference of this pilot project from other hydropower projects in Zambia is that it is a run of the river project in the smaller capacity range with very limited or minor environmental impacts. The electricity produced is used mostly to promote income-generating activities, which is one of the major objectives of the proposed full project.

Applicable Business Model

113. Mini-hydro is already commercially viable with a generation cost in the 3-5.2 ¢/kWh range. Its commercial deployment by private investors is fairly straightforward, and would be the first choice for the rural electrification, as long as the specific rural area has sufficient hydro resources with no adverse environmental or social impacts.

114. The Shiwang'andu Estate owner and ZESCO have expressed strong interests to jointly invest in this pilot project, which will demonstrate a joint-sector investment (public-private) business model. The success of this pilot project can facilitate the eventual transfer to total private sector ownership for future mini-hydro projects.

115. More details on Shiwang'andu mini-hydro business model are given at Annex F.

Biomass Gasification Based Business Model at Kaputa

Rationale

116. ZESCO currently has diesel generator station serving the Kaputa town, which is in a remote corner of Northern Province. The station currently has two Volvo Penta diesel generators of 267 kW and 181 kW, respectively. Due to the very high imported diesel fuel cost, the cost of electricity produced from this station is in the 25-30 ¢/ kWh range. Diesel transport is extremely difficult due to

the terrain and bad road conditions. At present ZESCO is servicing on an average 200 – 250 kW load amounting to about 0.9 million units (kWh) annually. ZESCO is interested in finding alternative generation methods to reduce this high cost. Several businessmen in Kaputa have already urged ZESCO to increase the power supply so that they can start the fish processing plants. Due to the anticipated load increase, there is even more urgency for ZESCO to look for cost effective power generation method.

Proposed Intervention

117. In this pilot mini-grid, a biomass power generation unit will replace all the diesel based electricity generations at the ZESCO's Kaputa power station. Due to the anticipated power supply increase urged by the local businessmen, the biomass gasification plant is designed for 1,000 kW output.

118. The power generation will be made of two 500 kW gasifiers with gas engines. The gasifiers have the capability of multi-fuel option to provide flexibility in using agro residues or forest residues as the fuel. Use of gas engine totally eliminates the fossil fuel used, thus commercially attractive and environmentally acceptable. Thus, gas engines will use the producer gas totally, and would completely eliminate the diesel fuel consumption. The existing diesel engines will still be used but only for backup generation and providing startup power for the biomass gasifiers.

119. While a tendering procedure will be used, the project seeks an intermediate technology of relatively low cost to suit the local conditions with due importance to performance²⁴ and environmental conditions.

120. Aside from the biomass gasifiers and gas engines, the generation plant will also include:

- A biomass receiving system
- A biomass preparation system for cutting, briquetting, and drying the gasifier feed to the required size consist and moisture content
- A feed loading system to the gasifiers
- A handling system to collect, transport, and use ash and char produced from the gasifiers (ash can be used as a soil supplement and char as a cooking fuel)
- A water treatment system to treat the circulated water for scrubbing and cooling of the gasifier product gas

121. The power produced will be delivered to the customers through the existing local grid, which will be further strengthened. The electric switchyard and the distribution system, however, will have to be expanded because the electricity to be delivered is 1,000 kW rather than 500 kW.

122. The biomass feed to the gasifiers at the rated capacity is about 1,200 kg/hr. With an average generation of 5.7 to 7.5 million units²⁵ (kWh) per annum (averaging 6700 hrs annual operations), the biomass consumption (at the maximum capacity) is expected to about 9,000 tonnes per year. The feed will be mainly lops and tops and fallen branches (from power pole fabrication) from the existing forests and milling waste or from new forest plantation (>90%) on fallow lands available in the

²⁴ Swiss/India cooperation has resulted in interesting applications in Switzerland/India, and similar cooperation will be sought to establish and support the African manufacturing of biomass gasification systems and their applications

²⁵ The biomass demonstration project assumes up to 7500 hours of annual operation (averaging 6,700 hours) will be achieved early in the plant's life (from third year of its operations). This is to plan for sustainable supply of biomass. It is expected that there will be a gradual load increase. Kaputa has population about 90,000, and at present, there are only 170 domestic consumers and 50 commercial, with a peak load of about 260 kW. The 75- 85% load factor may also take into account some load management (scheduling of off peak uses).

vicinity, supplemented by agriculture residue (< 10%). Assuming the forest plantation can produce residues in the range of 6-7 tonnes/hectare woods annually and the woods will be harvested in a 5-year rotation cycle, the land required is less than 7,000 hectares, which is only about 0.8 - 1.0 % of the total forest area in the Kaputa District. Kaputa is a farmland area, which produces primarily corn (maize), rice, millet, and groundnuts (peanuts) but also some beans, cassava, and sweet potato. In addition to wood, the agriculture waste to the gasifiers would mainly comprise of corncobs and groundnut shells collected in the vicinity of the power plant.

123. The Department of Forest under the Ministry of Tourism, Environment, and Natural Resources has agreed to participate in the pilot project, and shall be responsible for managing the feed supply on sustainable basis (introducing mandatory forestry certification). The biomass will be supplied to the Kaputa power station under a purchase agreement with ZESCO. Private investors will be invited to partake in this biomass supply in collaboration with the Department of Forest.

124. The major reasons to choose Kaputa as the pilot site for biomass based mini-grid include, among others, a pending request from the local business community for enhanced and reliable power supply, abundance of biomass in the vicinity and national priority for removing the suppressed generation towards meeting the local energy requirements. This pilot project will, for sure, promote income-generating activities such as fish and agro products processing, which is one of the key objectives of the proposed full project. The biomass gasification has never been tried in previous projects or programmes in Zambia. Hence the pilot mini-grid at Kaputa will introduce this new technology to Zambia.

Applicable Business Model

125. Preliminary discussions revealed a strong interest from ZESCO to invest, own and operate this pilot mini-grid. But several biomass gasifier suppliers and renewable energy project investors have also shown a keen interest to invest, including a BOT (build, operate, and transfer) approach or a PPA (power purchase agreement) with ZESCO. Depending on the outcome of the negotiations between Government, ZESCO and investors, this pilot project will demonstrate the business model of either joint partnership between the public and private sectors or total private sector ownership.

126. In this pilot mini-grid, the biomass gasification is expected to produce electricity below 12 ¢/kWh depending on the costs on collection, processing and transportation of biomass fuel. For the future privately owned commercial units, the implementation costs can be significantly reduced (in the range of 30-40 %) because:

- The commercial units will not have some of the cost provisions typical of pilot projects, such as vendor support, over-design due to technical uncertainty under the Zambian conditions.
- The private investors will pay the operating and maintenance labor costs based on the national commercial norms.
- The gasifier can be operated to convert 5-10% of the biomass feed to charcoal, which can be sold to compensate 25-50% of the biomass feed cost, and help reduce the unauthorized harvesting of forests, and harmful emissions from conventional charcoal-production kilns.

127. It is envisioned that this type of mini-grid will not just be ZESCO's undertaking to reduce financial losses in their diesel generation stations, but also has large commercial potential for replication in the country.

128. More details on Kaputa biomass based mini-grid business model are given at Annex E.

Solar PV Based Business Model at Chinsanka

Rationale

129. Situated in the Northern Province with no grid connection, the main economic activity in the rural areas of Samfya District is fishing from the nearby Bangaweulu Lake and surrounding swamp. Chinsanka is the biggest commercial centre in this district. It has 875 households and 70 shops, all clustered in an area of 2 km long and 1 km wide. Paraffin, candles, dry cells, firewood, and charcoal provide most of the current energy needs in Chinsanka. Lack of reliable energy services is a key barrier to the economic development.

130. The Samfya District has the need of electricity to further promote the fishing business and other economic activities. Due to the steady income from the fishing activities as identified during the PDF-B phase studies, the local people in the district have shown willingness to pay the higher cost for getting reliable energy services. The electricity provided could supply lighting to the shops to run longer businesses hours. It might also induce people to look for profitable business ventures, such as refrigeration of the fish catch to expand the sale and water pumping for irrigation of high value crops. Aside from the income generating activities, the electricity produced might further find use in social sectors, such as providing light to schools, powering refrigerators for storing vaccines in clinics, and running water purification to improve water supply quality.

131. The fishing in Samfya is usually done in the night with the use of kerosene lanterns to lure the fish. The kerosene purchased is very costly. There is also urgent need to find an alternative energy source to substitute for the kerosene used to catch fishes during the night.

Proposed Intervention

132. As Chinsanka is a small town, the power demand is not sufficiently high to justify conventional electrification methods. In view of availability of various renewable energy resources during the field studies, solar PV emerged as most attractive option to meet the local power needs.

133. The PV mini-grid is being proposed has 36 kW peak capacity to serve 550 homes and 50 shops, including provision for overcapacity to meet future demand increase and fluctuations. It is designed based on solar radiation of 5.2 peak sun hours per day over the annual 12-month period and has included technology package (mix of CFL/LED clusters) as well as the environmental management plan including recycling and disposal/management of the lead acid battery storage used. The electricity charges to these homes and shops will be collected through the use of prepayment cards, which will set a predetermined amount of electricity delivered periodically subject to the amount of payment deposited by the customers prior to the use. By sharing the battery storage, it can be sized for 2-day system autonomy rather than the 3-days typically required for the off-grid Solar Home System to reduce the life cycle costs.

134. The pilot project will also include 10 large solar lanterns and 10 small solar lanterns to demonstrate their use in fishing as substitute for the kerosene lanterns. These solar lanterns will be charged by electricity generated from the PV panels during the daytime.

135. The major difference of this pilot project from the previous ones is that it is structured based on mini-grid rather than dispersed SHS. The previous PV projects showed the users tend to overuse the SHS by overdrawing the power. The central power generation in the mini-grid arrangement can be better monitored and controlled. It also allows commercial uses of the power generated, such as irrigation and food processing. Further more, the users' peak demands may not occur all at the same time. As a result, the central power generation will require less generation capacity and battery storage. Further, the project will utilize LED cluster lamps²⁶ to bring down the cost over period of time.

²⁶ The project will aim at introducing Light Emitting Diodes (LEDs Clusters) at Samfya, as there could be substantive savings over a period of time, provided they meet local requirements of lumen/watt. The possible life cycle savings could

Applicable Business Model

136. Both ZESCO and a private investor experienced in designing, building, and servicing the solar PV based power distribution system have shown interest to co-finance and operate this mini-grid.

137. The PV mini-grid is an expensive power supply option with a generation cost in the US \$ 1-1.5 per kWh range but on a monthly basis, the expenses are comparable to what people are already spending on traditional energy sources in many rural areas of Zambia. It will find its commercial value, as the power demand in a given rural area is very low to justify other electrification methods or lack of adequate availability of other renewable energy sources in the vicinity. Successful deployment of LEDs technologies for commercial applications such as solar lanterns to be used for fishing at night as envisaged under the project would also result in favorable economics, as any increase in income levels would further enhance the willingness of local population to pay more for the reliable energy services based on solar PV systems.

138. ZESCO is interested in this business model because it could be an intermediate solution to their social-economic obligation to the rural electrification. When the power demand in a rural community has grown to the point of needing to switch to other power generation methods or even to be connected with the grid, the distribution system built in the PV mini-grid can continue to be used as part of the new system. The PV generation unit can then be moved to other sites. In essence, the solar mini-grid could be a pre-investment for ZESCO in their rural electrification program. However, it is also expected that the rural electrification niches where PV power generation is competitive and reliable, and where a strong linkage to productive use activities (e.g. solar lanterns for fishing) and social programmes (e.g. education and HIV Aids prevention through ICT) is carefully established, will grow over a period of time in Zambia as well as in the region.

139. The applicable business model to use this renewable energy source would be a joint partnership between the public and private sectors or total private investment (ESCO mode), but either case probably would require subsistence from the government or donors. As PV cost has steadily been reduced in the past, the subsistence would get reduced or even eliminated in the future, particularly if Zambia can transition into a totally market driven electricity pricing at that time. More details on Samfya solar PV business model are given at Annex G.

4. PROJECT ACTIVITIES AND EXPECTED RESULTS

140. The project activities that will address the key barriers to the deployment of renewable energy based mini-grids in Zambia can be broadly divided into five categories: a) designing and establishing institutional and policy framework; b) building national and local capacity to promote renewable energy based mini-grids; c) Setting up public/private financing mechanisms to attract private sector investment in renewable energy based mini-grids projects; d) Implementing pilot RE based mini-grids to demonstrate commercial viability of business models; and e) project coordination, management and information dissemination.

141. Each activity is composed of immediate objective, specific outputs and a number of sub-activities designed to address the key barriers that constrain development of renewable energy technologies in Zambia. Collectively, project activities will aim at the establishment of commercial business models for renewable energy based mini-grids at three rural locations, and their replication in the rest of the country.

come from the fact that recent advances made in the LED technology have made it possible that LED clusters can last upto 50,000 hrs when compared to 4000 hrs for Compact Fluorescent Lamps (CFLs). A detailed comparison and analysis of the costs across LEDs, CFLs and Kerosene lamps in the context of the local applications will be undertaken as a start-up activity of the full phase project before finalizing the technology design for the solar mini-grid.

142. Cross cutting themes such as gender issues, community participation and environment concerns will be mainstreamed into various project activities to ensure effective implementation of the project.

143. The project activities, immediate objectives and outputs are described as follows:

Activity 1: Designing and Establishing Legal, Institutional, and Policy Framework

144. The immediate objective of this activity will be to create a favourable enabling environment in terms of the legal, institutional, and policy framework for commercial deployment of renewable energy based rural mini-grids in Zambia. Except for a few donor funded renewable energy (mainly solar home system PV) projects, there is no past experience, policies or regulatory framework in place to support or encourage renewable energy based mini-grids in Zambia. Lack of any incentive or tax waiver to promote renewable energy technologies further hinders investment by the private enterprises. This activity will facilitate formulation of a policy and regulatory framework at the national level to mainstream renewable energy into the overall development strategy and integrated energy programmes in Zambia. It would also assist in providing a level playing field to renewable energy technologies to compete with conventional power generation (diesel based gensets) projects in the country.

145. Although renewable energy agenda is dispersed over several departments and ministries, Department of Energy (DOE) under the Ministry of Energy and Water Development, Government of Zambia has the overall responsibility for guiding the renewable energy planning and programmes at the national level. All other agencies, e.g. ERB, REA, NGOs etc, actually work within the policy framework set by the Ministry to support renewable energy projects in Zambia. In addition, the project proposes to set up a national steering committee under the chairmanship of PS, DOE, which would have representation from all key ministries, and besides providing oversight, would also act as coordination mechanism for regular meetings, exchange of information and synergies in policies and programmes on renewable energies. As regards the energy sector uncertainties, which include lack of coherent policies, absence of level playing field and non-existent incentives for renewable energies, the project aims at catalyzing inputs and targeted policies to mainstream renewable energy agenda in the poverty reduction strategy paper (PRSP) and rural electrification planning process.

Output 1.1 An enabling framework in terms of policy, institutional and regulatory mechanisms for supporting renewable energy based mini-grids is established and made operational.

146. Sub-activities:

- Examine and review all the existing policies, legislations, and regulations dealing with the renewable energy based power generation along with the gaps identified;
- Suggest new policy provisions and regulatory framework to provide a level playing field for the deployment of renewable energy technologies in Zambia as input to the Rural Electrification Authority (REA) and to the Department of Energy (DOE) formulating the rural electrification legislation and policies;
- Set up a national steering committee to oversee inter-departmental coordination and on devising a single window approach for clearance of new renewable energy based mini-grid projects;
- Assist DOE, REA and ERB in updating the National Energy Policy and regulations with emphasis on the commercial use of renewable energy sources, particularly in the rural areas ;
- Forge linkage among the key policies and programmes in the agriculture, industry, and community developments to ensure the mainstreaming of renewable energy agenda in PRSP and rural electrification planning process;
- Draft and circulate to Investors and DBZ for review and comments on a model power purchase agreement for harnessing renewable energy for rural electrification; and
- Develop and suggest incentive schemes and tax waivers to the policy makers for attracting renewable energy investors and service providers.

Output 1.2: National quality assurance standards on renewable energy technologies and mini-grids developed and disseminated.

147. Sub-activities:

- Assist the ERB, ZABS, REA and DOE to prepare national standards and norms on renewable technology performance and evaluation benchmarks to ensure the quality of both imported and domestically manufactured equipment and facilities;
- Assist DOE, ZABS, REA and ERB in developing norms for RE mini-grids systems to ensure timely returns, quality standards and effective implementation; and
- Hold workshops and seminars to widely disseminate information on the standards, norms, and quality issues to the public and private sector, consumers, and other key stakeholders, such as service and maintenance providers.

Output 1.3: Guidelines on environment impact assessment for renewable energy based mini-grids projects developed and disseminated.

148. Sub-activities:

- Assist Department of Energy, REA, ERB, Environmental Council and national institutions to formulate guidelines to evaluate new renewable energy projects on environmental concerns;
- Assist ERB to incorporate and internalize environmental and social costs in its rules and procedures while deciding on tariffs and PPAs for rural areas; and
- Assist Department of Energy and Ministry of Tourism, Environment and Natural Resources to develop environment management plans for renewable energy based projects.

Activity 2: Building National and Local Capacities to Promote Renewable Energy Based Mini-grids

149. The immediate objective of this activity is to build national and local capability to facilitate commercial deployment of renewable energy based mini-grids for rural electrification in Zambia. This activity will address capacity barriers, and assist in building local manufacturing capacity to harness the potential of renewable energy technologies. Capacity building of the major stakeholders including the Government Ministries, national institutions, universities, enterprises, R&D institutions, financing institutions and banks will be undertaken to enable them to support renewable energy technologies and mini-grids on a commercial basis.

150. Capacity building and training programmes will be organized for the local and national government officials, public and private sector officials, manufacturing units, maintenance service providers, NGOs and communities to build a solid technical and planning base. The project would facilitate strengthening of the renewable energy cell at the Department of Energy (DOE) and training of key policy makers and experts at REA. Among others, key institutions identified for training and capacity building would include DOE, REA, ERB, ZESCO, School of Engineering, University of Zambia, DBZ, Department of Forests, NGOs and private sector representatives.

Output 2.1: Main stakeholders are trained on evaluation and benchmarking of renewable energy mini-grid projects for Rural Electrification.

151. Sub-activities:

- Train the key stakeholders, such as planners, professional, and experts, on evaluation, benchmarking, and validation of standards for renewable energy technologies through workshops and study trips;
- Provide training to the stakeholders on the techno-commercial status of renewable energy technologies in terms of specifications, inputs and outputs, capital and operating costs, minimum viable project sizes, and ranges of economic viability indicators; and

- Disseminate more widely techno-commercial status and evaluation of renewable energy technologies through workshops and seminars.

Output 2.2: Key Stakeholders are trained on the management aspects of renewable energy based mini-grids.

152. Sub-activities:

- Train the key stakeholders on general aspects of operational management of renewable energy based mini-grids, such as sustainable biomass supply through energy plantations, technical back-up for solar PV systems and mini hydro systems, and project financial and administrative operations; and
- Train the stakeholders for using national and international database on renewable energy resources, technologies, project experience, market applications, business opportunities, policies, regulations, financing sources, and participating players.

Output 2.3: Technology experts and policy planners are trained to manage technical and financial services for projects appraisals, information dissemination, and implementation of replication strategy.

153. Sub-activities:

- Facilitate strengthening of the renewable energy cell at the Department of Energy (DOE) to augment capacity of the nodal department in DOZ and training of key policy makers and experts.
- Organize training courses and seminars for the project team, experts, and planners to manage the technical and financial services, disseminate information on the project activities to a wider audience, and implement the replication strategy;
- Hold training workshops for relevant government organizations and private enterprises on the effective linkages between renewable energy technologies and productive use activities; and
- Include local communities and consumer groups under the various training programmes to ensure their close involvement in the project activities as well as in the replication strategy.

Output 2.4: National capacities are strengthened to manufacture, assemble, and maintain renewable energy based mini-grids, and reduction in the implementation costs.

154. Sub-activities:

- Strengthen national/local technical institutions and manufacturing units involved in the manufacturing, servicing and maintenance of renewable energy equipments through technology selection, field visits, training workshops, and seminars;
- Train skilled personnel to enhance local capacity to assemble and build renewable energy based mini-grids;
- Assist training and research institutes, such as TDAU, NISIR, and KGRTC, in developing appropriate curricula on renewable energy technologies; and
- Facilitate strengthening of research and development activities at the School of Engineering, University of Zambia to dedicate and coordinate R & D efforts at the national level. The proposed collaboration would primarily envisage introduction of academic courses on renewable energy technologies at the School of Engineering to train manpower for future needs in the private sector (a critical gap area), procurement of equipment and strengthening R & D linkages for catalyzing technology transfer and adoption at the national level.
- While the GEF funds will primarily be used to seek inputs from the international experts and institutions on renewable energy technologies, GOZ and UNIDO would contribute towards in-country training.

Output 2.5: Capacity of financial institutions and banks is built to evaluate renewable energy based rural electrification projects.

155. Sub-activities:

- Organize study trips, training workshops, and seminars for officials of the DBZ and other financial and public utility institutions to appraise, evaluate, and analyze renewable energy based projects; and
- Develop and provide guidelines to bankers, investors, and other relevant personnel regarding the required business, finance and technical skills, including the provision of business tools and financial mechanisms for evaluation of renewable energy projects.

Activity 3: Planning and Setting up Innovative Project Financing Mechanisms and Structures

156. The immediate objective of this activity is develop financing plan and procedures, including a “Risk and Replication Management Fund (RRMF)” to attract private sector investments for future commercial renewable energy projects in Zambia. A specific objective of this activity will be to attract foreign investments as well as lower the implementation costs of renewable energy projects. This activity would facilitate setting up of a innovative financial mechanism at the national level to support development of renewable energy technologies throughout the country. A detailed analysis of fund flow, internal rate of return, interest rate and investment needed for business models in order to succeed in the local conditions revealed that the investment financing by the private companies would require an upfront targeted financial support to make the business models viable and attractive for the private investment. Rather than using a grant mechanism, soft finance is considered to be avoid dependence of industry on up front subsidies.

Output 3.1: An innovative funding mechanism is developed and made operational for supporting renewable energy based business models and their replication. The fund will generally follow DBZ’s operational procedures for technical assistance and finance. ANNEX 11 describes DBZ activities in detail.

157. Sub-activities:

- Develop financial rules/procedures working closely with the DBZ for setting up and managing the RRMF. The fund will essentially be an interest free loan to cover a part of the private investment component that will be taken as GEF risk sharing contribution to the private investors upfront. Once the demonstration period is over and the agreed grace period expires, the private investor will have to pay back the interest free loan to the risk and replication management fund (RRMF). The replenished fund will act as a revolving fund for the replication and development of renewable energy investment projects throughout the country. In addition, on completion of the project, RRM fund²⁷ will meet the costs on the pre-feasibility studies on a cost-sharing basis with private developers for the new investment projects in Zambia.
- Assist the DBZ and other agencies to address critical issues in project financing, such as terms of the interest free loan, grace period, and penalty clauses if the loan is not returned on time by the investors. Consultations and meetings held with the DBZ have revealed a high degree of ownership and willingness to participate in the project, and to support new funding mechanism. DBZ will play a key role in managing the RRMF fund during the demonstration period. This experience will facilitate creating an enabling environment and building local capacities for setting up and management of a national level revolving fund to support renewable energy development at a later stage; and

²⁷ For instance, the Risk and Replication Fund will support renewable energy feasibility studies through contingent loans. If the project is successful in achieving finance for construction the borrower will repay the loan (i.e. say at a pre-determined commercial rate). The Development Bank of Zambia and the Ministry of Energy will solicit donor funding to maintain or expand the operations of the fund. Reflows from the initial fund will be sufficient to finance feasibility studies or implementation of small or pilot projects up to 30,000 USD each. Applications will follow Development Bank of Zambia’s normal procedures except that a DOE, DBZ and UNIDO joint committee will review the applications and award them on a first come first served basis (more details about RRMF are given in Annex 11).

- Frame procedures for recovery and recycling of RRM fund. DBZ along with other financial agencies will look into, among others, critical issues like terms of the interest free loan, length of demonstration period, grace period and penal clauses if the loan is not returned on time by the investors. The DBZ would also work out criteria for allocating funds for future projects on activities such as undertaking feasibility studies, size and capping of study funding for each project, developer/financier share of the feasibility study, repayment schedule of the loan component, separate schemes for power generation developers under each mini-grid, interest of financing partners for replication and terms and conditions for setting up of a national level revolving fund to promote renewable energy technologies in Zambia.

Output 3.2: Methodology and procedures are developed for the use of replenished fund for future projects and feasibility studies.

158. Sub-activities:

- Develop methodology and procedures to enable the replenished fund to act as a revolving fund for the replication and development of renewable energy investment projects throughout the country. In addition, on completion of the project, RRM fund will also meet the costs on the pre-feasibility studies on a cost-sharing basis with private investors; and
- Establish criteria for allocating funds for future projects on activities such as undertaking feasibility studies, size and capping of study funding for each project, developer/financier share of the feasibility study, repayment schedule of the loan component, interest of financing partners for replication and terms and conditions for setting up of a national level revolving fund to promote renewable energy technologies in Zambia.

Output 3.3: Capacity of national banks and financial institutions is built to manage investments funds for renewable energy project

159. Sub-activities:

- Sensitization of finance and technical officers of various agencies on appraisal and management of RRMF and investment funds. This would greatly assist in creating an environment where new renewable projects will be analysed more professionally, and power purchase agreements, financial guarantees etc., will get finalized within a reasonable time limit.
- Regular consultations between finance officials and technical officials and experts from ZESCO, REA and DBZ will help in simplifying procedures to attract new investments in renewable sector. Best practices world wide on financial evaluation, and investment processes will be compiled and shared with the key financial institutions and banks as well as prospective investors.
- Focused training programmes to impart information on business, finance and technical skills for bankers, renewable energy entrepreneurs and personnel in the selected renewable energy technologies will be undertaken. Training will include the provision of business tools, training on financial mechanisms to financial intermediaries, and additional training to major stakeholders inside or outside the project in biomass, solar and mini-hydro energy technologies.

Activity 4: *Implementing Pilot Renewable Energy Based Mini-Grids to Demonstrate Business Models.*

160. The main objective of this activity is to successfully install and demonstrate the commercial viabilities of three pilot mini-grids based on mini-hydro, biomass gasification, and solar PV technologies for rural electrification in Zambia with their applicable business models. The site selection as well as technology design for each of the three business units has been done in view the

resource availability, logistics involved, national priorities and willingness of the local consumers to pay for the cost of energy services to be provided by renewable energy technologies. This activity would oversee the tendering, installation and demonstration of the commercial viabilities of three pilot mini-grids based on mini-hydro, biomass gasification, and solar PV technologies for rural electrification in Zambia. The site selection as well as technology design for each of the three business units has been done in view the resource availability, logistics involved, national priorities and willingness of the local consumers to pay for the cost of energy services to be provided by renewable energy technologies.

Output 4.1: Three pilot mini-grids based on renewable energy technologies are implemented.

161. Sub-activities:

- Conduct technical and financial design for the pilot projects, and prepare technical specifications for the key equipment or performance targets for the systems to be procured;
- Finalize financial packaging in consultation with ZESCO, private investors and financial institutions in a consortium approach;
- Pursue and finalize power purchase agreements, legal setup, fund flow arrangements, environmental guidelines and operational structures.
- Procure equipment and services through an open bidding process and complete contractual arrangements including legal agreements wherever applicable;
- Oversee the installation of the pilot mini-grids in a systems approach to complete the implementation in a timely manner; and
- Local community and women groups will be sensitised and closely involved in the implementation of the proposed mini-grids.

162. UNIDO will facilitate the tendering and bidding process, and may facilitate purchase of the equipment to obtain tax waiver (wherever applicable or as requested by the national counterparts). Although UN Tendering procedures (i.e. UNIDO financial procedures and rules) would be followed, GRZ rules and procedures will be taken into account wherever found feasible/ applicable during the implementation. The installations will be transferred to the owners and financiers with the legally binding repayment requirement to the RRMF on commissioning of the plant. Local suppliers will be short-listed and local institutions will be promoted through open bidding processes as a part of local content and capacity building. The local companies would then be involved in the replication strategy. They will be, therefore, taken on board to gain experience, and to facilitate technical tie up with the international companies supplying the technology transfer and know how.

Output 4.2: Training is imparted to operational and management staff of the pilot mini-grid projects, and close linkages between energy services provided by pilot projects and productive use activities established.

163. Sub-activities:

- Train the pilot project staff to successfully operate and maintain the mini-grids with technical support from the technology vendors;
 - A Build Operate and Transfer arrangement could be used for the biomass gasification plant and the biomass preparation activities.
 - The IPP operating the PV mini-grid would train the local operators and sensitize the local consumers.
 - The mini-hydro if operated by ZESCO would not require training except for local subcontracted maintenance.
- Train the operators and managers in environmental management – monitoring, performance targets and mitigation measures;
- Train the managers in the financial management and legal requirements for effectively managing the mini-grids; and

- Identify business and employment opportunities linking with reliable energy services, and train the key stakeholders to initiate productive use activities (i.e. setting up of agro-based SSI units).

Activity 5: *Establishing Project Coordination and Management Structures and Dissemination of Information and Lessons.*

164. The main objective of this activity is to ensure that the project is properly executed. This activity will help in developing a dedicated management and technical team with inter-disciplinary expertise to ensure the ultimate success of the activities. Formats for project activity, sub-activity, task-based monitoring, evaluation and lessons learned will be prepared, discussed and finalized in consultation with key stakeholders. These will be tested for specific tasks and activities, and applied in the implementation of the project activities.

Output 5.1: Project management team and core experts are identified and recruited, and management structures are made operational.

165. Sub-activities:

- Prepare work plan and TORs for all national and international experts to assist the effective implementation of project activities;
- Identify team members and recruit the team and experts through an open selection process;
- Frame TORs for national steering committee and advisory expert group, and reach agreement with the national counterparts on their membership;
- Undertake regular monitoring of the progress being made under the project, and take corrective steps wherever required; and
- Explore public-private partnerships and joint venture mechanisms for the implementation of pilot projects, and the establishment of innovative financial mechanism at DBZ.

Output 5.2: Capacity building and training of the key stakeholders – technical experts, planners, investors and experts achieved.

166. Sub-activities:

- All key stakeholders including technicians, experts, possible investors and planners will be trained in the management of renewable energy based mini-grids, and a comprehensive manual prepared to ensure the use of the technical equipment and application of maintenance procedures.
- An updated national and international database on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and stakeholders would be created and shared with the national partners and key stakeholders.
- A network of institutions and trainers will be set up and trained whose responsibilities would include, among others, train other stakeholders.

Output 5.3: An effective replication strategy and a comprehensive information dissemination programme are developed and implemented.

167. Sub-activities:

- Create and compile project database, technology newsletter, technology hand-book, model pre-feasibility study, detailed pilot project reports, model energy purchase agreements, project development agreements, fuel supply agreements, and package of bid documents;
- Prepare and disseminate model appraisal guidelines for different renewable energy projects;
- Prepare an effective replication strategy and implement reaching out to a wider audience in the region for maximizing the impact; and

- Create and update regularly a website to act as a clearing-house for providing detailed information renewable energy resources and technologies

Output 5.4: Lessons learned and information disseminated, and regional networking is undertaken.

168. Sub-activities:

- Create a regional network of agencies and institutions to share experiences and lessons learned from renewable energy projects;
- Disseminate results and exchange information by using regional initiatives such as NEPAD, SADC, COMESA, Partnerships for Africa, and AREED programme on renewable energy etc.
- As a part of replication strategy, lessons learned and experience gained under the project will be documented and disseminated by UNEP to a wider audience through brochures, workshops, press, electronic media and Internet.
- Create a network of investors²⁸, utilities, NGOs and financial institutions in the South Africa region to provide a common front to exchange information and mobilize resources for renewable energy mini-grid projects.

Output 5.4: Monitoring and close supervision of project operations undertaken and corrective steps taken, wherever needed.

169. Sub-activities:

- Project activities will be closely monitored and evaluated through a management information system which would also help in taking corrective steps where required. Best practices and lessons learned will be documented and disseminated.
- The project will be monitored and evaluated according to GEF, UNEP and UNIDO standard rules and procedures. For each of the activities, a monitoring plan will be put in effect with the detailed set of indicators shown in the Logical Framework Annex B. In addition, record keeping will also be strengthened to enable adequate attention to information about electricity generation and sales, as well as renewable energy generation. Information about the quantity of energy provided by renewable sources vs. fossil fuel will be an important measure of the project success. This aspect will assume special significance for information sharing in the Africa region.
- A Monitoring and Evaluation Plan has been provided at Annex I.

5. RISKS AND SUSTAINABILITY

5.1 *Sustainability*

170. The national economic policies in Zambia accord priority to private investments, and has introduced a number of policies and measures to engage foreign enterprises in the local production of goods and services. The energy sector is included among the priority economic areas authorized for foreign partnerships, and some private initiatives are already at an advance stage of consideration by the Government. Presence of a vibrant and active Energy Regulatory Board and a well-established legal system further add to the conducive environment prevalent in the country for attracting private investments into the energy sector.

171. Active involvement of key partners under the various activities will be ensured to provide techno-commercial and management mechanisms suitable for long-term sustainability of renewable

²⁸ Sharing of information by the demonstration project owners/investors was one of the key points discussed during the meeting held with potential investors in February 2004 at Lusaka, and the response of project owners/investors was quite positive on the subject as they showed willingness to share such information with the PMU and other projects on regular basis.

energy based mini-grids. Another measure to ensure sustainability will be the capacity building element mainstreamed into each activity and outputs.

172. The project will use grant funding to remove the barriers to expanded RET markets but the private sector providers of RET will only receive soft finance mechanisms to deploy the RETs. After the demonstrations, replication is much more likely in this case. The returned funding will be reused for replication as described earlier.

173. It is expected that the renewable energy based mini-grids can be sustained for rural electrification in Zambia based on the following reasons:

- The government has the general policies to encourage the use of renewable energy for rural electrification and is committed to this project. Setting up of Rural Electrification Authority (REA) is a testimony to the Government's resolve to tackle rural energy issues on priority.
- Zambia has very abundant renewable energy resources, which are available indigenously all over the country, and in comparison, the imported diesel is very expensive.
- The renewable energy based mini-grids are probably most practical and cost effective solution for the electrification in many far-flung rural areas where even if grid is extended at a very high cost, maintenance of transmission and distribution lines for these areas will be very expensive and difficult.
- Zambia already has some experience with renewable energy projects, particularly in the areas of harnessing the potential of mini-hydro and solar PV home systems.
- Except for wind and geothermal, other three renewable energy sources, namely the mini-hydro, biomass, and solar can be harnessed in expanded commercial niche markets.

174. Further, the project activities have been designed in such a way so as to provide techno-commercial and management mechanisms, which are suitable for long-term sustainability to be achieved through active involvement of key partners in the various activities. Another measure to ensure sustainability will be the capacity building element mainstreamed into each activity and outputs. Aside from these fundamental reasons, the project is designed also to further ensure the sustainability by establishing policy/regulatory framework, and pursuing creative financing. The project activities will further contribute to the sustainability by strengthening linkages with other ongoing renewable energy projects and programs in Zambia and other countries through participation in crucial meetings and exchanging information on regular basis.

175. When seen in the overall economic context in the country, the key end results of the proposed project to ensure the sustainability are as follows:

- Monitoring, analysis and dissemination of information on power generated and exported from the renewable energy projects – biomass, solar and mini hydro power;
- Skill up-gradation of the key stakeholders including financial institutions, R&D institutions, entrepreneurs and project developers, experts, consultants and engineers, central and local governments and institutions, equipment and technology providers to ensure their close long term involvement;
- Establishment of a management mechanism for certification, pre-investment studies, consultancy services, training, R & D, leasing & financing, insurance; and
- Lessons learned and information dissemination to ensure long-term availability of institutional service support.

5.2 Replicability

176. The project has several salient features to ensure replication on a wide scale. Some of these features are: overall policy framework to attract private sector investment to promote renewable energy based mini-grids, technology design and packaging to replace fossil fuels, targeted financing

incentives and mechanism for speedy processing of new project profiles, sustainable management of forests, developing certification standards, reduction in development time and cost, continuous monitoring of technical and financial inputs, and information sharing on lessons learned.

177. The project will promote technologies, which are commercially proven; have long-term market penetration; can be produced or assembled locally to ensure their wider acceptance and public support; and have the capacity to reduce greenhouse gas emissions. The financing mechanism (risk and replication management fund) applied to demonstration of pilot mini-grids and follow-on investments will boost short-term supply, test regulatory and commercial procedures, and promote early commercialisation and regional replication of renewable resources. Technical and financial advice for streamlining procedures and refining them, combined with capacity building among stakeholders will reduce the development time and costs of future projects. The public access to reliable and high quality data on renewable energy resources, performance of new technologies and cost-effectiveness will enhance the confidence level, and would strengthen the market linkages and growth. To enhance the replicability of the project, GEF technical assistance will support dissemination of project outcomes through appropriate channels, including regional workshops involving bilateral and multilateral donors, country officials and private investors.

178. Zambia has huge tracts of barren lands. There is a huge potential in the form of forestry wood (where ever sustainable harvested), bio-wastes, crop residues and energy plantations on the degraded lands by planting indigenous fast growing species, which will be available at lower prices due to better collection and handling techniques. Mandatory forestry certification will be designed to verify good forest management practices, which would also include protection and conservation of biodiversity. Once the supply chain of biomass raw material becomes reliable and biomass gasifiers are demonstrated at Kaputa and mini-grid succeeds in enhancing the confidence level of investors and government alike, replication potential could be as high as 500 MW in Zambia itself as economics will work out much favourably (given the high prices of fossil fuels touching about \$ 60 per barrel in international market) for investors and ZESCO to replicate the mini-grids. Further, there exists ample scope for the development of other alternative and renewable sources of energy (i.e. cogeneration from bagasse and wastes from sugar mills, independent small producers of renewable based electricity for agricultural watering), whose development is also limited by technical or financial barriers, and these technologies also require the support and application of similar financial and institutional mechanisms as being tried in the proposed mini-grids to facilitate their penetration in the market.

179. At project completion, the risk and replication management fund will provide the financial mechanism for a national level revolving fund to support the pre-feasibility and feasibility studies for new renewable energy projects. This fund will also provide the technical and administrative means to implement support services. Repayment of interest free loan released to the investors through risk and replication management fund will be fully invested in replication activities, and will act as a precursor for a national level renewable energy revolving fund in Zambia. DBZ will manage and invest this fund with commensurate fiduciary responsibility and accountability. *Is there interest or not? pls see previous sentences.* Interest earned would exceed management costs allowing for some defaults to occur without much running down the fund. If the market grows as anticipated, it may be possible to establish a renewable energy equity fund that is capitalized by various local and foreign investors and bi/multilateral agencies. Such a fund mobilization strategy will be developed during the project implementation phase, and could be a significant outcome.

180. To the extent that this project is successful, the Zambian experience can easily be replicated in other countries of the region having biomass, solar and small hydro resource potential, where similar Government commitment exists but policy and financing barriers hamper the implementation of renewable energy projects. UNEP will disseminate the project experience in the region through regional meetings and globally through various media. Key dissemination and replication activities within Zambia will be executed by UNIDO. These are detailed in activities section. Broader significance of the activities for the region will be disseminated and replication encouraged by UNEP through workshops and publications. This activity is budgeted under Coordination. The outcome will

be shared with the projects referenced in the project brief but mainly impacting wind and biomass technologies and use of the financial modalities. A UNEP and UNIDO cosponsored regional dissemination meeting would take place in Lusaka after the mini-grids become operational.

5.3 Risk Assessment

181. This project has potentially several risks as summarized in Table 2. These risks and the mitigation measures to take are discussed as following:

- **The pilot projects have low performance:** The project has chosen near commercial renewable energy technologies to minimize the low performance caused by the technologies. The project will also have rigorous monitoring of the pilot project operation to minimize the low performance caused from mismanagement of the pilot projects. Thus, this risk is considered low.
- **Regulators are reluctant to support establishment of renewable energy policy/regulatory framework:** Since the preparatory phase of this project has been done in close consultation with the regulatory body and the government already has a national policy to use indigenous energy sources for electricity generation, this risk is low.
- **Reliable biomass supply cannot be secured:** This risk is moderate as lack of any previous substantive experience in this area, and weak institutional and commercial infrastructure available locally to supply biomass fuels could pose a risk. To mitigate this risk, the project has engaged the Forestry Department to manage the supply of biomass for the pilot project at Kaputa and the capacity building programme has included the survey and compiling of biomass resource data and information dissemination of biomass gasification technology to potential biomass suppliers. Introducing mandatory forestry certification in the project area (i.e. Kaputa) further abates this risk.
- **The project has slow progress:** The long distance and bad road conditions to reach the rural areas, where the pilot projects are located, can cause slow progress on the pilot facility construction and make facility maintenance and services difficult. As this risk is important to overcome, it can be treated as moderate. To mitigate this risk, the project will anticipate this problem and more carefully plan and schedule the facility construction and services accordingly.
- **Delay in identifying project promoters**

Since national policy is already in place to facilitate private sector participation in the provision of public services, including electricity services, this risk is low. Moreover, development costs related to the contractual agreements in respect of joint ventures will be financed under the present project. This situation will be closely monitored during the project finalisation and implementation.

The private investors, especially those from outside Zambia, may not feel comfortable investing in the country in view of the poor state of the economy. Recent trends in investments in the country counter this risk to a great extent, and UNIDO/UNEP have letters of intent for foreign and national investments and purchases that are more than sufficient to warrant project initiation.

- **The pilot projects impose environmental impact:** The environmental impact assessment carried out during the PDF-B phase at all three sites revealed that implementation of these pilot projects are not expected to cause any environmental concerns. For instance, the mini-hydro pilot project is based on run-of-river design, and hence will have very little or no

impact on the surrounding environment. Also, it has been proposed in the project design to place a rigorous environmental monitoring after the pilot project becomes operational. The biomass pilot project has minimal environmental impact as less than 1.0 % of total forest area in the vicinity will be used to provide biomass needed for the gasification plant, and further no globally significant endemic species (flora and fauna) were identified, which would be adversely affected by the biomass pilot project. However, to further mitigate this risk, the pilot project is designed to supply the biomass by lops and tops of normal operations, new forest plantations on fallow land and use of agriculture residues available in the area. The solar PV pilot project could have environmental impact if the spent batteries are not properly treated and disposed. To mitigate this risk, the pilot project has included an environment management plan for inspection, recycling and disposal of the lead battery storage used. Thus, this risk is considered low.

- **The replication of renewable energy based mini-grids is difficult:** Even though the sustainability of renewable energy use is shown to be high in Section 5.1, there are barriers to the replication, which relate to overall economic situation and policies prevalent in the country. These barriers include the current high interest rate, ZESCO’s uniform low electricity tariff in the country, high unemployment rate, low-income levels in the rural areas and low awareness about the potential value of renewable energy technologies. All these barriers are related to the poor economic state in Zambia. It is the objective of this project to influence policies along with other projects and promote the economic activities in Zambia in the long run, including enhancing job opportunities in the rural areas and consequent increase in their income levels. This risk is considered as moderate, and it will be overcome by implementing a well-defined replication plan.

Table 3
Potential Risks and Mitigation Measures

Risks	Mitigation measures
Low performance	<i>Risk level: Low</i> Proven renewable energy technologies for rural electrification proposed; Continuous, rigorous technical performance monitoring & reporting; Qualified technical advisors are involved at multiple stages; Maintenance contracts will ensure quick rectification of problems.
Role of Regulators to Uphold Renewable Energy Policy Guidelines	<i>Risk level: Low</i> Capacity building activities to focus on building suitable regulatory environment for renewables; Association of ERB officials in the project activities to ensure optimal communication.
Biomass Supply Risks	<i>Risk level: Moderate</i> Long-term supply contracts to be established between the local forestry department and the business model operators to ensure supply of biomass feedstock; Adequate local employment benefits and biomass efficiency improvements; Pre-feasibility study shows that biomass supplies are sufficient to justify investments; A targeted capacity building activity to create the proper business-institutional structure that will sustain the biomass production .
Slow progress	<i>Risk level: Moderate</i> Commitment of the key stakeholders has been obtained; Flexible ownership and purchase agreements would ensure that demonstrations are deployed on time; Local implementing agency involved from inception of project preparation activities; Close monitoring of the project proposed.
Delay in identifying	<i>Risk level: Moderate</i>

project promoters & sponsors	Promoters and sponsors involved at the project design stage; Risk and Replication Management fund mechanism to be put in place to induce investors.
Environmental impact	<i>Risk Level: Low</i> Closely monitoring of the environmental risk factors; Selection of the appropriate renewable technology keeping in view the resource availability; Adoption of a sustainable environment management plan for each pilot site.
Replicability	<i>Risk Level: Moderate</i> Close monitoring of the project proposed; A comprehensive information dissemination thrust proposed both at the national and international level to ensure replicability of business models.

6. STAKEHOLDER PARTICIPATION

6.1 *Key Stakeholders*

182. In this project, a number of key stakeholders and institutions participated during the PDF-B phase activities, and their close involvement was also found to be critical during the implementation of the main phase. Some of the key stakeholders are as follows:

- *Department of Energy, MEWD:* It is the national counterpart agency with overall ownership and responsibility for guiding the implementation of the project at the national level. It will closely coordinate with UNEP and UNIDO for the execution of the project activities.
- *Ministry of Tourism, Environment and Natural Resources:* It is the national operational GEF focal point, endorsing the project.
- *Rural Electrification Authority:* It is the national authority, which has been set up to oversee the implementation of national rural electrification programme. This authority would also promote use of renewable energy resources under the rural electrification programme.
- *ZESCO:* The national electric utility company is the key government implementer for the rural electrification program in Zambia. It has shown willingness to invest in all the three pilot mini-grids singly or jointly with other investors, and has the expertise to assist in the planning, design, and operation of the power distribution system in the mini-grids.
- *Energy Regulation Board:* This regulatory board is interested in seeing the use of renewable energy as a sustainable solution to rural electrification. It will be involved in setting the electricity tariff and incentive programs to favor the use of renewable energy based power generation. It will also be instrumental in specifying the standards/norms to control the quality of renewable energy based equipment and system components.
- *Ministry of Finance and National Planning:* It is responsible for the planning and control of the national budget and expenditure. It has the interest in seeing the use of renewable energy to promote economic activities in the rural areas and to cut back national expenditure on imported diesel fuel.
- *Development Bank of Zambia:* It will administer the RRMF for the pilot projects, and manage the revolving fund to be set up later on to foster more renewable energy based projects in Zambia.
- *Department of Forest, Ministry of Tourism, Environment and Natural Resources:* It will be responsible for the supply of biomass for the biomass gasification pilot project. It will be further involved in the planning of feed supply for future biomass projects.

- *Office for Promoting Private Power Investments (OPPI):* It will be involved in establishing the policy/regulatory framework to sustain the renewable energy based mini-grids and provides assistance to the investors for pursuing this type of project.
- *Financing Institutions and Banks (such as Micro Banker Trusts):* These institutions will be involved in financing renewable energy based projects and will participate in the training to evaluate these projects.
- *Local Administrations in Provinces, Districts, and Townships:* These organizations will be the local facilitators for the renewable energy based projects to benefit their communities. They will provide input in formulating the policy/regulatory framework.
- *ESCO and Other Interested Business Associations (such as Zambia Chamber of Commerce and Industry and National Farmers Union of Zambia), and Investors:* Currently there are a number of ESCOs in Zambia which are either captive power generation companies or have received upfront assistance from some donor agency. They will have keen interest in renewable energy based projects, as these projects will present investment and service opportunities for them. They are also the key players in sustaining and replicating these projects.
- *Research and Training Institutes and Organizations (such as Ministry of Science, Technology and Vocational Training, University of Zambia, School of Engineering, Ministry of Education, CEEZ, NISIR):* These institutes and organizations are the key players in the capacity building of renewable energy based power generation technologies and projects
- *Rural Households and Business Owners:* They will be the major beneficiaries of the renewable energy based mini-grids. Their active participation and favorable reaction is crucial to the success of this project. Most of these stakeholders participated actively at the stakeholders meetings held during the PDF-B phase activities, where they provided their inputs and comments.

6.2 Public Involvement

183. The project team, in close collaboration with local administrations, will ensure active local community and public participation at every stage of the implementation phase, and to enhance local ownership of the project activities. As a start-up activity, the project team will organize “awareness meetings” with the local people to secure their support to the pilot mini-grids, and to explain to them the benefits that would accrue to them from the proposed project. Using the mechanism of national steering committee, local committees and stakeholders group, which were created during the PDF-B phase and comprises of key stakeholders, the project team will reach out to the general public, civil society, women groups and industrial associations to sensitise them about linkages between renewable energy technologies and productive use activities, and opportunities for income generation activities under the project. It is expected that the successful implementation of business models would greatly improve the financial status of participating enterprises, and consequent enhanced employment opportunities in Zambia.

7. IMPLEMENTATION PLAN

7.1. Project Implementation Arrangements

184. For the GEF, UNEP is the Implementing Agency, which will oversee the successful achievement of the project objectives, while UNIDO, as the executing agency will execute the project activities. Department of Energy (DOE) under the Ministry of Energy and Water Development, Government of Zambia is the national counterpart agency with overall ownership and responsibility for guiding the implementation of the project at the national level. It will closely coordinate with UNEP and UNIDO for the timely execution of the project activities. Development Bank of Zambia – a national level financial and banking company to fund developmental projects in Zambia will assist in managing RRMF. UNIDO will set up a Project Management Unit (PMU) expanding the existing national field office to coordinate and execute the project activities. The project staff and experts will

report to PMU on their inputs, which will be headed by a project coordinator. The project coordinator, who will be appointed by UNIDO, shall report to both – DOE and UNIDO for better coordination and timely implementation of the project activities.

185. A Project Steering Committee (PSC) will be set up to oversee the project implementation under the chairmanship of Permanent Secretary (PS), Department of Energy (DOE). The project steering committee would comprise of members drawn from the key Government departments and agencies (including Ministries of Energy and Water Development, Environment, Finance and Industry), REA, ERB, local administration, financial community, public utility, civil society and the private sector. Department of Energy (DOE) would approve and notify the PSC, which among other things, would also advise on inter-ministerial coordination and cooperation, besides serving as a platform for sharing information on the project's progress. At the end of the project, this committee will also decide on the follow-up action. A small group comprising of DOE, DBZ and UNIDO/UNEP would serve as the decision making body (advisory committee) for the RRMF being proposed under the project, and subsequent setting up of revolving fund.

186. An Advisory Expert Group (AEG) comprising of experts and other key stakeholders including local administration, NGOs and local industrial organizations will be set up, which will be responsible for the replication and coordination of the project activities. The AEG will facilitate public participation in the implementation phase, and would ensure local ownership of the project through information dissemination on regular basis. The AEG will also ensure that all key decisions on location of various facilities under the proposed project are taken after taking into account inputs provided by the public representatives, NGOs and local industrial associations. The AEG will assist PSC at every stage including mainstreaming gender issues into the project activities by involving women groups in decision-making processes at every stage.

187. Implementation of the project activities would require close monitoring and rigorous evaluation to meet the key objectives. The Project Management Unit will coordinate the project activities and monitor indicators in Zambia for the sustainability and replicability of the project outputs beyond its life. A close supervision and monitoring of indicators for outputs and outcomes will be undertaken jointly by the Department of Energy (DOE) and UNIDO through the project management unit (PMU) to establish global and local benefits accrued from the project.

188. UNEP will review UNIDO project monitoring reports, and as necessary join the Steering Committee meetings. Further details on the monitoring, evaluation and reporting along with the proposed management structure are given at Annex H. DOE, UNEP and UNIDO will jointly execute dissemination in the country as well as in the region.

7.2 Project Schedule

189. The project is expected to start in the fourth quarter of 2005, and complete by the 2010 with a total duration of 5 years.

190. The pilot mini-grids will take two years to design, procure, construct, and start up. They will then be operated for 3 years. The sustainability activities, including establishing policy/regulatory framework, building national and local capability, and setting up innovative project financing mechanism, will commence when the pilot projects become operational and conclude at the same time when the pilot projects finish with the soft financing.

191. Activity-wise Time Frame is given in Annex 2.

8. INCREMENTAL COSTS AND PROJECT FINANCING

8.1 Incremental Costs

192. This project is designed to remove barriers to the renewable energy technologies based rural electrification in Zambia. In doing so, it would aim at achieving the stated objectives of GEF Operational Program 6 as well as meeting secondary objectives of reducing the risks to the environment. The up-front cost of the proposed alternative is higher than the respective baseline project, i.e. the baseline is diesel generator. A RRM fund to provide for high upfront costs and attract private investments has been proposed for supporting the business models using the GEF funds. This involves the support of a new and innovative funding mechanism to provide interest free loan to ensure the long-term replicability, and to share risks with investors.

193. It is unlikely that the project activities would take place in the absence of GEF, UNEP and UNIDO support. But the life cycle cost analysis shows that pilot projects are more economic than diesel generation over the typical facility life (PV mini-grid will take more time to repay back the loan unless consumers pay higher costs for the services). Other than the GHG reduction, the use of the indigenous renewable energy source will curtail the use of diesel power generation and the harmful emissions from it.

194. The biomass gasification technology was perceived as too risky by ZESCO and MEWD prior to this project. The demonstration of this win-win technology is highly justified. The PV model is different from most PV demonstrations – adopting a mini-grid approach in a clustered community with high willingness to pay for the service. Willingness on the part of consumers to pay for the reliable energy services and possibility of using new LED technologies would make solar mini-grid a viable option where other renewable sources can not be harnessed commercially. The mini-hydro demonstration as public-private partnership model would not go ahead without this project, although the amount of soft finance and technical assistance will be much lower than solar mini-grid.

195. The CO₂ emissions abatement potential calculated on fifteen years of operation at average of 75% capacity factor for mini-hydro and biomass gasification pilot projects and 21% capacity factor for the PV pilot project, comes to about 220,000 tonnes of CO₂ reduction over the expected life period of the mini-grids (20 years for mini-hydro and solar mini-grids and 15 years for biomass mini-grid) as compared to the diesel baseline.

8.2 Global and Local Environmental Benefits

196. The project will focus on renewable energy technologies that will provide global environmental benefits as well as support the role of renewable energy technologies in meeting energy needs of remote rural areas of Zambia. The project would promote commercial or nearly commercial renewable energy technologies that are making a difference in terms of the global environment as well as the local environment, consistent with the goals of global environment conventions.

197. The implementation of this project will yield reduction of CO₂ to the tune of 12500 tonnes²⁹ annually, which would amount to 37,500 tonnes of CO₂ in 3 years and about 220,000 tonnes of CO₂ during life period of all three projects (life cycle analysis of mini-grids). For mini-hydro and solar PV

²⁹ At Kaputa - biomass gasifier based mini-grid (with the generation capacity on an average 75%), the amount of CO₂ saved annually would vary between 5400 to 6900 tonnes. Assuming an average value, the annual CO₂ savings is expected to be 6200 tonnes. At Shiwag'andu hydro mini-grid, based on the seasonal availability of water, it is expected that up to 6.6 million units are generated annually. This would replace 188571 liters of diesel (assumption: 1 liter of diesel emits about 3.2 kg of CO₂), thus saving about 6200 tonnes of CO₂ annually. At Samfya solar mini-grid, for 36 kW and plf of 16-21 %, it sums up to 36 kW x 8760 hours per year x 0.21 (availability) = 66225 kWh. Diesel saved toward these units is 18921 liters, which amounts to CO₂ saved - 18921 x 3.2 = 60549 kg or 60 tonnes. Annual savings of CO₂ from all three-mini-grids would amount to about 12460 or 12500 tonnes.

Total abatement of CO₂ during life period of all three projects (life cycle analysis of solar, hydro and biomass mini-grids) would come to about 220,000 tonnes. For mini-hydro and solar PV mini-grids, life cycle analysis has assumed 20 years of their performance, while for biomass mini-grid, 15 years has been assumed for the analysis.

mini-grids, life cycle analysis can assume 20 years of their performance, and for biomass mini-grid, 15 years can be assumed for the life cycle analysis.

198. ZESCO has already identified 10 diesel mini-grids as eligible for conversion to biomass gasification technology. This represents a concrete immediate replication potential in Zambia alone. The impact of this project in combination with the World Bank project would help in replication of renewable energy based mini-grid projects. Since this WB/GEF project is mainly promoting smaller run of the river mini-grids, the replication impact may be higher as there are minimal or negligible environmental and social concerns associated with such projects. Also in case of biomass gasification technology, replication potential will again be in the range of a factor of ten. Total indirect impact is therefore estimated at 1.8 million tonnes in reduction of CO₂.

199. The project will demonstrate significant additional local benefits in terms of reduced emission of pollutants (NO_x, SO_x, CO, HC, and particulates) dangerous to human health and habitat. One additional benefit of the project would be the reduced import of expensive diesel fuel. This can lead to increased energy independence and reduced foreign currency expenditure for Zambia. The project will also have a positive impact on the economy in the rural areas. It can create more jobs due to the need to harvest and utilize the locally available renewable energy sources. The electricity supplied can promote income-generating activities (such as agro-industries, fishing processing and cold storage and small handicraft units) to increase the living standards in the rural communities. Further, the present use of inefficient processes and techniques to generate charcoal can be further mitigated by using the residue available from the biomass gasification system as a cooking fuel.

8.3 Project financing

200. During the PDF phase, UNIDO and DOE organized consultations both at Lusaka and mini-grids sites to engage private sector investors and companies in business models being proposed under the project. In all, three meetings and consultations were held at Lusaka where about 10 companies including ZESCO participated. During the consultations, few companies and ZESCO showed a keen interest in investing and joining the project, and they were involved in detailed discussions. A brief summary of the key technical and financial parameters of the proposed mini-grids was shared with them to seek their views, and also to explore their continued interest in the project. All the companies and ZESCO have, in-principle, agreed with the technical and financial analysis carried out during the PDF phase, and sent strong letters of interest to participate and invest in the project in part (in one business model) or all business models. These letters have been put on file and shared with the GEF Sec. The GEF will provide assistance equivalent to the incremental cost originated in replacing the baseline case scenario (i.e. replacing generation capacity with fuel oil generators at Kaputa) by a CO₂ reduction scenario (using biomass gasification, solar and small hydro technologies). The incremental cost calculations for the project are based on the economic analysis of each activity and global benefits thereof. The GEF assistance will be used in all those activities that will enable the implementation of the CO₂ reduction activities and remove barriers such as technical assistance, financial, capacity building, training, project management, etc.

201. Technical assistance (TA) is needed for the following activities:

- Assist the government in developing and implementing a legal and policy framework for renewable energy technologies based mini-grids;
- Facilitate early clearance of renewable energy projects proposed by investors by streamlining the process (adopting a single window clearance approach);
- Selection of technology package and transfer biomass and solar how to a broad base of stakeholders (ZESCO already has a cadre of trained people in small hydro technology that would also be used to train private investors);
- Remove environmental barriers to renewable energy technologies and assist in introducing mandatory environmental certification;

- Provide policy planning and project evaluation capacity to the local / national institutions and agencies involved in dissemination of renewable energy technologies and
- Adopt an information dissemination and replicability strategy for mini-grids implemented under the project.

202. TA would, among others, also include business, finance and technical skills for bankers, renewable energy entrepreneurs and personnel working in the renewable energy sector. Training courses will focus on the provision of business tools, training on financial mechanisms to financial intermediaries, and capacity building of major stakeholders in renewable energy technologies – biomass, solar and small hydro energy technologies.

203. A new financial modality (RRM Fund) to provide interest free loan to investors to partially meet their upfront risk costs for undertaking business models is being proposed in the project to address the financial barriers. During the duration of the project, the project management team along with the DBZ will administer the RRM Fund under the overall supervision of the national steering committee, and backstopped by UNIDO.

Risk and Replication Management Fund (RRMF)

204. A risk and replication management fund of US \$ 2.0 million is proposed under the project to cover early project development and operating costs to share risk of new investors. The fund, which essentially will be an interest free loan, would cover a part of the investment component that will be taken as a GEF risk sharing contribution to the private investors. After the pay back period of the respective investment, or when investment has been recovered, the private investor will have to repay the GEF contribution to a revolving fund at the rate that will not affect his capacity to fulfil his obligations with the final payment and it will be possible to start financing replication activities in the shortest possible period of time. The fund is to be set up at the national level as Risk and Replication Management Fund (RRMF) with the DBZ, which has experience in this area. The design of the RRM fund will include legal and contractual measures to avoid inappropriate use of funds or unnecessary losses. On completion of the project, the RRM fund will act as a precursor to a national level renewable energy development fund, and also pay for the pre-feasibility and feasibility studies on a cost-share basis with private developers for new renewable energy projects in the pipeline.

205. At present, national and regional banks and investors are not providing funds for renewable energy projects due to their unfamiliarity with the sector, foreign exchange risk and partially due to the lack of a clear legal and policy framework for investing. Well-prepared projects, using best practices and providing high-quality engineering and financial analysis are more likely to become success stories for the emerging renewable energy markets in Zambia, and would facilitate transfer of skills to consultants and developers. The risk and replication management fund has been proposed to provide interest free loans to attract private investments, and meet a part of upfront costs on the civil construction, technology package and contractual costs on three mini-grids proposed in the project. GEF funds would be directed to the renewable energy technology portion while ZESCO and others will cover the grid system extensions and the development aspects. The RRM Fund and grants of interest free loans to mini-grids will be coordinated by the DBZ under the overall guidance of the national steering committee, and backstopped by UNIDO. A small group comprising of DOE, DBZ and UNIDO/UNEP would be set up to serve as the decision making body (advisory committee) for the RRMF on day to day basis. However, at the end of the project, overall ownership of the funds at the national level will lie with the Department of Energy, Ministry of Energy and Water Development, Government of Zambia.

206. As a part of risk and replication management fund, the development costs covered by the GEF will be capitalized in the total project costs, and will be replenished into a national level revolving fund primarily meant for replication activities, and for carrying out the pre-feasibility and feasibility studies to attract investments on future renewable energy projects in Zambia. In this way, GEF funds will reach more broadly into the market based approach besides reducing the initial risk on

investments. The RRM fund facility will also be used to support development of a pipeline of potential renewable energy projects in Zambia. This initial project identification and screening will be carried out during the implementation phase.

207. A summary of the financial structure of the project is given in Annex 1 A and B. As shown in Annex 1 B, the GEF fund requested is US \$ 2.95 millions. The GEF fund will be split into two – US \$ 2 million to set up Risk and Replication Management Fund (RRMF) which will provide the interest-free loan to assist part financing of the pilot projects, and the remaining US\$ 0.95 million (along with funding from other sources) for establishing policy framework, capacity building, technical assistance, and project management. The interest-free loan will be paid back into a national level revolving fund (RRMF will converted into a national level revolving fund before the end of the project) to finance additional renewable energy based mini-grid projects in the future as part of the replication strategy and plan.

208. UNIDO/UNEP and the Zambia government will contribute US\$0.55 million and US\$1.256 million to the project, respectively. The UNIDO/UNEP funds will be used primarily for the capacity building, innovative financing mechanism, technical assistance and replication. The Zambia Government fund will include US \$ 0.256 million in-kind contribution related to the water rights, land and other logistic support and US \$ 1.0 million in cash spread over 5 years for national level activities including workshops, study trips and support to pilot projects. The investors will invest US\$ 2.75 million to the pilot projects. However, modalities of investor's contribution will be worked out as start up activity under the full phase project because it would depend upon the Government policy on allowing sole ownership versus joint sector approach by the investors as well as scope and kind of association of ZESCO in the pilot projects.

9. MONITORING, EVALUATION & DISSEMINATION

209. The project will follow all standard UNEP, GEF, and UNIDO procedures for monitoring and reporting. UNEP will conduct a mid-term assessment and an end of project assessment. UNIDO and the project management unit (PMU) will closely monitor the indicators for outputs and outcomes to establish global and local benefits accrued from the project. UNEP will review UNIDO's project monitoring reports, and as necessary, join the Project Steering Committee meetings in order to represent to the GEF the status and impact of the project.

210. The Project Steering Committee will be responsible for the general monitoring and supervision of the project implementation. It will provide to UNEP and UNIDO independent assessments of the project progress based on annual reports provided by the PMU, which in turn are prepared based on reports received from experts, contractors and consultants. Based on the assessment of the progress, the Project Steering Committee will make recommendations for adjustments to the work plans.

211. The Project Steering Committee will evaluate the annual progress against the work plans and reports developed by PMU at the start of the project and updated at regular intervals. These will be based on the log frame matrix (see Annex B). At the inception of each activity, a work plan will be established, whereby the sub activities will further monitored on time-bound milestones or indicators. Progress against these milestones will be reported from the PMU to the PSC, UNEP and UNIDO.

212. Each business model will also be annually reviewed against work plans established by the PMU in a similar manner to that described above. These will be developed initially in collaboration with the lead investors to whom business models will be awarded, based on guidelines provided by the PSC. The PMU will review each annual report and work plan and pass it on to the UNIDO, UNEP and PSC with comments as necessary.

213. The lessons to be learned from the project will be disseminated through a wide range of media to a number of targets to ensure that maximum benefit can be gained from the project. This dissemination will be through both mechanisms designed to achieve this and elements that are integral

to the project. Business Models by their very nature are designed to disseminate the lessons learned as far as possible. Where relevant, they will be used as focal points for various projects activities such as the exchange program, and will be proposed as locations for training and awareness workshops and meetings. The progress and results of these activities will be regularly available through hard copy and electronic newsletters. A publication addressing the best practices used and lessons to be learned will also be produced. More generally, newsletters will be provided regular updated on activities at the national and regional level.

214. As well as dissemination outside the project, there will also be mechanism within the project to ensure that lessons learned can be shared across the country. This is especially important in terms of making sure that valuable experience gained can be applied in the rest of the country. The project will be subject to a joint review by UNEP, UNIDO and the Government of Zambia once a year. The national project coordinator shall prepare and submit to each review meeting a progress report highlighting the milestones achieved.

215. Sustainability prospects of business models implemented under the project will be evaluated by UNEP/UNIDO at the project conclusion, by examining the funding situation for continued operation, such as co-financing and revenue generation, commitment of investors and cooperating organizations and demonstration of growing demand for renewable energy technologies based power generation among key stakeholders in Zambia. A close coordination with ongoing national renewable energy projects and programmes as well as with projects of the World Bank and other donors will be ensured in order to complement field activities, support potential synergies and avoid any duplication or overlap. UNEP/UNIDO will participate in the development of the rules for the operation of the RRMF, particularly for the "cost-sharing" and capping of funds for the pre-feasibility studies, and any change in rules and procedures will be reported to GEF as a part of PIR exercise.

216. More details on monitoring and evaluation plan are given at Annex I.

SECTION 3 - WORKPLAN AND TIMETABLE, BUDGET AND FOLLOW-UP

Work plan and Timetable

217. A tentative Work plan and Timetable can be found in **ANNEX 2**.

Budget

218. The project funding will be used to finance the activities mentioned in Section 2. A detailed budget following UNEP format can be found in **ANNEX 1A** of this document. This budget is based upon the GEF approved budget provided in GEF format in **ANNEX 1B**. The total budget proposed for the full phase activities is US\$ 7.506 million with a GEF contribution of US\$ 2.950 million, co-funding amounting to US\$ 500,000 from UNIDO, US\$ 50,000 from UNEP, in-kind/cash contribution in the amount of US\$ 1.256 million from the Zambian Government and US \$ 2.750 million from the private sector.

Follow-Up

219. The follow-up activities will include dissemination of lessons learned and results of the project, documentation of best practices, networking of institutions to strengthen cooperation between institutions for promoting replication of business models, strengthening national as well as regional manufacturing base for renewable technologies and operationalization of national fund to support renewable energy based power generation in Zambia.

SECTION 4 - INSTITUTIONAL FRAMEWORK AND EVALUATION

Institutional Framework

220. All the activities proposed under the project will be completed in a period of 5 years. The implementation of the project will be monitored in accordance with the objectives and activities outlined in Section 2 of this document by the UNIDO Headquarter staff (Energy and Cleaner Production Branch) as well as by the UNIDO Regional Office in South Africa. UNEP as the implementing agency will monitor progress and GEF eligibility as well as integration with regional programs in three renewable technologies. In addition to the UNIDO and UNEP monitoring and evaluation, the national counterpart agency - DOE will have a major role in this monitoring process. This will be beneficial, firstly because of their ownership and overall responsibility for timely implementation of the project activities, and secondly, as a nodal department to guide national energy policies, their knowledge and understanding of national priorities and ground realities will ensure coordination and synergies with other ongoing programmes. It is expected that during implementation, other participating agencies will also join hands as full and firm project partners for effective monitoring of the field activities.
221. The UNEP/DTIE GEF Co-ordination will monitor implementation of the activities undertaken during the execution of the project. The UNEP/DTIE GEF Co-ordination will be responsible for clearance and transmission of financial and progress reports to the Global Environment Facility. UNEP retains responsibility for review and approval of the substantive and technical reports produced in accordance with the schedule of work.
222. Prior to contracts, sub-contracts, or letters of agreement being entered into by UNIDO, UNIDO will submit to DTIE GEF Co-ordination Unit copies of all these documents. Within ten working days, DTIE GEF Co-ordination Unit will review, provide guidance and give UNIDO substantive clearance on the technical content of these contracts, sub-contracts and letters of agreement.
223. All correspondence regarding substantive and technical matters should be addressed to:

At UNIDO:

Dr. Pradeep Monga
Senior Industrial Development Officer
Energy and Cleaner Production Branch
UNIDO, Vienna International Centre
P.O. Box 300, A-1400
Vienna
Austria
Tel: (43-1) 26026 3018
Fax: (43-1) 26026 6855
Email: p.monga@unido.org

At UNEP:

Tom Hamlin
Climate Change Task Manager
UNEP
Tour Mirabeau,
39/43 quai André Citroën
75739 Paris cedex 15
France
Tel: (33 -1)-4437-3003
Fax: (33 -1)-4437- 1474

Email: tom.hamlin@unep.org

With a copy to:

Dr. Cahit Gurkok
Director
Energy and Cleaner Production Branch,
UNIDO, Vienna International Centre
P.O. Box 300
A-1400
Vienna
Austria
Tel: (43-1) 26026 4575
Fax: (43-1) 26026 6855
Email: c.gurkok@unido.org

Mr. Ahmed Djoghlaif
Assistant Executive Director
Division of GEF Coordination, UNEP
P. O. Box 30552
Nairobi, Kenya
Tel: (254-20)-624 165
Fax:- (254-20) 624 041
Email: Ahmed.Djoghlaif@unep.org

224. All correspondence regarding administrative and financial matters should be addressed to:

At UNIDO:

Ms. Amita Misra
Director Finance, UNIDO
Vienna International Centre
P.O. Box 300
A-1400
Vienna, Austria
Tel: (43-1) 26026 3671
Fax: (43-1) 26026 6825
Email: a.misra@unido.org

With a copy to

Mr. A. Noro
Finance Officer, UNIDO
Vienna International Centre
P.O. Box 300
A-1400, Vienna, Austria
Tel: (43-1) 26026 3978
Fax: (43-1) 26026 6825
Email: a.noro@unido.org

At UNEP

Mr. David Hastie

Chief
Budget and Financial Management Service (BFMS)
UNEP
P.O. Box 30552
Nairobi, Kenya
Tel: (254-20) 623 821
Fax: (254-20) 623 755

With a copy to:

Ms. Elaine King
Fund Management Officer
Division of GEF Coordination, UNEP
P.O. Box 30552
Nairobi, Kenya
Tel: (254-20) 624 605
Fax:(254-20) 623 162/624 041/624 042
Email: Elaine.King@unep.org

Evaluation

225. Standard evaluation of the project will be carried out according to the well established GEF Evaluation Procedures and Guidelines.
226. Because of the complex nature of ascertaining the different socio-economic benefits of this project and innovative approach being adopted to implement mini-grids, business models and new financial mechanisms in Zambia, a number of additional methods of evaluation will be employed to gauge the effect of mini-grids and their impact on replication potential in the region. While the Department of Energy as the national counterpart agency will be involved closely for overall monitoring of the project activities, Rural Electrification Authority will be associated particularly to evaluate the impact of the mini-grids on rural development. In terms of the biomass based power generation, Ministry of Forestry will conduct inbuilt and continuous monitoring and evaluation of the sustainability of biomass supply. The Ministry of Tourism, Environment and Natural Resources - National Focal Point for GEF matters in Zambia and the Ministry of Finance and National Planning, which oversees all aspects of international technical assistance and cooperation initiatives, will also conduct regular monitoring and evaluation of the project activities. All monitoring and evaluation procedures will be coordinated between the different stakeholders in an open forum manner. Furthermore, many of the cooperating institutions and partner agencies are expected to be involved in the M&E process to different degree.
227. Every year, UNEP Division of GEF Coordination will undertake a desk evaluation using the format given in **ANNEX 7**, to measure the degree to which the objectives of the project have been achieved. This will be in addition to the standard mid-term and final evaluations of the project per UNEP procedures as outlined in Section 2 paragraph 228 as well as supervision missions conducted by the UNEP Task Manager.

SECTION 5 - MONITORING AND REPORTING

Management Reports

Progress Reports

228. Within 30 days of the end of the reporting period, UNIDO will submit to UNEP, with a copy to Division of GEF Coordination, using the format given in **ANNEX 5A**, half-yearly progress reports as at 30 June and 31 December.
229. The Inventory of Outputs/Services should be submitted with all Progress Reports and the Terminal Report. The report is due within 30 days of the end of each half-yearly period when submitted with a Progress Report or within 60 days of the completion of a project when submitted with a Terminal Report. The format of the report is given in **ANNEX 5B**.

Terminal Reports

230. Within 60 days of the completion of the project, UNIDO will submit to UNEP, with a copy to UNEP/DGEF Coordination, a Terminal Report detailing the activities taken under the project, lessons learned and any recommendations to improve the efficiency of similar activities in the future, using the format provided in **ANNEX 6**.

Substantive Reports

231. At the appropriate time, UNIDO will submit to UNEP three copies in draft of any substantive project report(s) and, at the same time, inform UNEP of its plans for publication of that report(s). UNEP will give UNIDO substantive clearance of the manuscript, indicating any suggestions for change and such wording (recognition, disclaimer, etc.) as it would wish to see figure in the preliminary pages or in the introductory texts.
232. It will equally consider the publishing proposal of UNIDO and will make comments thereon as advisable. It may request UNIDO to consider publication on a joint imprint basis. Should UNIDO be solely responsible for publishing arrangements, UNEP will, nevertheless, receive 10 free copies of the published work in each of the agreed languages, for its own purposes.

Financial Reports

233. UNIDO shall submit to UNEP quarterly project expenditure accounts and final accounts for each project, showing amount budgeted for the year, amount expended since the beginning of the year, and, separately, the unliquidated obligations as follows:
 - (i) Details of project expenditures on an activity-by-activity basis, reported in line with project budget codes as set out in the project document, as at 31 March, 30 June, 30 September and 31 December each year, providing details of unliquidated obligations separately (see formats in **ANNEX 4A** and **ANNEX 4B**). The expenditure accounts will be dispatched to UNEP within 30 days after the end of the quarter to which they refer.
 - (ii) The expenditure account as at 31 December is to be received by UNEP by 31 March each year.
 - (iii) A final statement of account, in line with UNEP project budget codes, reflecting actual final expenditures under the project, when all obligations have been liquidated.

234. Within 30 days of the reporting period, UNIDO shall submit to UNEP GEF Coordination Office, a cofinancing report for the project as at 30 June and 31 December, using the format provided in **ANNEX 1C** showing:

- (a) Amount of cofinancing realized compared to the amount of cofinancing committed to at the time of project approval, and
 - (b) Cofinancing reporting by source and by type.
- ◆ Sources include the agency's own cofinancing, government cofinance (counterpart commitments), and contributions mobilized for the project from other multilateral agencies, bilateral development cooperation agencies, NGOs, the private sector, and beneficiaries.
 - ◆ Types of cofinance. Cash includes grants, loans, credits and equity investments. In-kind resources are required to be:
 - dedicated uniquely to the GEF project,
 - valued as the lesser of the cost and the market value of the required inputs they provide for the project, and
 - monitored with documentation available for any evaluation or project audit.

Terms and Conditions

Non-expendable equipment

235. UNIDO will maintain records of non-expendable equipment (items costing US\$1,500 or more as well as items of attraction such as pocket calculators, cameras, computers, printers, etc.) purchased with UNEP funds (or with trust funds or counterpart funds administered by UNEP). UNIDO will submit an inventory of such equipment to UNEP, indicating description, serial no., date of purchase, original cost, present condition, location of each item attached to the half yearly progress reports, using the format in **ANNEX 5C**.

236. Within 60 days of completion of the project, UNIDO will submit to UNEP a final inventory of all non-expendable equipment purchased under the project indicating description, serial number, original cost, present condition, location and a proposal for the disposal of the said equipment. Non-expendable equipment purchased with funds administered by UNEP remains the property of UNEP until its disposal is authorized by UNEP, in consultation with UNIDO. UNIDO shall be responsible for any loss or damage to equipment purchased with UNEP administered funds. The proceeds from the sale of equipment (duly authorized by UNEP) shall be credited to the accounts of UNEP, or to the appropriate trust fund or counterpart fund.

Responsibility for Cost Overruns

237. UNIDO is authorized into commitments or incur expenditures up to a maximum of 20 percent over and above the annual amount foreseen in the project budget under any budget sub-line, provided the total cost of the UNEP annual contribution is not exceeded. This may be done without prior authorization, but once the need for these additional funds becomes apparent, a revised budget request should be submitted to UNEP immediately. Cost overruns are the responsibility of UNIDO unless a revised budget has been agreed with UNEP.

238. Any cost overrun (expenditure in excess of the budgeted amount) on a specific budget sub-line over and above the 20 per cent flexibility mentioned above should be met by UNIDO, which originally assumed responsibility for authorizing the expenditure, unless a revision has been agreed to by UNEP prior to the authorization to cover it. Savings in one budget sub-line may not be applied to overruns of 20 percent in other sub-lines, even if the total cost to UNEP

remains unchanged, unless this is specifically authorized by UNEP upon presentation of the request. In such a case, a revision to the project document amending the budget will be issued by UNEP.

Claims by Third Parties against UNEP

239. UNIDO shall be responsible for dealing with any claims which may be brought by third parties against UNEP and its staff, and shall indemnify UNEP and its staff against any claims or liabilities resulting from operations carried out by UNIDO under this project document, except where such claims and liabilities arise from negligence or misconduct of the staff of UNEP.

Cash Advance Requirements

240. An initial cash advance of US\$ 500 000 will be made upon signature of the project document by both parties and will cover expenditures expected to be incurred by UNIDO during the first three months of the project implementation. Subsequent advances are to be made quarterly, subject to:
- (i) Confirmation by UNIDO at least two weeks before the payment is due, that the expected rate of expenditure and actual cash position necessitate the payment, including a reasonable amount to cover "lead time" for the next remittance; (see format of request in **ANNEX 3**) and
 - (ii) The presentation of:
 - A satisfactory financial report showing expenditures incurred for the past quarter, (see format in **ANNEX 4A**) under each project activity and
 - Timely and satisfactory progress reports on project implementation.

Publications

241. For publications issued with UNIDO, both the cover and the title page of the publication will carry the logo of UNEP and the title United Nations Environment Programme together with that of UNIDO. UNIDO will submit three copies of any manuscript prepared under the project for clearance prior to their publication in final form. UNEP's views on the publication and any suggestions for amendments of wording will be conveyed expeditiously to the agency, with an indication of any disclaimer or recognition which UNEP might wish to see appear in the publication.

Amendments

242. The Parties to this project document shall approve any modification or change to this project document in writing.

Terrorism Finance Provisions

243. The United Nations Security Council Resolution 1373 of 28 September 2001 on the fight against terrorism shall be adhered to by the Executing Agency, failure to which shall without prejudice to other legal actions, lead to the immediate cancellation of the project.

ANNEX 1A BUDGET IN UNEP FORMAT

	Total		Oct-05		2006		2007		2008		2009		Sep-10	
	W/M	US\$	W/M	US\$	W/M	US\$	W/M	US\$	W/M	US\$	W/M	US\$	W/M	US\$
10 PROJECT PERSONNEL														
1100 National Consultants														
1101 Project Coordinator (1)	60	120,000	3	6,000	12	24,000	12	24,000	12	24,000	12	24,000	9	18,000
1102 Technology Experts	16	32,000	2	4,000	4	8,000	4	8,000	2	4,000	2	4,000	2	4,000
1199 Sub-Total	76	152,000	5	10,000	16	32,000	16	32,000	14	28,000	14	28,000	11	22,000
1200 International Experts														
1201 International Experts	8	112,000	1	14,000	2	28,000	2	28,000	1	14,000	1	14,000	1	14,000
1299 Sub-Total	8	112,000	1	14,000	2	28,000	2	28,000	1	14,000	1	14,000	1	14,000
1300 Administrative Support														
1301 Project Assistant (1)	60	33,000	3	3,000	12	6,000	12	6,000	12	6,000	12	6,000	9	6,000
1399 Sub-Total	60	33,000	6	3,000	12	6,000	12	6,000	12	6,000	12	6,000	12	6,000
1600 Project Travel														
1601 Project Travel		70,000		5,000		15,000		15,000		15,000		15,000		5,000
1602 UNIDO Mission		40,000		4,000		8,000		8,000		8,000		8,000		4,000
1699 Sub-Total		110,000		9,000		23,000		23,000		23,000		23,000		9,000
1990 Component Total		407,000		36,000		89,000		89,000		71,000		71,000		51,000
20 SUB-CONTRACTS														
2200 Subcontracts														
2201 DBZ		2,000,000		0		1,000,000		1,000,000		0		0		0
2202 Unspecified		100,000		10,000		20,000		20,000		20,000		20,000		10,000

2299	Sub-Total		2,100,000	10,000	1,020,000	1,020,000	20,000	20,000	10,000
2999	Component Total		2,100,000	10,000	1,020,000	1,020,000	20,000	20,000	10,000
30	TRAINING COMPONENT								
3200	Study Tours								
3201	Study Tours		50,000	5,000	20,000	20,000	5,000	0	0
3299	Sub-Total		50,000	5,000	20,000	20,000	5,000	0	0
3300	In-service Training								
3301	Meeting/Workshops		50,000	5,000	20,000	10,000	5,000	5,000	5,000
3399	Sub-Total		50,000	5,000	20,000	10,000	5,000	5,000	5,000
3999	Component Total		100,000	10,000	40,000	30,000	10,000	5,000	5,000
40	EQUIPMENT AND PREMISES								
4100	Expendable Equipment								
4101	Office supplies		30,000	5,000	5,000	5,000	5,000	5,000	5,000
4102	Library Acquisitions		2,000	0	1,000	1,000	0	0	0
4103	Computer Software		5,000	2,000	2,000	1,000	0	0	0
4120	Unspecified		6,000	1,000	1,000	1,000	1,000	1,000	1,000
4199	Sub-Total		43,000	8,000	9,000	8,000	6,000	6,000	6,000
4200	Non-expendable equipment								
4201	Computer Hardware		14,000	2,000	4,000	2,000	2,000	2,000	2,000
4202	Office Equipment		29,000	20,000	2,000	2,000	2,000	2,000	1,000
4220	Unspecified		6,000	1,000	1,000	1,000	1,000	1,000	1,000

4299	Sub-Total		49,000	23,000	7,000	5,000	5,000	5,000	4,000
4300	Premises rent								
4301	Office Rental		27,500	2,500	5,000	5,000	5,000	5,000	5,000
4302	Maintenance of premises		11,000	1,000	2,000	2,000	2,000	2,000	2,000
4399	Sub-Total		38,500	3,500	7,000	7,000	7,000	7,000	7,000
4999	Component Total		130,500	34,500	23,000	20,000	18,000	18,000	17,000
50	MISCELLANEOUS								
5100	Operation and maintenance of equipment								
5101	Rental and maintenance of computer equipment		11,000	1,000	2,000	2,000	2,000	2,000	2,000
5199	Sub-Total		11,000	1,000	2,000	2,000	2,000	2,000	2,000
5200	Reporting Costs								
5202	Brochures, Pamphlets, Newsletter		16,397	3000	3,000	3,000	3,000	3,000	1,397
5203	Website		3,000	500	500	500	500	500	500
5204	Unspecified		6,000	1,000	1,000	1,000	1,000	1,000	1,000
5299	Sub-Total		25,397	4,500	4,500	4,500	4,500	4,500	2,897
5300	Sundry								
5301	Communications (telex, phone, fax)		33,000	3,000	6,000	6,000	6,000	6,000	6,000
5303	Support Cost		140,353	4,813	59,238	58,588	6,588	6,338	4,788
5399	Sub-Total		173,353	7,813	65,238	64,588	12,588	12,338	10,788

5400	Hospitality													
5401	Hospitality		2,750		250		500		500		500		500	500
5499	Sub-Total		2,750		250		500		500		500		500	500
5999	Component Total		212,500		13,563		72,238		71,588		19,588		19,338	16,185
9999	Grand Total	144	2,950,000	12	104,063	30	1,244,238	30	1,230,588	27	138,588	27	133,338	24

ANNEX 1B

BUDGET BY PROJECT COMPONENT ACTIVITY Summary of financial structure of the project (in Million US \$)

	Total Cost (million USD)	Zambian Government contribution	GEF contribution	UNEP / UNIDO**	Private investment
Activity 1. Designing an institutional, policy and regulatory framework to provide enabling environment to the development of RE based mini-grids	0.206	0.056*	0.025	0.125	0.000
Activity 2. Building local and national capacity to utilize the commercial potential of renewable energy technologies	1.276	0.675	0.326	0.275	0.000
Activity 3. Setting up appropriate financial mechanisms and structures to encourage private sector investment in RE based mini-grids projects	2.300	0.250	2.000 ***	0.050	0.000
Activity 4. Implementation of business models to demonstrate commercial feasibility of RE based mini-grids for electricity generation and productive use	3.096	0.250 ****	0.046	0.050	2.750 *****
Activity 5. Establishment of project management structures for coordination, monitoring and dissemination of results from the project	0.628	0.025	0.553	0.050 *****	0.000
TOTAL	7.506	1.256	2.950	0.550	2.750

* Government of Zambia's in-kind contribution as diverted effort to put a policy framework in place for promoting renewable energy technologies.

** UNIDO in-kind/cash contribution (US \$ 500,000) for activities such as capacity building, study trips and training workshops.

*** GEF funding to set up a RRMF, and to meet costs on capacity building of financial institutions on financial appraisals, contractual obligations and modalities for a revolving fund.

**** Government of Zambia's in-kind contribution to meet costs on land, building and related infrastructure including providing logistics support to the project team and experts.

***** Consultations held with private investors and companies during the PDF-B phase yielded documented results (letters of intent to bid on file).

***** UNEP in-kind contribution (US \$ 50,000) for information dissemination and replication efforts in Africa.

ANNEX 1C

UNEP/GEF REPORT ON PLANNED PROJECT COFINANCE AND ACTUAL COFINANCE RECEIVED
(report required as at 30 June and 31 December during project execution)

Title of Project:	Renewable Energy Based Electricity Generation for Isolated Mini-Grids in Zambia						
Project Number:							
Name of Executing Agency:	UNIDO						
Project Duration:	From: October 2005			To: September 2010			
Reporting Period:	From:			To:			
Source of Cofinance	Cash Contributions			In-kind Contributions			Comments
	Budget original	Budget latest revision	Received to date	Budget original	Budget latest revision	Received to date	Received to date
UNIDO							
UNEP							
Government of Zambia							
Investors							
Additional Cofinance:-							
Total	0	0	0	0	0	0	
							<i>All amounts in US dollars</i>
Name:	Tom Hamlin						
Position:	Task Manager						
Date:							

ANNEX 2 TIME TABLE AND WORKPLAN

ACTIVITIES		2005 Oct.	2006	2007	2008	2009	2010 Sept.
1. Designing and establishing an institutional, policy and legal framework							
1.1	Review of national policies and legal provisions on renewable energy based rural electrification undertaken and gap areas defined.	→					
1.2	Process initiated to integrate renewable energy planning within national energy planning made operational. A renewable energy cell is set up in DOE.		→				
1.3	National quality assurance standards on renewable energy based mini-grids performance and evaluation benchmarks set up and widely disseminated.		→				
1.4	Guidelines on environment impact assessment of renewable energy based mini-grids projects formulated and disseminated.		→				
2. Building national and local capacities to promote renewable energy based mini-grids							
2.1	Main stakeholders are trained on renewable based mini-grids design, management and benchmarking.	→					
2.2	Experts and planner are trained to manage the technical and financial services, and implement the replication strategy.		→				
2.3	National manufacturing capacities strengthened to manufacture, assemble and maintain the renewable energy based mini-grids, and reduction in costs of renewable energy technologies.		→				
2.4	Capacity of financial institutions and banks built to evaluate and appraise renewable energy based mini-grids projects.		→				

3. Planning and setting up financial mechanisms and structures to attract private sector investment in renewable energy based mini-grids projects	
3.1	RRMF is set up to attract investment in business models on renewable energy based mini-grids.
3.2	Methodology and procedures agreed and implemented for the use of revolving fund for future renewable energy based mini-grids projects.
3.3	Capacity of national banks and financial institutions is built to manage RRMF and investments funds for renewable energy project.
4. Implementing renewable energy based mini-grids to demonstrate business models	
4.1	Installation and implementation of three pilot renewable energy based mini-grids projects.
4.2	Training imparted on the operational and management issues to business models operators.
4.3	Linkages established with productive use and income generation activities in the project area.
4.4	Close supervision of performance of business units conducted and corrective steps taken on regular basis
5. Establishing project management structures for implementation, coordination and monitoring of the project activities and dissemination of results.	
5.1	Project team selected and management structure agreed with the national counterparts.

5.2	Capacity building and training of the key stakeholders – technical experts, planners, investors and experts achieved.	
5.3	An effective replication strategy and a comprehensive information dissemination programme are developed and implemented.	
5.4	Lessons learned and results disseminated to a wider audience and a regional network created.	
5.5	Monitoring and close supervision of project operations undertaken and corrective steps taken, wherever needed.	

ANNEX 3

FORMAT FOR CASH ADVANCE STATEMENT

Statement of cash advance as at
And cash requirements for the quarter of

Name of Cooperating agency/
Supporting organization _____
Project No. _____
Project title _____

I. **Cash statement**
1. Opening cash balance as at US\$ _____
2. Add: cash advances received:

Date	Amount
.....
.....
.....
.....

3. Total cash advanced to date US\$ _____
4. Less: total cumulative expenditures incurred US\$ (_____)
5. Closing cash balance as at US\$ _____

II. **Cash requirements forecast**
6. Estimated disbursements for quarter
ending US\$ _____
7. Less: closing cash balance (see item 5, above) US\$ (_____)
8. Total cash requirements for the quarter US\$ _____

Prepared by _____ Request approved by _____
Duly authorized official of Cooperating agency/
Supporting organization

ANNEX 4A

FORMAT OF QUARTERLY PROJECT EXPENDITURE

Quarterly project statement of allocation (budget), expenditure and balance (Expressed in US\$) covering the period.....to.

Project No. **Agency Name**

Project title:

Project commencing:(date) **Project ending:**(date)

Object of expenditure by UNEP budget Code	Project budget allocation for year.....		Total expenditure for quarter	Total unliquidated obligations*	Cumulative expenditure for year	Unspent balance of budget allocation for year.	
	m/m (1)	Amount (2)	(3)	(4)	m/m (5)	m/m (6)	Amount (2)-(5)
10 PROJECT PERSONNEL							
1101 Project Coordinator							
1102 Technology Expert							
1199 Sub-total							
1201 International Expert							
1299 Sub-total							
1301 Project Assistant							
1399 Sub-total							
1601 UNIDO staff							
1681 UNEP staff							
1699 Sub-Total							
1999 Component Total							
20.SUBCONTRACTS							
2201 DBZ							
2202 Unspecified							
2299 Sub-total							
2999 Component Total							
30.TRAINING COMPONENT							
3201 Study Tours							
3299 Sub-total							

3301 Meetings/Workshops							
3399 Sub-total							
3999 Component Total							
40.EQUIPMENT & PREMISES							
4101 Office supplies							
4102 Library acquisitions							
4103 Computer software							
4120 Unspecified							
4199 Sub-total							
4201 Computer hardware							
4202 Office equipment							
4220 Unspecified							
4299 Sub-total							
4301 Office rental							
4302 Maintenance of premises							
4399 Sub-total							
4999 Component Total							
50.MISCELLANEOUS							
5101 Rental/Maint computer equip							
5199 Sub-total							
5202 Borchures,pamphlets,newsltr							
5203 Website							
5204 Unspecified							
5299 Sub-total							
5301 Communications							
5399 Sub-total							
5401 Hospitality							
5499 Sub-total							
5999 Component Total							
99 GRAND TOTAL							

*See breakdown of unliquidated obligations, by object of expenditure attached as **ANNEX 4B** Signed: _____

Duly authorized official

NB: The expenditure should be reported in line with the specific object of expenditures as per project budget

ANNEX 4B

FORMAT OF QUARTERLY FINANCIAL REPORTING ON UNLIQUIDATED OBLIGATIONS

Project No. _____

Agency Name:

Unliquidated obligations
during _____
(period covered)

Expressed in US\$

UNEP allocation	1100	1200	1300	1600	2200	3200	3300	4100	4200	4300	5200	5300	Total 99
TOTAL													

NB: The unliquidated obligations should be reported in line with the specific object of expenditures as per project budget

ANNEX 5A

FORMAT FOR HALF YEARLY PROGRESS REPORT TO UNEP
As at 30 June and 31 December
(Please attach a current Inventory of Outputs/Services and
Inventory of Non-Expendable Equipment when submitting this report)

1. Background Information

1.1 Project Number:

1.2 Project Title:

1.3 Division/Unit:

1.4 Coordinating Agency or Supporting Organization (if relevant):

1.5 Reporting Period (the six months covered by this report):

1.6 Relevant UNEP Programme of Work (2002-2003) Subprogramme No:

1.7 Staffing Details of Cooperating Agency/ Supporting Organization (Applies to personnel / experts/ consultants paid by the project budget):

Functional Title	Nationality	Object of Expenditure (1101, 1102, 1201, 1301 etc..)

1.8 Sub-Contracts (if relevant):

Name and Address of the Sub-Contractee	Object of Expenditure (2101, 2201, 2301 etc..)

2. Project Status

2.1 Information on the delivery of outputs/services

	Output/Service (as listed in the approved project document)	Status (Complete/Ongoing)	Description of work undertaken during the reporting period	Description of problems encountered; Issues that need to be addressed; Decisions/Actions to be taken
1.				
2.				
3.				

2.2 If the project is not on track, provide reasons and details of remedial action to be taken:

3. Discussion acknowledgment

Project Coordinator's General Comments/Observations	First Supervising Officer's General Comments
<p style="text-align: center;">Name: _____</p> <p style="text-align: center;">Date: _____</p> <p style="text-align: center;">Signature: _____</p>	<p style="text-align: center;">Name: _____</p> <p style="text-align: center;">Date: _____</p> <p style="text-align: center;">Signature: _____</p>

ANNEX 5B
ATTACHMENT TO HALF-YEARLY PROGRESS REPORT
FORMAT FOR INVENTORY OF OUTPUTS/SERVICES

a) Meetings (UNEP - convened meetings only)

No	Meeting Type ⁴	Title	Venue	Dates	Convened by	Organized by	# of Participants	List attached Yes/No	Report issued as doc no	Language	Dated
1.											
2.											
3.											

List of Meeting Participants

Name of the Participants	Nationality
1.	
2.	

b) Printed Materials

No	Type ⁵	Title	Author(s)/Editor(s)	Publisher	Symbol	Publication Date	Distribution List Attached Yes/No
1.							
2.							
3.							

⁴ Meeting types (Inter-governmental Meeting, Expert Group Meeting, Training Workshop/Seminar, Other)

⁵ Material types (Report to Inter-governmental Meeting, Technical Publication, Technical Report, Other)

c) Technical Information / Public Information

No	Description	Date
1.		
2.		
3.		

d) Technical Cooperation

No	Type ⁶	Purpose	Venue	Duration	For Grants and Fellowships		
					Beneficiaries	Countries/Nationalities	Cost (in US\$)
1.							
2.							

e) Other Outputs/Services (e.g. Networking, Query-response, Participation in meetings etc.)

No	Description	Date
1.		
2.		
3.		

⁶ Technical Cooperation Type (Grants and Fellowships, Advisory Services, Staff Mission, Others)

Annex 5C

**Attachment to Half Yearly Progress Report
 FORMAT OF INVENTORY OF NON-EXPENDABLE EQUIPMENT
 UNIT VALUE US\$1,500 AND ABOVE AND ITEMS OF ATTRACTION**

Project title:.....

Implementing Agency

Internal/SO/CA (UNEP use only).....

FPMO (UNEP use only).....

Description	Serial No.	Date of Purchase	Original Price US\$	Present Condition	Location	Remarks Recommendation for disposal

The physical verification of the items(s) above was done by: Name

(Duly authorized official)

Title:

Signature:

Date:

ANNEX 6

FORMAT FOR TERMINAL REPORT (For External Projects only)

<i>1. Background Information</i>	
1.1	Project Number
1.2	Project Title
1.3	UNEP Division/Unit
1.4	Implementing Organization
<i>2. Project Implementation Details</i>	
2.1	Project Needs and Results (Re-State the needs and results of the project)
2.2	Project Activities (Describe the activities actually undertaken under the project, giving reasons why some activities were not undertaken, if any)
2.3	Project Outputs (Compare the outputs generated with the ones listed in the project document)
2.4	Use of Outputs (State the use made of the outputs)
2.5	Degree of achievement of the objectives/results (<i>On the basis of facts obtained during the follow-up phase, describe how the project document outputs and their use were or were not instrumental in realizing the objectives / results of the project</i>)
2.6	Determine the degree to which project contributes to the advancement of women in Environmental Management and describe gender sensitive activities carried out by the project.
2.7	Describe how the project has assisted the partner in sustained activities after project completion.
<i>3. Conclusions</i>	
3.1	Lessons Learned (Enumerate the lessons learned during the project's execution. Concentrate on the management of the project, including the principal factors which determined success or failure in meeting the objectives set down in the project document)
3.2	Recommendations (Make recommendations to (a) Improve the effect and impact of similar projects in the future and (b) Indicate what further action might be needed to meet the project objectives / results)

4. Attachments

4.1	Attach an inventory of all non-expendable equipment (value over US\$ 1,500) purchased under this project indicating Date of Purchase, Description, Serial Number, Quantity, Cost, Location and Present Condition, together with your proposal for the disposal of the said equipment
4.2	Attach a final Inventory of all Outputs/Services produced through this project

Annex 7
FORMAT FOR SELF-EVALUATION FACT SHEET

(To be completed by UNEP Task Manager and approved by Executing Agency)

- 1. Project Title:**
- 2. Project Number:** (include number of latest revision)
- 3. UNEP Programme of Work Component Number: (3 digits), or Relevant UNEP Programme of Work (2004-2005) Subprogramme Number and Specific Objective Number**
Include a statement of how effective the project has been in attaining this component/objective and its contribution to overall Subprogramme implementation.
- 4. Performance Indicators:**
UNEP Programme of Work: {State the relevant Performance Indicators (with the Quantity figure) from the Programme of Work, and compare against actual results}
- 5. Scope:**
- 6. Implementation:**
- 7. Duration:**
 - (a) Initial {(as indicated in the original project document). List day/month/year of start and end of project. List project duration in terms of total months}.
 - (b) Actual {(as indicated in the latest project revision). List day/month/year of start and end of the project. List project duration in terms of total months}.
 - (c) Reasons for the variance {when there is a difference between the initial and actual duration, list the consecutive project revisions (number and date of approval), and summarize justification for each revision}.
 - (d) List day/month/year of start of current year Work plan.
 - (e) List day/month/year end of current Work plan.
- 8. Cost:**
 - (a) Initial {(as indicated in the project document). List the total project cost (UNEP and "Others") and give breakdown by funding source. Give actual figures and contribution in terms of percentages}.
 - (b) Actual {(as indicated in the latest project revision). List the total project cost (UNEP and "Others") and give breakdown by funding source. Give actual figures and contribution in terms of percentages}.
 - (c) Reasons for the variance {(When there is a difference between the initial and actual cost, list the consecutive project revisions (number and date of approval) involved in amending the project costs. List any other reasons for discrepancy}.
 - (d) Relate expenditure to achievement of outputs (e.g. 100% expenditure and 82% output completion).
 - (e) Relate expenditure to achievement of outputs to date against overall project Work plan.
- 9. Project status at the time of evaluation:**
- 10. Needs:**
 - (a) Identified needs (as indicated in the original project document).
 - (b) Satisfied/realized needs (List needs fulfilled due to implementation of the project).

- 11. Results:**
- (a) Expected Results (as indicated in the original project document).
 - (b) Actual Results (indicate actual results achieved/attained from project implementation) during current year.
 - (c) Actual results to date against overall project work plan.
 - (d) Reasons for the variance (state the reasons for the difference between expected and actual results).
 - (e) State corrective action(s) to be taken.

- 12. Outputs:**
- (a) Expected Outputs (as indicated in the original project document).
 - (b) Actual Outputs (List actual outputs resulting from project implementation emphasizing activities undertaken during current year)
 - (c) Reasons for the variance (state reasons for the difference between expected and actual outputs) during current year.
 - (d) Actual outputs to date against overall project work plan.
 - (e) State corrective action(s) to be taken.

- 13. What are UNEP's substantive inputs to the project?**
(Do not repeat UNEP's financial contribution).

- 14. What are the catalytic effects of the project on other agencies or governments?**
- (a) Intellectual:
 - (b) Financial

15. On Gender - describe

- (a) Project's contribution to the advancement of women with regard to their participation in ecosystem related provisions of Agenda 21, Chapter 24.
- (b) Sensitive activities carried out by the project, for example: level of participation in decision making process in the planning and development and implementation of the project and women's participation in capacity-building and awareness activities.

16. On Sustainability

Describe sustainability of the project in terms of: enabling environment (e.g. national or regional legislation and policies); institutional capacity (human resource and planning and management systems); and financial sustainability (reliability of funding sources).

17. Describe the problems encountered during project implementation:

<u>Problems:</u>	<u>Causes:</u>	<u>Consequences:</u>
(a) Substantial/Programmatic		
(b) Institutional		
(c) Financial		

18. Lessons learned from the achievement and/or weaknesses of the project:

19. Further follow-up action required:

- (a) Action Required:
- (b) Responsible unit(s):
- (c) Schedule:

20. Evaluated by:

Name and position of Evaluator:

Date: _____

Noted by:

Cooperating Agency/Supporting Representative:

Date: _____

21. Approved by:

Name of Programme Manager/Regional Director

Date: _____

ANNEX 11

RISK AND REPLICATION MANAGEMENT FUND

Based on detailed discussions and consultations held with the key stakeholders (DOE and DBZ), overall legal and financial parameters and experience gained as well as lessons learned in similar projects in other countries, tentative operational modalities of the Risk and Replication Management Fund (RRMF) will be as follows:

The Risk and Replication Management Fund (RRMF) will be set up at Development Bank of Zambia (DBZ), whose main mission is to effectively mobilize short, medium and long term financial resources required for development in the country. It has requisite expertise and experience in setting up funds targeted at supporting enterprises in core economic sectors and related infrastructure including power. DBZ is a Development Finance Institution (DFI) established in the early 1970s by an Act of Parliament, as a joint venture between the Government of the Republic of Zambia (GRZ), Public Sector Financial Institutions, on one hand, local private sector and foreign bilateral and multilateral institutions, on the other. DBZ has played a pivotal role in promoting Zambia's economic development. In its mandate to provide medium and long-term development finance, the Bank invested extensively in Agriculture, Agro and Mineral Processing, Forestry, Quarrying, Textile Pulp and Paper, Fisheries and Manufacturing sectors. Between the 1970s and early 1990s, the Bank held its place as the most significant financing institution providing medium and long-term finance for fixed assets to medium and large scale enterprises in Zambia. As the major catalyst in the establishment of industries, the Bank has been in the forefront of country's industrial and commercial development. It has recently undergone financial, organisational and operational restructuring. DBZ has introduced a diversified portfolio of products and services in order to promote financial stability and expand its revenue base. Its portfolio among others, include project finance, funds management, credit and leasing finance.

Based on its experience in dealing with funds management, DBZ will operate RRMF¹, which essentially would provide concessional finance for renewable energy projects, and is expected to attract foreign/domestic investments as well as lower the implementation costs of such projects in Zambia. It would link up with the Rural Electrification Fund for channelling targeted funding for renewable energy systems. Once the project has been implemented and the GEF support has been phased out, it would act as a seed revolving fund to support future renewable energy based rural electrification projects in Zambia. Along with WB project and projects of other donor agencies, it would fund pre-feasibility studies, help in making PPAs and legal agreements and provide assistance in financial appraisal to scale-up replication potential.

To begin with, RRMF will act as an interest free loan to cover a part of the private investment component that will be taken as GEF risk sharing contribution to the private investors upfront. Once the demonstration period is over and the agreed grace period expires, the private investor will have to pay back the interest free loan as a part of their contribution to the risk and replication management fund (RRMF). The replenished fund will act as a revolving fund for the replication and development of renewable energy investment projects throughout the country.

RRMF will support renewable energy feasibility studies through contingent loans. If the project is successful in achieving finance for construction the borrower will repay the loan (at a predetermined

¹ Fee to be charged by DBZ to administer the RRMF will be worked out and agreed as a part of the start up activities. However, it will be as per the actual costs incurred by DBZ on over-heads and other related costs, and shall not exceed 5%.

commercial interest rate). The Development Bank of Zambia and the Ministry of Energy will solicit donor funding to maintain or expand the operations of the fund. Reflows from the initial fund will be sufficient to finance feasibility studies or implementation of small or pilot projects up to 30,000 USD each. Applications will follow Development Bank of Zambia's normal procedures except that a DOE, DBZ and UNIDO joint committee will review the applications and award them on a first come first served basis.

All applications for facilities should be in writing covering the following:

1. Background information on the applicant to include:

Company name and ownership details

Names of shareholders and directors

Share capital

Full description of the business activities

History of the company highlighting major development, product mix and other relevant information

2. Requested facility. *This should include:*

Amount

Type of facility

Purpose and tenor

Draw-down and repayment plan

3. Key Industry information.

The information under this heading should include

Key industry players and assessment of own performance and standing compared to competitors.

Competitive advantage vis-à-vis other players highlighting details of critical success factors

List of major competitors and their market share

Company's market size and share

List of major buyers and suppliers and the terms of trade

Key risks and how they are mitigated

Business trade cycle

Marketing strategy

4. Management and employees' information.

Management structure

Key personnel, their qualifications and experience

5. Financial information to include the following:

Audited financial statements for the last 3 years

Management accounts since the last financial year-end

Budgets (profit and loss budget and cash flow projections and underlying assumptions) for the duration of the loan

Debtors and creditors together with age analysis

Explanations should be given for any material negative or positive variances in the trading and financial information

6. Security being offered for the facility

Indicate type

If property, valuation reports to be provided

7. Present bankers.

Full details to be provided on the following:

Name of bankers

Facility enjoyed if any

Security given where relevant

Status report

Copies of bank statements for the last 12 months

FURTHER REQUIREMENTS

The following information is required for all applications for Leasing Finance, Trade Finance, Project Finance, Bonds and Guarantees and Business Advisory Services:-

Company name and profile

Names of Shareholders/Directors and copies of their identities (this would include their track records and resumes).

Copies of Certificate of Incorporation together with copy of Memorandum & Articles of Association

Copy of VAT and Tax Payers Identification Number (TPIN) Certificates

Audited Financial Statements for the past three years and latest Management Accounts

Bank and Trade / Supplier references, which the Bank will be authorised to contact for verification of details

Furthermore the following additional information is required for application of the facilities stated above:

RENEWABLE ENERGY FEASIBILITY STUDY ASSISTANCE

- Pre-feasibility study
- Letter of support from the authority having jurisdiction over the energy service
- Letter of interest from potential energy purchaser(s)
- Type and details of service required