GEF

Global Environment Facility

MOHAMED T. EL-ASHRY
CHIEF EXECUTIVE OFFICER
AND CHAIRMAN

September 15, 2000

Dear Council Member:

I am writing to notify you that UNDP, the Implementing Agency for the project entitled, *Malawi: Barrier Removal to Malawi Renewable Energy*, has submitted the proposed project document for CEO endorsement prior to final approval of the project in accordance with UNDP procedures.

Over the next four weeks, the Secretariat will be reviewing the project document to ascertain that it is consistent with the proposal included in the work program approved by the Council in May 1999, and with GEF policies and procedures. The Secretariat will also ascertain whether the proposed level of GEF financing is appropriate in light of the project's objectives.

If by October 12, 2000, I have not received requests from at least four Council Members to have the proposed project reviewed at a Council meeting because in the Member's view the project is not consistent with the Instrument or GEF policies and procedures, I will complete the Secretariat's assessment with a view to endorsing the proposed project document.

We have today posted the proposed project document on the GEF website at www.gefweb.org. If you do not have access to the Web, you may request the local field office of UNDP or the World Bank 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,

for Mohamed T. El-Ashry
Chief Executive Officer and
Chairman

Cc: Alternates, Implementing Agencies, STAP

United Nations Development Programme
GLOBAL ENVIRONMENT FACILITY (GEF)

2 August, 2000

Dear Mr. El-Ashry, Mohamed:

Subject: **MLW/99/G31/A/1G/99 – Barrier Removal to Malawi Renewable Energy**

I am pleased to enclose the project for Malawi entitled **"Barrier Removal to Malawi Renewable Energy"** approved by the GEF Executive Council in May 1999. Also enclosed is the response to comments provided by Council members.

As per paragraph 29 and 30 of the GEF Project Cycle, we are submitting this project to you for circulation to the Executive Council Members for comments and, subsequently, for your final endorsement.

Thank you in advance for expediting the review and approval of this project.

Yours sincerely,

Rafael Asenjo
Executive Coordinator

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PM

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Barrier Removal to Malawi Renewable Energy (MLW99G31)

(Response to GEF Council and GEF Secretariat Comments)

The project was provisionally approved by the GEF Council at its meeting May 5-7, 1999 with some Council Members indicating concern regarding impediments to the successful implementation of the project. UNDP, as the GEF Implementing Agency, indicated that a number of provisions will be included in the final project document submitted for CEO endorsement to ensure that the project achieves its ultimate objectives. Principally, UNDP has designed an institutional arrangement that provides a high likelihood of success and assures a high degree of accountability. UNOPS will be the Executing Agency in conjunction with the Government of Malawi.

Following are specific comments from the Council members, and including a discussion of how these comments are addressed in the Project Document.

1. Assumptions: Fans on tobacco kilns replace diesel gensets … schools do not use lighting at all etc. calculations not shown (Netherlands).

The PV fan replaces natural draft with damper control. Lighting replaces kerosene in the estimates. These baseline calculations are included. Please refer to the prodoc Annex I and to Table 1 of Annex VII.

2. Clarification of PV market: What are/have the 5000 PV systems installed in Malawi been used for? (Netherlands)

Firstly the number reported was an estimate by one of the PV suppliers in Malawi who estimated the number installed and suggested that they were used for telecommunications, pumping and lighting installations. Please refer to Table 1 of Annex VII in the project document.

3. Status of PV market in Malawi: What is the status of the current PV market in Malawi? (Canada)

This is now addressed in the above point and in the project document as shown in Annex VII.

4. Woodfuel and PV: The project brief mentions a major problem attributable to "dwindling supply of woodfuel" which is outside of the PV energy services. (Germany)

Dwindling woodfuel is undoubtedly an enormous energy problem in Malawi. While this project deals with Photovoltaic energy it also addresses woodfuel in two ways: firstly, and directly, through the controlled combustion of woodfuel in tobacco curing, and secondly, and indirectly, by providing an affirming demonstration of the application of renewable energy in meeting energy service needs in Malawi.

The original project brief included renewable biomass technologies and techniques, including addressing the dwindling woodfuel issue. This component was separated from this submission and is being prepared separately as a PDF document. Please refer to B3. paras 37 and 38 and B4.1. para 40 in the project document.

5. Woodfuel and PV: PV systems will not "provide a least cost least-cost solution to satisfy basic energy needs in Malawi" (Germany)

This critique is noted and corrections have been has been made to the text. As correctly affirmed it will certainly not provide the least-cost energy solution for thermal energy services. It will, however, provide a competitive lighting service when compared in unelectrified areas with candles and kerosene as a baseline measured in US$/lumenhour. Initial scoping of this project made life-cycle cost estimates that reflect this conclusion. Please refer to B1. para 17 and 18 in the prodoc.

6. Formatting of contents: Why is component 3 "Development of a regulatory framework" not part of component 1 "Capacity building". (Netherlands)

The consultants agree that part of the project is indeed capacity building, but the remaining two activities are to do with the development and implementation of regulatory instruments, which are distinct from capacity building. We therefore consider the components to be separate, and have left it as such in the final prodoc. For further detail please refer to section D1.3 in the prodoc.

7. GEF and equipment: The GEF will not pay for any equipment (Netherlands)

The GEF makes a small contribution to the Component 5: PV demonstration projects, which in total costs US$4 559 000. The GEF contribution is not for purchase of hardware or equipment but is allocated to activities 5.1: Development of demo approach protocols; and 5.3: Publicise lessons learned from demos. Of this component, the balance is from co-funders predominantly for contributions to the costs of equipment.

8. Sustainability of project: What happens to the initiative post the GEF project? (Canada)

Three options were raised in the project brief, these are repeated in the prodoc. For details refer to section F, para 112.

9. Subsidy and sustainability: It remains unclear what if any subsidy for the end-user, particularly under the activities of component 4 is included in the budget. (Germany)

All or part of the contributions of SOBO, Danida and those of government reflected in the budget under component 5 are for economy of scale subsidies for equipment. Please note that component 4 is predominantly an exercise in removing barriers to financing within financial institutions. Please note that the application of these subsidies may be applied to reducing price and/or financing costs to end-users. See section J of the project document.

10. CO2 for embodied energy in different technologies: Is it possible to compare the embodied energy in the technologies included in the baseline and the alternative? (Germany)

Embodied Energy: GEF have never done an analysis of the embodied energy in any of the nearly 20 photovoltaic projects that have been supported to date. Not only have we not examined the embodied energy in any of the other sectors where we have proposed projects, the inclusion of embodied energy would represent a new major departure in

policy and praxis, but one which might justify an element of targeted research to understand better.

11. Incremental Costs: In most PV projects, the baseline assumption made is that there would be no project intervention in the absence of the GEF initiative. This means that in the first instance, the baseline would consist of a very small market for PV systems growing slowly and unevenly. At the beneficiary level, the baseline would involve continued use of woodfuel and kerosene for lighting by rural households; continued excessive use of firewood for tobacco drying; and some limited use of kerosene refrigeration in rural shops. The costs of these initiatives would represent the baseline costs. The project costs would then be the costs of the project, making the incremental costs equal to the project costs minus the baseline costs.

In the evaluation of this case, it was judged by both UNDP and DANIDA that the DANIDA funding would be devoted to rural energy in Malawi, with or without the GEF project support. Its nature may have been changed by the focus of the GEF initiative, but it would still have been allocated to Malawian rural energy. Therefore, the DANIDA contribution is considered part of the baseline. All other contributions are consider to be baseline activities as well-- SOBO, the GoM, and UNDP would make their contributions in any event. Their nature, but not their magnitude, would be changed by the GEF contribution. Therefore the only incremental contribution to the project is the GEF contribution. This is a slightly different approach than that which has been adopted in other PV projects, but we would maintain that it better fits the unique case of this project context, wherein GEF support ties up a reasonably coherent programmatic approach for rural energy initiatives in the country.

In any event, the German delegation writes that the "result of the incremental cost calculation is not verifiable". This statement is always true, by definition--incremental costs are calculated by utilizing a counter-factual scenario--i.e. by answering the question "What if?". This is then supplemented with active negotiations. Therefore, we feel that the approach adopted in this case has resulted in a reasonable allocation of GEF resources which are dedicated almost exclusively to the technical assistance costs of barrier removal.

12. Solar drying of tobacco: Can solar not be used for drying tobacco? (Germany)
The consultants raised this question in familiarising themselves with the tobacco industry and what they were told is that solar energy is used for drying certain types of tobacco, but this is a different class of tobacco to that which is cured in a kiln using wood. No discussion of this issue is included in the prodoc.

13. Off-grid electrification financial sustainability: How will off-grid electrification sector finance itself in the medium term future? (France)
In component 4 and to a lesser degree in component 1 this issue will be addressed as the project is implemented. The key to sustainable financing is, firstly to ensure that electricity and oil levies reach the Energy Fund, and that modalities exist for its access. Secondly, that financial institutions design and market an affordable and dedicated financial product for the purchase of PV systems. Success during the GEF project will

encourage other local, bi and multi-lateral donors to contribute to the Energy Fund for a continuation of the rural electrification. For further details consider sections E1 and F.

14. Budget allocations: Support activities and institutional measures appear over-scaled in relation to the scope of the physical investments called for. (France)
Two issues need clarification here, firstly the project does not reflect the US$7.29million additional funds that are from purchasers of the systems, and Malawi is institutionally weak. Section J Note 2.

15. Financial barriers: The allocation of funds to component 4 of US$0.638 million is too small for the crucial nature of this intervention. (Switzerland)
This is a small amount considering the project budget, but the activities assigned to this component are to design and implement financial mechanisms tailored to the project's niches using the finances available under component 5 and presumably other finances available during and post project. The amount does not include resources available to the financial institutions for their financing of PV systems.

16. Capacity building and institutional strengthening: Capacity building of technicians for the design, installation and service of PV systems could be better considered; capacity of the private sector being determinant for the sustainability of the project. (Switzerland)
The project designers are in accord with this comment and have considered the solution in the project document in a number of sections. For further detail consider the following in the project document: B1.4, B1.5, B1.6, B2, B4.2.1, B4.2.3, B4.2.5, D1.1, D1.3, and D1.5.

17. Maintenance mechanism for PV systems: The project considers delivery but not maintenance mechanisms. (Switzerland)
The maintenance mechanisms will flow from the delivery mechanisms based on the outcome of component 3 that considers codes of practice for installation and maintenance. Once the codes are developed the mechanism for maintenance can be designed potentially as addenda to the delivery modalities. The issue is further discussed in D1.3 and Annex IX.

18. Maintenance mechanism for PV systems: Costs of maintenance should be taken into account in the financial analysis (Switzerland).
The costs of battery replacements every 4 years and the replacement of 20% of the regulators in the first 4 years of their operation have been included in the Net Present Value incremental cost estimates and the financial estimates.

United Nations Development Program
Project Document

PROJECT NUMBER: MLW99G31/A/1G/99

PROJECT TITLE: Barrier Removal to Malawi Renewable Energy

COUNTRY: Malawi

DURATION: 5 years

ESTIMATED START DATE: August 2000

ESTIMATED END DATE: July 2005

ACC SECTOR/SUB-SECTOR: Environment

EXECUTING AGENCY: Government of Malawi

IMPLEMENTING AGENCY: Department of Energy

COOPERATING AGENCIES: UNOPS & DANIDA

UNDP and Cost-Sharing

UNDP:	
GEF (main)	$3,353,000
GEF (PDF B)	$ 64,800
TRAC	$1,199,000
OTHER:	
DANIDA	$2,250,000
SOBO	$2,000,000
Government	$1,855,000
TOTAL:	**$10,721,800**

Summary:
The project will help to mitigate greenhouse gas emissions by addressing institutional, information, know-how, perceived risk and other investment barriers to increased use of photovoltaic energy sources by households, institutions, commercial entities and agro-industries. Specifically the project will: Assist local stakeholders in building local capacities to promote, install and service PV applications; help to develop and implement favorable regulatory frameworks, facilitate the establishment of viable financial mechanisms (micro lending). The latter will address up-front investment cost barriers and related risk perceptions. The project will help to demonstrate viability of investments in photovoltaic energy and encourage widespread replication. Expected project outputs: Increase of off-GRID PV installations from about 5000 systems in 1998 to at least 30.000 systems by the year 2015. This will result in a total abatement of about 600,000 tonnes of carbon over the lifecycle of these systems. The following progress monitoring milestones are suggested: At least 9.000 systems will be installed by 2004(project completion), installation of 20,000 systems is foreseen by 2010.

For the United Nations Development Programme (UNDP):

……. Date:……..

For the Government of Malawi:

……. Date:……..

For Danish International Development Assistance (DANIDA)

……. Date:……..

For UNOPS:

……. Date:……..

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ABBREVIATIONS

ARET	Agricultural Research and Extension Trust
CDC	Community Development Committees
CEEDS	Center for Energy, Environment and Development Studies
CO_2	Carbon Dioxide
CURE	Coordination Unit for Rehabilitation of the Environment
DANIDA	Danish International Development Assistance
DDC	District Development Committees
DEP	
DOE	Department of Energy
EAP	Energy and Atmosphere Programme of the UNDP
ESCOM	Electricity Supply Commission of Malawi
ESMAP	Energy Sector Management Assistance Programme
FINCA	
FINESSE	Financing Energy Services for Small Scale Energy Users
GEF	Global Environmental Facility
GOM	Government of Malawi
GTZ	German Development Agency
IFC	International Finance Corporation of the World Bank
IndeBank	Investment and Development Bank
IndeFund	Investment and Development Fund
MASAF	Malawi Social Action Fund
MDC	Malawi Development Corporation
MEM	Ministry of Energy and Mines
MEDI	Malawi Entrepreneurship Development Institute
MIDCO	Minerals Investment and Development Corporation
MIRTDC	Malawi Industrial Research and Technology Development Center
MW	Megawatt
MRFC	Malawi Rural Finance Corporation
MUSCO	Malawi Union of Savings and Credit Co-operations
NEAP	National Energy Action Plan
NEP	National Energy Plan
NSREP	National Sustainable and Renewable Energy Programme
PAC	Project Advisory Committee
PCC	Petroleum Control Commission
PM	Project Manager
PMU	Project Management Unit
PPER	Project Performance Evaluation Report
PSC	Project Steering Committee
PSD	Project Support Document
PTR	Project Termination Report
PV	Photovoltaic
RD&D	Research Development and Dissemination
REIAMA	Renewable Energy Industry Association of Malawi
REP	Rural Electrification Programme
RET	Renewable Energy Technologies
REU	Renewable Energy Unit
SACCO	Savings and Credit Operation
SADC	Southern African Development Community
SADC-TAU	Technical and Administrative Unit of the SADC Energy Sector
SBBA	Standard Basic Assistance Agreement
SHS	Solar Home Systems
SOBO	Southern Bottlers (Malawi) Ltd (subsidiary of Carlsberg and Coca Cola)
SPV	Special Purpose Vehicle

TAMA	Tobacco Association of Malawi
TOR	Terms of Reference
TRAC	Target Resource Allocation (from) Core
TSG	Technical Support Group
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1. A. CONTEXT

A1. Description of Sector

1. Malawi is a landlocked, densely populated country south of the Sahara occupying the southern part of the East African Rift Valley.

2. The population of Malawi is estimated at 12 million and is growing at 3.2% per year. About 85% of the population live in rural areas Malawi is one of the poorest countries in the world, ranking 157 out of 174 countries according to the UNDP Human Development Index, which uses GDP, life expectancy and education as a composite indicator. Infant mortality has risen since 1995 when it was estimated at 133/1000 and Gross National Product per capita of US$170 is lower than the average for sub-Saharan Africa. Adult literacy is 43%.

3. Malawi's energy balance is heavily biased towards woodfuel (93%) with petroleum, electricity, coal and other biomass accounting for only 3.5%, 2.3%, 1% and 0.2% respectively. About 90% of the population depend on woodfuel for their thermal services, while paraffin and candles are used for lighting. Only 4% of the population have access to electricity, and of this, less than 1% resides in the rural areas. 30% of the urban population have access to electricity.

4. The inability to secure enough fuel for cooking has an adverse effect on the quality of food cooked. The dwindling supply of woodfuel (firewood and charcoal) results in rapidly increasing prices, which negatively affect the poor and the low-income strata of the urban population. For rural women who do not buy woodfuel but collect it, the time to secure enough supplies of wood is increasing with negative repercussions on the time needed for income generating activities, subsistence activities, childcare, and education.

5. Paraffin, candles and batteries deliver light of inferior quality at comparatively high cost per unit of light. But these are the only light sources that low-income groups have access to and can afford. This has the consequence of limiting evening activities to a minimum and further reducing opportunities for income generation or educational activities.

6. Malawi enjoys an abundance of sunshine for most of the year (21.1 MJ/m^2/day). Wind energy resources are not yet established, but these are currently being monitored as a component of the DANIDA energy programme. Besides the large hydropower plants already commissioned or nearing completion, feasibility studies have shown that there is still a large potential for mini and micro hydro. Many RETs such as solar water heaters (SWH), solar photovoltaic (PV) systems and biogas, have been introduced, albeit with varying degrees of success. In any case, the scale of introduction and dissemination has not been such that lessons learnt can be applied to this programme. Lack of information on renewable energy resources constitutes a barrier to their programmatic utilisation.

A2. Host Country Strategy

7. Currently the UNDP and other donors are taking a programmatic approach to development in Malawi. This project fits into the sub-programme entitled the National Sustainable and Renewable Energy Programme (NSREP), which in turn is one of four sub-programmes under the Environment and Natural Resources Programme. These sub-programmes are in draft Project Support Document (PSD)

forms. The intention is that they are executed nationally with the National Economic Council being the leading institution in Government.

8. Sustainable and equitable development are central to GOM's overall development policy, Vision 2020. This is achieved through fiscal and monetary policies that aims to ensure rapid and sustained economic growth that will alleviate poverty while ensuring the sustainable use of the environment and its natural resource base for the benefit of present and future generations. The strategy for achieving this goal has three main components, namely: (1) focus on poverty alleviation; (2) decentralize the process of policy development, planning, implementation, monitoring and evaluation; and (3) facilitation of popular (community) participation in decision making.

9. However, it has been observed that traditional approaches to the problem of poverty, which are macro- economic and growth in nature and mainly oriented towards human capital investment and income re-distribution, do not address directly the energy problems of the poor and do not guarantee an adequate and sustainable energy supply. In order to address this imbalance, GOM has recently prepared a draft National Sustainable and Renewable Energy Programme (NSREP) framework with support from UNDP. NSREP is a national energy programme whose objective is to increase the sustainable use of, reliance on and access to energy in Malawi, focussing on the country's underutilised renewable energy resources in order to provide a viable and sustainable contribution to the country's energy mix.

A3. Prior and ongoing assistance

10. The German Government assisted GOM in developing a 5MW mini-hydro plant at Wovwe in Rumphi district. This plant, which has replaced stand-alone diesel generators in Mzuzu and Karonga, was commissioned in 1996. It is owned and operated by ESCOM through its national grid.

11. The World Bank has under Power V supported two major studies as inputs into GOM's Energy Policy preparation effort. These are: *The Biomass Production and Marketing Study* which was finalised in March, 1997*; and The Urban Household Energy Demand Side Strategy (1996*) which presents a comprehensive analysis of household energy consumption patterns.

12. DANIDA is currently working with GOM in implementing a two-phase project initially to assess renewable energy resources. The objective of this work is to come up with a database on renewable energy potentials especially solar, wind and biogas, whereby the best sites will be selected. The remaining three phases will focus on the implementation of renewable energy demonstration/pilot projects, training and the promotion of renewable energy systems. Danida's programme has significant overlaps with the GEF interests, and as a result has become a co-financier of this project.

13. UNESCO financed the Makanjira Solar project that included the electrification of a school, clinic and staff houses. This serves as a demonstration of the practical applications of photovoltaic lighting in Malawi.

14. Malawi is one of the six SADC countries where the programme for FINESSE is currently being implemented with financial support from the Netherlands Government and OPEC through UNDP-EAP Energy Account. The main objective of

FINESSE is to provide assistance to SADC member states to deliver technically feasible and economically viable alternative energy services to household, commercial, agro-industrial and institutional energy users. At a national workshop held between 4th and 5th May 1998, business plans for biogas and PV for rural lighting were approved. One of the critical issues to be addressed before these business plans can take off is the recognition of the existence of commercial and other barriers and thus the need for support for the implementation of parallel activities to level the playing field and thus transform the RET market.

A4. Institutional Framework

15. NSREP of the DOE (August 1997) expresses a primary objective: "to increase access to and efficient use of renewable energy in Malawi for a larger cross-section of the rural and peri-urban population and to provide a viable and sustainable contribution to the country's energy mix." The NSREP was initiated at a time when efforts to develop a national energy policy were underway. Coincident with the conceptualisation of the NSREP has been the preparation of a PSD outlining a framework for the execution of activities that support renewable energy developments in Malawi. Efforts in this regard have to date been sponsored by the UNDP and DANIDA. It is into this PSD framework that this GEF barrier removal project neatly fits. The contribution of GEF, UNDP, and other co- and parallel financiers will provide leverage for the support of the many other activities described in the PSD.

16. Realising that rural electrification activities were contributing negatively to ESCOM's cash flow, GOM took over this responsibility in 1994 and adopted it as an integral component of its social development policy for poverty alleviation. To this effect, a National Technical Committee and a REP Unit have been on the planning agenda since 1995, which will have to be urgently set up. In addition, GOM set up an Energy Fund to support REP activities. The Energy Fund was expected to draw its revenue from levy on petrol and diesel sales, a proportion of the surtax on electricity bills and donor contributions. Although only funds from the petroleum levy have to-date been realized, what is essential is that GOM has demonstrated its commitment to rural electrification activities.

2. B. PROJECT JUSTIFICATION

B1. Problem to be addressed and the present situation

17. Electric power, a key ingredient to the industrial and commercial sectors of the Malawi economy, is supplied to only 4% of the population primarily based in the urban centres. The growing need for power for lighting, refrigeration and media is therefore not being met using grid electricity, but if met at all, through the use of expensive and fossil based CO_2 emitting alternatives. With the rapid decline in the value of Malawi currency, the Kwacha, and increasing pressure by international financing institutions on the national utility (ESCOM) to provide a cost reflective tariff, the price of electricity and electrical connections is increasing making access to electrical power ever more remote for the majority of Malawians. Lack of access to electricity for small commercial energy services hinders the ability of rural Malawians to advance their economic development.

18. In many cases, stand-alone solar PV systems could provide a lower cost solution to satisfy basic electrical service needs (such as lighting, radio and communications) in Malawi than the candles, kerosene and dry batteries currently used in terms of cost

per unit of light (lumenhour). This project aims at removing/reducing barriers to expanding the use of PV systems in four principal markets where PV systems have the greatest potential to be the least-cost alternative. These are: households that use lighting and radio/TV (both rural and urban); institutional (schools, health clinics and other facilities); tobacco farms for PV-powered fans to control the combustion process (including the use of PV systems for lighting in between curing); and, beverage retailers for refrigeration, lighting and radio/TV. In all applications PV could be the least cost solution only where grid electricity is not available.

19. The project addresses institutional, financial, technical, normative, and human capacity/ informational barriers to the development of a market for PV technologies and proposes mechanisms that can integrate PV systems into the above-mentioned niche sub-sectors of the economy. The project specifically considers, improving the skills and knowledge of the main stakeholders, providing subsidies and credit facilities and monitoring to build the market for PV electrical power generation for rural electrification.

B1.1. Institutional barriers

B1.1.1.Private sector

20. The PV industry in Malawi is quite immature with only 3 companies operating in the area. The limited number of retailers implies low levels of competition and a limited knowledge base in the country. Knowledge of, and confidence in, PV systems as well as dedicated financing mechanisms for the purchase of PV systems, are all clearly barriers to the development of a market for PV systems and are addressed separately under other project components below. Barriers to the Private Sector are therefore: i) latent market for PV systems in Malawi; ii) the limited size of the PV industry; iii) the limited number of PV technicians who can install and maintain PV systems; iv) lack of information on technological advances; and operational finance; v) lack of an industry voice on issues pertaining to policy, regulation and codes of practice; and, viii) lack of resources to undertake RD and D into the most appropriate PV systems for low income Malawian households.

B1.1.2. Government

21. Specific barriers hindering the development of renewable energy technologies at the level of governance are: i) lack of an integrated energy policy; ii) incomplete mechanisms for the collections and disbursement of resources earmarked for the Energy Fund for Rural Electrification; and iii) limited personnel capacity in DOE to facilitate implementation and monitoring of an integrated energy policy.

B1.1.3. Non-Government Organisations (NGOs) and Community Based Organisations (CBOs)

22. The main barrier of this component is the limited knowledge amongst NGOs and CBOs of the technical and financial aspects of PV.

B1.2. Financial barriers

23. One of the keys to the development of this market is financing mechanisms and incentives for PV system purchasers. If PV technologies are to see widespread applications in Malawi, the impact of the first cost (cash price) needs to be mitigated. This implies the need for dedicated credit at affordable interest rates to support purchasers and potential suppliers of this technology. Barriers that will be overcome

in this component of the project include; i) lack of dedicated and affordable financing mechanisms for PV (and other RETs) systems purchasers and suppliers; ii) lack of knowledge of financiers and suppliers on how to establish dedicated financing mechanisms and appraise applications for credit; iii) lack of skills to develop business plans for the use of RETs; iv) lack of knowledge of local, regional and international financial facilities dedicated to the supply and efficient use of cleaner energy; v) lack of confidence in technologies and returns on investment (for end-users) and loans (for financiers); and, vi) the imposition of import duties and/or other taxes on these technologies.

B1.3. Technical barriers

24. The role PV systems have played in off-grid electrification is very low in Malawi. This is attributed to various factors including the following technical barriers: i) poor quality of systems; ii) poor installation and maintenance practices; and, iii) inappropriate applications of the technologies.

B1.4. Information barriers

25. Delivery of project outputs aimed at the rural and urban household, commercial (beverage retailing), agro-industrial (tobacco flue curing) and institutional (schools and distant learning facilities) sub-sectors will require tailored delivery mechanisms. These delivery mechanisms and associated activities are new to Malawi and will need to be tested. The demonstration projects aim to increase the awareness and confidence in PV technologies, improve technical and installation quality compliance, institute installation inspections and maintenance protocols, gain experience of systems in use and refine delivery modes. In addition, if sustainable delivery of PV systems is to be achieved, a “critical mass” or momentum in the financial, supply and maintenance of systems has to be in place before the end of the project.

26. Barriers to be removed include: i) lack of affirming demonstrations of functionally and financially viable PV system applications; ii) lack of tangible fully functioning PV systems in Malawi; iii) lack of knowledge of the tangible benefits of PV electrification; iv) lack of experience in the financing, installation and maintenance of PV systems; and, iv) lack of knowledge or experience in PV system delivery modalities in Malawi.

B1.5. Normative barriers

27. In Malawi there is a lack of ‘codes of practice’ and systems standards for RETs. This has meant a proliferation of systems of questionable quality that are often poorly installed with no supporting maintenance programmes. In order to reverse negative perceptions and instill confidence in the market, these regulatory mechanisms have to be in place if RETs are to be implemented on a sustainable basis. Codes of practice and standards need to be developed in close collaboration with the industry and potential users of the technologies. These regulations should cover performance of components, system installation, system commissioning, system warrantees, system maintenance, theft avoidance and a code of PV business ethics. In addition, compliance monitoring needs to be designed and undertaken.

B1.6. Human capacity barriers

28. In addition to the human capacity barriers in Private, Government, NGO and CBO sectors, amongst the public, the awareness of the role PV systems can play in off-grid

electrification is very low in Malawi. This is attributed to various factors: i) RET efforts have largely focused on R&D and demonstration activities with little or no linkages created for commercial marketing; ii) as new and up-coming technologies, RETs dissemination programmes have lacked both policy direction and appropriate techno-economic information to assist end-users in their energy mix decisions and for financiers and entrepreneurs to invest in RETs projects; and iii) RETs have had a poor track record in Malawi because maintenance has been limited.

B2. Expected end-of-project situation

29. There are actually some 5,000 PV systems installed in Malawi. However, half of them are not operational because of poor installations and/or lack of maintenance. In the absence of the proposed project, the PV market is expected to develop very slowly, and in the year 2015 there would be only some 7,000 PV systems operative in Malawi. The total potential market size for PV systems in Malawi is estimated at a minimum of 130,000 units.

30. The proposed project would help the market develop and it is estimated that as a result, more than 30,000 units would be installed in 2015 (Annex VIII, page 57). This would have significant local as well as global benefits: about 25,000 households would have access to high-quality lighting with no in-house pollution: 7,600 tobacco farms and beverage retailers would have improved their economic efficiency; and 794,368 tons of firewood would have been saved thus conserving the natural and regenerated woodlands. The global benefit of the proposed project would be the avoidance of an additional 578,395 t_c of greenhouse gas emissions.

31. The extent of the markets for PV systems in the light of low levels of grid electrification can be estimated as follows:

32. TABLE 1: Estimated Mature Market Size: PV Systems in Malawi (see Annex VIII for details)

Target market	**Sector size**	**Estimated potential market penetration (%)**	**Numbers of systems**
Households	1.78 million	Urban: 18% Rural: 5%	123,000
Educational and health institutions	n/a	n/a	900(*)
Tobacco curing	3,800	50	1,900
Beverage retailers	n/a	400 new systems/year	6,400(*)

(*) Estimated number of installed systems in 2015 if the market barriers are removed.

33. In summary, the main objectives of the project include: to remove technical, financial, institutional and informational barriers to the creation of a market for the purchase and use of PV technologies in rural and peri-urban areas of Malawi. By learning from the experiences of other countries in the region, the project is designed to take regional experience further through developing a market for PV systems in Malawi. This will be achieved by:

    i. contributing to the design of enabling renewable energy and fiscal policy;
    ii. developing dedicated financial mechanisms for the financing of PV systems and potentially suppliers of PV systems;
    iii. widely demonstrating and promoting sustainable provision of PV systems through affordable credit facilities;

iv. increasing awareness among Malawi's civil society of renewable energy technologies and techniques;
v. building the capacity to identify photovoltaic and other renewable energy projects to contribute to energy service solutions;
vi. building the institutional and technical capacity in the financial sector, PV industry, government, NGOs and utilities to deliver renewable energy services for the duration of the project and beyond;
vii. developing and instituting compliance with standards and codes of practice for the PV technologies, their installation and maintenance; and
viii. developing and implementing monitoring and evaluation protocols describing the progress of the project that will facilitate replication of successful components.

34. In the development of this project, experiences have been drawn from the Zimbabwe GEF project, the Namibian Home Power project and the PV electrification of remote clinics and schools, privately owned solar homes systems, PV pumping and telecommunications in South Africa. Particular attention in these regional examples of PV projects is paid to critiques of: financial mechanisms (to end-users and the PV industry); project institutional arrangements; institutional arrangements (external to the project) and delivery modes; credit ratings of PV purchasers; project bulk purchasing and warehousing; performance standards (and compliance protocols); codes of practice; training and accreditation of technicians trainees. Lessons learned from these projects will facilitate the Malawi project's contribution to the momentum of PV electrification in Africa. The Malawi project builds on the regional experience which include:

- The Zimbabwe GEF project where more than 9000 solar home and institutional systems were installed making use of external soft financing using predominantly commercial delivery modes.
- The Namibia Solar Home Project installed some 100 solar home systems during its pilot phase that ended in 1998. This carefully crafted project used government long term zero interest loans to the parastatal Namibia Development Corporation to operate as an agent of the Ministry of Mines and Energy financing the end-users. The next phase of the Project intends increasing the number of systems to 500. The project to date has been Government driven with private sector PV suppliers involved in the installation of systems.
- In South Africa estimates suggest that the total installed PV capacity is approximately 5MWp. Most of the systems have been entirely subsidised except for the telecommunications systems and some of the PV pumping and the majority of the solar homes systems. In South Africa, dedicated financing has been organised by suppliers using their own limited resources, typically requiring repayment over 6 months at high interest rates.

35. The win-win possibilities of this project include the benefits to Malawi, on the one hand, and on the other, the potential to generate market development for PVs leading to sustained reduction in carbon dioxide emissions globally. The GEF resources will result in leveraging financial resources from the government, private sector, bi-lateral donors and end-users predominantly for the demonstration/pilot component of the project. Some of these resources (e.g. Danida) have already been programmed but the

project streamlines their utilisation through synthesising their application within this GEF project framework

36. These results will have a sustained impact on the quality of life of the rural and urban populations, improve energy service affordability for tobacco farmers and beverage retailers, improve the energy service quality in health care and educational facilities. The impacts of a successful project on the global environment through a reduction in the emissions of GHGs would continue well beyond the lifetime of the project.

B3. Target beneficiaries

37. The major target beneficiaries of the project will be the Malawian people. The main beneficiaries will be:

- Rural and urban households that do not have electricity but can afford to make use of photovoltaic electricity for lighting (and radio);
- shops and bottle store in areas away from the electricity grid that sell refrigerated SOBO beverages;
- suppliers of PV systems, and later when replication occurs, biogas technology, energy efficient solid fuel stoves, briquette manufacturing apparatus etc;
- tobacco farmers interested in improving the process control and reducing the quantity of woodfuel combusted in curing tobacco (and having basic electricity services outside of curing season);
- health workers and patients in clinics and teachers and students attending educational facilities beyond the reach of the electricity grid; and
- worker households on commercial farms.

38. It is envisaged that beyond the project there will be further beneficiaries as the project momentum extends to other technologies and end-use sectors.

B4. Project strategy and implementation arrangements

39. The project will implement activities to enable the GOM to adequately transform the energy market and thus allow greater use of renewable and sustainable energy services in accordance simultaneously with the UNFCCC objectives.

B4.1. The project design strategy

40. The approach to the project has been to select technologies that look promising from the perspective of technical, financial and environmental criteria. A method of ranking technologies using a composite of technical, financial and social indicators established high rankings for renewable biomass and rural photovoltaic electrification interventions in meeting energy service needs. Of these, PV technologies were targeted through Government prioritisation processes, implying a degree of fuel switching. The sustainable biomass strategies have been separated and will be contained in a separate proposal currently under development.

41. In developing the project some, 30 to 40 institutions were visited by a team of consultants. Each bilateral meeting consisted of a briefing on the proposed barrier removal project. Institutions were asked to contribute to its development by volunteering information on the barriers to transforming the energy market in favour of renewable energy from their perspective. Many of the same organisations were asked whether they were involved in complimentary work and if their mutual interests would constitute grounds for co-financing of the project.

42. Further development of the strategy involved two multilateral workshops with the main stakeholders and a presentation of the project concept to the final FINESSE national workshop. These workshops provided an opportunity for detailed criticism of the project as it was designed.

43. The project will explore energy problems and PV energy options of poor urban and rural households, facilitate income-generating activities, address renewable energy opportunities amongst agricultural processing sub-sectors, and institutional facilities. Where possible, leverage will be applied to private sector beneficiaries of project outputs (such as the agricultural sector) to provide additional services to employees or customers. For example, shops that make use of PV powered lights, refrigerators and media services will be encouraged to demonstrate the technology and become agents for PV suppliers. Tobacco farmers will be encouraged to electrify their worker's dwellings.

B4.2. The project implementation strategy

44. The project implementation strategy is to have the project steered by public and private sector institutions in collaboration with the government. The institutional arrangement that is required to undertake the project is defined by the tasks to be performed. These tasks use various instruments to reduce and/or remove the identified barriers.

45. The PSC will guide the implementation of the project to ensure that the results are disseminated to and evaluated by relevant stakeholders and that they support the smooth transition from this enabling activity to the further development and growth of RETs markets in Malawi. Details of the project institutional arrangements are contained in section B7. below. Details of PV delivery modalities are included in Annex IX.

46. The National Electrification Plan is the framework for the proposed project. The existence of market and non-market barriers, however, prevents the full potential of PVs as a source of rural electricity from being achieved. By removing the identified barriers, this project will establish the necessary conditions to integrate solar photovoltaic systems into the plan in a sustainable manner. Below the objectives of the barrier reduction/removal measures are briefly described.

B4.2.1. Component 1: Capacity Building

Private Sector

47. There is a need for more qualified PV technicians and sales people to cope with the projected increases. Objectives of this sub-component include: i) to devise curricula and identify participating institutions such as the Polytechnic and Chancellor College to train PV technicians; ii) to provide technical and financial training to PV technology sales people; iii) to find immediate placements in the PV industry for the newly trained technicians and sales people; iv) to provide up to date technical information to the PV industry; iv) to stimulate the formation of an industry association; and, v) to identify the most appropriate PV systems for the target market with special attention to low to medium income Malawian households.

Government

48. The objectives include: i) to contribute to the drafting, promulgation and implementation of integrated Energy Policy; ii) to contribute to the establishment of institutional links and financial modalities for the effective management of the Energy Fund; iii) to build the capacity and skills of DOE officials in the interpretation of policy, contribution to good governance with respect to RE, and to facilitate, design and appraise projects in RE sub-sectors; and, iv) to establish a Renewable Energy Unit (REU) within the DOE.

49. As and extension at arms length of government, the project will build the capacity of a project management unit to take on the day-to-day tasks of managing the project and specified tasks. In the case of institutional capacity building in the PMU the following objectives apply: v) to establish an excellent PMU that has the capacity to plan, implement and review the project and contribute to the momentum for sustainability of the RE sector post-project; vi) for the PMU to network with key local and international role players that will focus interest and enthusiasm on the project and its outcome; and, vii) to design and implement a RE (focussing on PV) resource centre that archives and makes available information collected and generated over the duration of the project, and co-ordinates and provides courses/training on RE.

NGOs and CBOs

50. The primary objective is to increase knowledge of the costs and benefits of using PV systems in order to promote the appropriate application of PV technologies and credit facilities that support their purchase.

B4.2.2. Component 2: Creating public awareness

51. Support is required to: enhance public awareness of the efficacy of RETs so as to provide a base for PV market development, remove negative perceptions and biases and restore/ increase consumer and investor confidence in RETs with particular attention to PV systems.

52. The objectives include: i) to increase knowledge of, and exposure to, RETs, with special attention to PV systems, how they work, how they compare to other energy services, how and where to procure and finance them; ii) to increase knowledge amongst policy makers, planners and NGOs/CBOs of the end-users' energy situation and how to address this; and, iii) to develop a cadre of community based energy advisors who are the conduits and interpreters of two way information flows between the project and end-user needs and ultimately policy development.

B4.2.3. Component 3: PV regulatory framework

53. Objectives include: i) to design, tailor and/or adopt, implement and review standards, codes of practice and compliance protocols; ii) to train PV system inspectors; and, iii) to develop and issue to trained inspectors the tools to test PV systems and assess compliance with standards, codes of practice and anti-theft protocols.

B4.2.4. Component 4: Overcoming financial barriers

54. The objective of this component will be to assess different financing mechanisms for the purchase and supply of PV systems and select those most suited to the Malawi situation. Among the subsidiary objectives are: i) to enable financiers to gain an understanding and appreciation of the technology and the social, environmental and

economic costs and benefits associated with their use; ii) to enable financiers to evaluate loan applications and provide tailored credit facilities; iii) to decide on the optimal use of grant finance in the design of financial mechanisms and the provision of incentives that promote financial sustainability, encourages competition amongst suppliers and distributes incentives in an equitable manner to end-users; iv) to tailor technical and financial products that target low-income households; v) to design a mechanism that gently phases out subsidies to PV systems at the end of the project; and; vi) to prove the viability of financing PV technologies in order to open the window to other RETs in the future.

B4.2.5. Component 5: PV demonstration projects

55. The main objectives of the demonstrations of the PV systems are to address both demand and supply side issues in the use and provision of PV systems. Through visible, tangible and affirming demonstration, specific objectives include: i) to promote awareness of, and confidence in, photovoltaic systems to provide a useful and dependable energy services to the targeted sub-sectors of the economy. (Implicit in this objective is the creation of sustained demand for the PV technologies.), and; ii) to develop, test and refine mechanisms for the financing, quality assurance, supply, installation, inspection, and maintenance of PV systems for each of the targeted sub-sectors.

B5. Reasons for assistance from UNDP/GEF

56. UNDP's mandate is sustainable human development with special focus in four key areas: i) eradication poverty; ii) increasing women's role in development; iii) providing people with income earning opportunities and livelihoods; and iv) protecting and regenerating the environment. Energy production and consumption are closely linked to these issues as stated by the UNDP Initiative on Sustainable Energy (UNISE) and in the recent UNDP publication "*Energy after Rio: Prospects and Challenges"*. UNDP is focusing on energy as an essential instrument for socio-economic development. The document strongly emphases the efficient use of energy, as well as the use of renewable sources of energy.

57. As a non-annex 1 country, party to the UNFCCC, Malawi has access to the GEF to assist in undertaking projects that can show positive incremental costs in the reduction of Greenhouse Gas emissions.

58. The project is consistent with the objectives of the GEF Operational Program/Short-term measure: OP 6: Promoting the adoption of renewable energy by removing barriers and reducing implementation costs. This project responds to these guidelines by describing activities that remove barriers to the renewable energy programme in Malawi.

59. As an implementing agency for the GEF, UNDP has played the primary role in the development and management of capacity building and technical assistance projects funded by the GEF. Through its global network of field offices, UNDP is in an excellent position to assist countries in developing and implementing project activities of this type.

60. The proposed project will contribute directly to the installation of 6,790 PV systems and result in at least 33,000 installed systems by 2015. This compares favourably to the baseline case, where only 7,000 systems would be installed in 2015. In addition to

other domestic benefits, global benefits will include reduced emissions by 578,395 tons of carbon by the year 2015, implying a ratio of US$ 5.70/ton of C for the GEF grant. As the project is expected to have a sustained boosting impact on the Malawi PV market, the total reductions of GHG gases will be substantially greater.

B6. Special Considerations

61. The environmental impacts of this project are generally positive. The substitution of PV systems for fossil fuels reduces the emissions of CO_2, CO, suspended particulates etc. Likewise, it reduces the transport of fuel (kerosene, candles and woodfuel). A major risk of a negative impact on the environment could be the increased use of batteries containing lead and sulphuric acid and their improper displacement. To mitigate such an event, it will be necessary to strengthen the existing systems of recycling or to create new ones.

62. To enhance the possibilities of success of the project, the active participation of end-users is essential. This will be the challenge faced by the project as Malawi is such a poor country. The project is therefore designed around interventions that are most likely to succeed, and while succeeding, provide an affirming demonstration to potential future PV and other RETs users.

63. The project should end up in a situation, where the environment and the general conditions for a private enterprise interests in rural electrification using PV systems are improved. For this to happen, the participation of the private sector in the project is essential. This will be done through the Project Management Unit and Project Steering Committee of the project (see co-ordination arrangements Section B7. below). However, this should not result in conflicts of interest arising nor affect negatively the transparency and neutrality of the project with respect to the bidding and other commercial relationships the project will have with the private sector.

B7. Co-ordination arrangements

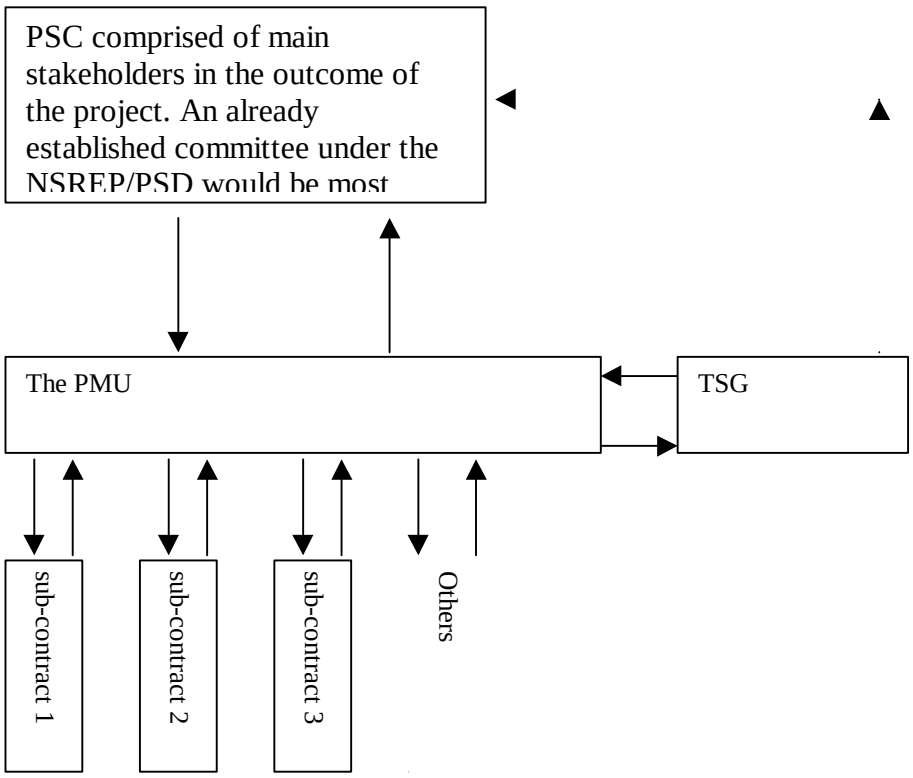
64. The barrier removal activities described in the project are to be implemented by a Project Management Unit (PMU) that will be in place for the 5-year duration of the project.

65. The project implementation strategy is to have the project steered by public and private sector institutions (that are key receivers of policy insights), but managed by institutions outside of Government.

66. The institutional arrangement that is required to undertake the project is defined by the tasks it has to perform. These tasks use various instruments to reduce and/or remove the barriers.

67. The following institutional arrangement is suggested, as shown in Figure 1.

FIGURE 1: The institutional arrangements of the project



68. The PSC will guide the implementation of the project to ensure that the results are disseminated to, and evaluated by, relevant stakeholders and that they support the smooth transition from this enabling activity to the further development and growth of the RET market in Malawi. PSC specific functions are:

- to review and sign off on the project proposal;
- to review all outputs of the project on a bi-annual basis and sign off on these, thus liberating the next tranche of resources directly to the PMU from the GEF and other co/parallel financiers;
- report on the progress of the project to the permanent secretary and the minister; and
- to interpret the policy implications of the outputs of the project and devise ways in which they can be incorporated into policy.

69. The existing NSREP/PSD steering committee will act as the PSC. This committee should consider co-opting the following organisations if they are not already part of the PSC:

- Department of Energy;
- Department of Environmental Affairs;
- National Economic Council;
- ESCOM;

- UNDP;
- Danida
- NGOs (CONGOMA, CEEDS, and CURE (one representative per NGO)); and
- REIAMA;
- Department of Met Services;
- Ministry of Women and Children Affairs;
- Ministry of Agriculture;
- City Assemblies (Blantyre, Lilongwe and Mzuzu);
- Ministry of Finance;
- Financiers (MDC, IndeBank, IndeFund, MRF, SEDOM, and FINCA);
- MIRTDC;
- SOBO;
- University of Malawi (Bunda, Mzuzu, Chancellor College, Polytechnic);
- Tobacco Industry (Agricultural Research and Extension Trust (ARET) and Tobacco Association of Malawi (TAMA)).

Additional members will include:

- Other United Nations Agencies e.g.UNESCO, UNEP etc.

The PSC will be chaired by a neutral development facilitator mandated to drive project consensus with the Department of Energy managing the project secretariat.

70. In determining the final composition of the PSC, efforts will be made to ensure that the key sectors are equally represented including key government ministries, financial institutions, training institutions, NGOs, private industry, and potential users, while at the same time maintaining a limited number of seats in order to keep the PSC effectively functional.

71. The PMU will take over part or all of the activities of the Danida supported Interim Support Unit (ISU). For a description of the role of the ISU refer to Annex X. The protocol for this will be established when the GEF project is launched. For a description of the roles of the Project Manager/Co-ordinator (PM) and the PMU refer to Annexes V and VI.

72. The technical support group (TSG) provides project back-stopping on all key areas to the PMU. In addition, it is involved at the planning stages of the project and negotiates project performance indicators that constitute part of the reporting methodology. The TSG has a third party ad hoc relationship with the project and may be called on to advise the PSC in their interpretation of the project's progress.

73. Members of the TSG include, where possible, in-country or international consultants from the region. However, where skills are not available or where specialist skills or experience cannot be located regionally, consultants from beyond the region will be recruited.

74. There are two types of subcontractors:

- organisations who are assisted in their barrier reduction/removal activities; and
- specialists to whom work is out-sourced.

75. As expressed in the Instrument of the Global Environment Facility, in the event of disagreements between UNDP and any entity concerning project preparation or

execution, UNDP or the concerned entity may request the GEF Secretariat to seek to resolve such disagreements.

B8. Counterpart support capacity

76. To ensure the successful implementation of the project, GOM through its Department of Energy has agreed to establish the PSC and take the first steps in employing a PM to lead the PMU. At these early stages of the project, the logistical support of GOM and UNDP agencies will be crucial in creating a collaborative momentum between the project staff and the Government.

77. The collaborative support capacity will be maintained throughout the project through the quarterly PSC meetings . A contribution of the Department of Energy will be to act as a secretariat for the PSC.

78. The Government of Malawi participates in the project with an in-kind and counterpart financing of US$1.855 million, which consists mainly of resources from the Energy Fund over the duration of the project, but also includes in kind contributions.

3. C. DEVELOPMENT OBJECTIVE

79. The development objective of the project is to remove barriers to increase photovoltaic electricity generation and renewable energy utilisation in the household, public institutional, commercial and agro-industrial processing sectors in Malawi. The use of these technologies will contribute to reductions in the long-term growth of the GHG emissions from the burning of fossil fuels and unsustainable cropping of biomass needed to satisfy the needs of urban and rural Malawians.

4. D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

D1. Immediate objective

80. To remove/reduce technical, financial, human capacity, normative and institutional barriers to the increased use of photovoltaic generated electricity for lighting, refrigeration, media and tobacco curing process control in Malawi.

D1.1. Component 1: Capacity building

81. The capacity building component of the project is targeted at three groups (the Private Sector (PV industry); the Government, and NGOs and CBOs) and for creating and strengthening an outfit (PMU) for managing and implementing the project. The component is accordingly divided into four sub-components D1.1.1., D1.1.2., D1.1.3., and D1.1.4. While there are capacity building activities included under Component 3. PV regulatory framework, the design of regulatory instruments predominates and thus component 3 has not been incorporated in this section and stands alone.

D1.1.1. Private sector

82. Output 1.1: Trained technicians are in place to install PV systems.

Activity 1.1.1:	the design and execution of specialized short courses tailored to build the capacity of the PV industry.
Activity 1.1.2:	the training of technical trainers.
Activity 1.1.3	the preparation and dissemination of a PV (installation, inspection, and maintenance) handbook.
Activity 1.1.4:	the establishment of a PV Industry Association within 12 months of the start of the project.

Activity 1.1.5: the planning and implementation of an RD&D activity to identify the most appropriate PV technologies and dissemination strategies for the market with specific attention to low-income Malawi households.

D1.1.2. Government

83. Output 1.2.1: National energy policy and policy instruments are in place to further enable the use of PV systems

Activity 1.2.1	contributing to the development of the National Energy Policy.
Activity 1.2.2	development of an operational/legal framework for the Energy Fund for Rural Electrification.
Activity 1.2.3	the establishment of a Renewable Energy Unit (REU) in the DOE.
Activity 1.2.4	designing and presenting policy seminars and workshops on RETs with stakeholders, Department of Energy officials and policy makers.
Activity 1.2.5	to organise joint study tours for government officials, policy makers, RE industry representatives, and members of the PMU.
Activity 1.2.6	training of REU staff.

And with specific reference to the PMU:

84. Output 1.2.2: The project management unit is equiped to manage a five year barrier removal project.

Activity 1.2.7	the establishment of a PMU.
Activity 1.2.8	the participation of PMU staff alongside other key project players in technical and management training courses/seminars/workshops.
Activity 1.2.9	the regular programming of planning, review and re-orientation workshops with other key players in the project facilitated by experienced management consultants.
Activity 1.2.10	the planning of study tours for PMU staff alongside other key role players in the project implementation.
Activity 1.2.11	the participation of the PMU staff with key project players in international conferences, workshops, trade fairs/expos.
Activity 1.2.12	the arrangement of secondments to and from regional projects for PMU staff and other key role players in the project implementation.
Activity 1.2.13	The PMU will design and implement a RE/PV resource centre.

D1.1.3. NGO/CBO

85. Output 1.3 The NGO/CBO community understand the implications of PV electrification and are able and willing to advocate its use for certain energy services where appropriate.

Activity 1.3.1	the design and execution of specialised short courses for NGO/CBO project workers on approaches to sustainable energy planning with specific attention to PV systems.

Activity 1.3.2 the planning and execution of advocacy and planning seminars/workshops.

D1.2. Component 2: Creating public awareness

86. Output 2: The awareness of the costs and benefits of PV systems essentially for end-users, but also for policy makers, planners, financiers, local governments, NGOs and CBOs is built.

Activity 2.1: A cadre of community based energy advisors is selected and trained.

Activity 2.2: A team is sub-contracted to focus their efforts on the public awareness component of the project is selected. Publicity and promotional campaigns will be developed and disseminated through community based energy advisors, workshops, printed, electronic, drama and other media routes.

Activity 2.3: The team will be involved in structuring and devising teaching aids for community/district based workshops. The Malawi Social Action Fund (MASAF) networks and/or the proposed District Development Committees (DDC) will be considered as ways to reach the public.

D1.3 Component 3: PV regulatory framework

87. Output 3: The standards and codes of practice for the PV technologies, their installation and maintenance are developed and implemented.

Activity 3.1: undertake workshops to negotiate standards, codes of practice and compliance protocols with industry and other stakeholders.

Activity 3.2: the preparation and publication of a PV testing kit that can be used by system inspectors to establish whether the systems meet installation and performance specifications.

Activity 3.3: the preparation and publication of draft codes of practice and standards for PV installation and maintenance.

Activity 3.4: the preparation and publication of draft compliance protocols.

Activity 3.5: the training of PV systems inspectors (initially employed by the project).

Activity 3.6: the establishment of a PV testing facility under one or more of MEDI, University of Mzuzu or MIRTDC.

D1.4. Component 4: Financial barriers removed

88. Output 4: Financiers understand the technologies and are willing to lend to purchases of equipment at an affordable interest rate.

Activity 4.1 the project will identify banks and other institutions that finance the PV technologies for institutional, commercial, agro-industrial and rural and urban household sectors in Malawi.

Activity 4.2: the project will compile, and develop, training tools to deepen the appreciation and implications of financing PV systems. Indicative training tools could include written and audio-visual

documentation, exposure to projects in the SADC region and beyond, study tours, workshops, staff exchanges, in-house short-term specialist consultancies and so on.

Activity 4.3: explore and refine different financing possibilities emerged during preliminary project development phases.

Activity 4.4: undertake feasibility studies for PV projects.

Activity 4.5: secure the removal of import duties on PV technologies and efficient end-use equipment prior to project implementation.

Activity 4.6: assist financial institutions in the development and implementation of special purpose wholesale/retail financial vehicles (or other appropriate financing vehicles) tailored for the different modalities/market niches and delivery modes.

Activity 4.7: design incentive targeting strategies and their phase-out at the end of the demonstration activities.

Activity 4.8: prepare and publish a PV guide for investors.

Activity 4.9: undertake financial engineering courses for financing PV systems.

Activity 4.10: network regional and international finance where this is complimentary with project financial strategies for end-users and/or suppliers and Malawi based financial institutions.

Activity 4.11: extend financial instruments to other RETs technologies on the basis of successful financing of PV systems.

D1.5. Component 5: PV demonstration projects

89. Output 5: 6790 PV systems are installed that provide an affirming demonstration for financiers, policy makers and potential users of the cost effective and reliable applications of the technology. The delivery mechanisms described in annex IX will form the basis of the demonstration.

Activity 5.1: develop and refine demonstration approach protocols.

Activity 5.2: facilitate the implementation of demonstration projects in each of the targeted sectors.

Activity 5.3: publicise the lessons leaned from PV demonstration projects.

E. INPUTS

90. Resource inputs to the project are in-kind and co-financing. The in-kind contributions are from government and other institutions on the steering committee which volunteer their time. The logistical support for the steering committee will be included in the project budget.

91. The opportunities for inputs to the project include:

- the Department of Energy through the Energy Fund;
- the UNDP for capacity building and further PSD funding through TRAC;
- the SADC TAU through the FINESSE country study and the potential bridging phase to follow;
- the Agricultural Research and Training Trust;
- Norad;
- the World Bank/ESMAP (through grant and potentially loan financing);
- Danida; and

- Carlsberg and Coca-Cola bottlers (SOBO).

92. All of the above institutions have expressed interest in the development of renewable energy in Malawi and have allocated or are in the process of allocation resources to the development of renewable energy and/or energy optimisation.

93. The following inputs are expected to be co-financing to the project budget:

E1. The Department of Energy through the Energy Fund.

94. The Department of Energy potentially has access to an Energy Fund for on and off-grid rural electrification. The Fund is resourced through a levy on oil and an electricity tax. Currently the tax on electricity is not being deposited into the fund and is remaining in the Treasury and being added to the fiscus. The oil levy is finding its way to the fund that adds on average MK35 million per year collected through this modality. But if the electricity levy component were added, this would be substantially more.

95. The project will assist in providing legal and economic assistance to facilitate gaining access to the electricity tax and developing a modality for the Department of Energy to gain access to the Fund's Reserve Bank holding account.

96. The project will secure US$1.5 million as a contribution to the Financial Special Purpose Vehicle for carrying risk on the loans for PV lighting and refrigeration. The Fund will also be approached to provide 50% of the resources for the 1000 demonstrations of PV lighting installations in institutions amounting to US$1.1 million. Both of these allocations are consistent with the aim of rural electrification, but as the fund does not have disbursement modalities in place, these resources cannot be confirmed as co-financing at this stage. However, the Department of Energy has given assurances that in principle this can be achieved. Once these modalities are in place the Government of Malawi will commit resources to the project to the amount of US$1.855 million.

97. The GOM will remove import duties on equipment used in this project.

98. In addition to the Energy Fund's contribution to the project, the project will receive contributions in kind through the effort of GOM officials.

E2. World Bank

99. While it appears that the World Bank will not be in a position to disburse funds for renewable energy work in Malawi for the next few years, it has agreed to finance the development of Malawi's first National Energy Policy. The World Bank have constributed US$145 000 for this exercise which began in March 2000.

E3. The UNDP through TRAC

100. The UNDP TRAC facility is supporting the development of the PSD, which provides rationale and thus support for this project proposal. The TRAC facility will assist in building capacity for the efficient execution of the project. The UNDP local office will schedule US$898 000 over the first 3 years of the project for such activities. In addition there will be other TRAC resources that can be programmed adding up to a total project contribution of US$1.19million over the 5-year duration of the project.

E4. DANIDA

101. Danida downplays its interest in the Malawi energy sector but has mobilised extensive funding for the development of renewables. The TOR for the Danida programme includes a 4-phase project that covers technical assessment, demonstration, and capacity building. Technologies that are being assessed include wind energy, biogas, and solar.

102. The Danida programme intends ramping up funding from US$1million in year 1 to US$3 million in year 5. The programme has developed an innovative institutional arrangement at arm's length from government, which is comfortable to both government and Danida. Danida had agreed to align the activities of this programme to the GEF project to the tune of about US $2.5 million over the five years of this project. Specifically Danida fund will cover the cost of developing information databases for biogas and PV, as well as assisting in covering the costs of the demonstration for biogas and PV technologies. (See notes referring to the 3 year budget in section J. and Annex X).

E5. Southern Bottlers (Malawi) Ltd (SOBO).

103. SOBO was approached to consider using photovoltaic powered energy efficient DC refrigerators for off-grid retailing of their products. The project team suggested that this would provide a marketing possibility for the Carlsberg Green Fund and provide a tangible demonstration of photovoltaic powered energy services. In addition, the bulk procurement of energy efficient refrigerators would pull the market in the direction of improved efficiency. SOBO requested more information and have been linked up with a local PV supplier, Sollatek, by the project preparation consultant team**.** SOBO's link to the beverage retailers provides both a marketing angle and bulk and retail financing possibilities. SOBO's contribution is equivalent to 2000 refrigerators costing US$1000 each, which they would be replacing anyway over the next 5 years.

104. SOBO is currently testing the PV installations and should these prove viable, SOBO are committed to providing US$2 million in co-financing along with other project donors for PV-refrigeration systems for their beverage retailers over the project cycle.

E6. NORAD

105. NORAD has suggested that energy is not a priority for them in Malawi, though they are interested in agricultural processing. The possibility therefore exists for NORAD to participate in considering co-financing of the ARET, sugar, tea and coffee industry interventions.

106. NORAD was not considered as a co-financier directly, but may be approached to share the costs of the ARET PV fan interventions one the project is implemented.

E7. The Agricultural Research and Extension Trust

107. ARET are committed to providing half of the resources for the tobacco curing intervention including PV fans for controlled combustion of wood fuel in tobacco curing barns. This contribution amounts to US$112,000.

108. ARET have agreed to be the retail financiers for the PV Fans to their farming constituency.

E8. The purchasers of RETs in Malawi

109. Purchasers will be asked to co-finance the demonstration projects. This contribution will amount to approximately US$7.29 million to add to the project contribution. (The total cash input to the project through co-financing is US$7.304 million, but is excluded from the co-financing contributions to the project. Commitments to make these payments will be made between end-users and retail financiers of the project where financing is required.)

E9. The Global Environment Facility

110. The Global Environment Facility has agreed to finance the incremental cost of the project. The Government of Malawi will complement the project with the baseline costs in cash and in kind. The incremental cost matrix is presented in Annex I. The contribution of GEF is US$ 3.353 million over the 5 years of the project.

5. F. RISKS

111. A risk inherent to a project which focuses on barrier removal is the expectation that in the medium to long term, private entrepreneurs will seize the opportunity of a transformed market and take over the investment process for replication and sustainability. The implementation of this project will improve the commercial attractiveness of PV technologies. By effectively reducing the price (limited subsidies that will be phased out, and waiving import duties), stimulating the provision of dedicated credit facilities, building capacity to design, evaluate, and undertake PV projects, providing an enabling policy environment, design and implementation of standards and codes of practice for the maintenance of systems, providing tangible demonstrations followed up by development of public awareness, etc. The implementation of this project should create conditions in which the private sector is stimulated.

112. To enable sustainability of the project momentum, it is expected that upon completion of the project, DOE shall continue to play a key co-ordinating role in the implementation of renewable energy activities in Malawi. Institutional mechanisms for this continuity are provided through the steady flow of funds into an operational Energy Fund and the functioning of the (REU), being guided by the NSREP. By attaching middle level managers and technicians to understudy the PM, other PMU task experts and Technical Support Group members in the project implementation process, the project shall have trained a pool of expertise whom the DOE and the Private Sector may redeploy for their own long term renewable energy activities.

113. There are three options for the continuation of the PMU at the end of this project: the unit may cease to exit; it may be subsumed by a semi-autonomous body in the government; or it may be taken over by the industry association. An appropriate decision on this would be made before the end of the project.

6. G. PRIOR OBLIGATIONS AND PREREQUISITES

G1. Prior Obligations

114. Malawi signed the UNFCCC at the Rio Earth Summit in June 1992. This was ratified on 2 April, 1994 and entered into force on July 21, 1994. The ultimate objective of the Convention is "*…the stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with*

the climate system. Such a level should be achieved within the time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner". (UNEP/WMO, 1992)

115. At the Rio Conference, energy played a major role, because energy supply and use was recognized as one of the major cause of environmental degradation both at the local level as globally. Energy issues prior to Rio were concerned mainly with increasing energy supply, energy consumption per capita being a key indicator of modernization and progress. After Rio, attention of energy planners shifted to the amount of energy services delivered not to the amount of energy used. The Rio Conference also recognized energy as essential for development and Malawi along with 149 other countries committed themselves to Sustainable Development and Protection of the Environment and this resulted in the Rio declaration, Agenda 21, and in the UNFCCC. To this effect, Agenda 21, Chapter Nine makes the following important point: "*Much of the world's energy is currently produced and consumed in ways that could not be sustained if technology were to remain constant and if overall quantities were to increase substantially. The need to control atmospheric emissions and other gases and substances will increasingly need to be based on efficiency in energy production, transmission, distribution and consumption, and on growing reliance on environmentally sound energy systems, particularly new and renewable energy sources of energy*".

116. As a signatory to the Convention, Malawi is fully committed to comply with the provisions of UNFCCC, and Agenda 21 by promoting the production and use of alternative energy technologies. As a first step to fulfilling its commitment, GOM has produced an inventory of greenhouse gas emissions and sinks for 1990 and with the assistance of UNDP drafted a NSREP document. The NSREP document has just been completed representing the first major step towards the establishment of a national sustainable energy policy.

G2. Prerequisites

117. i) GOM will support the project implementation process in cash and kind.
ii) Provision of data to project staff and consultants as may be required for the implementation of the project activities;
iii) Identifying qualified national and international experts and consultants to participate in project activities as and when required;
iv) Will provide and respect the mandate given to the PMU;
v) Designating, wherever necessary, qualified counterpart staff from relevant ministries and other institutions for the duration of the project;
vi) Authorising the PSC to be the main body to guide the implementation of the project;
vii) Undertaking the secretariate role of the PSC meetings and participating in PMU meetings upon reasonable request;
viii) The GOM agrees to remove import duties on technologies employed by the project; and
ix) Advising and administering the release of project and complementary government funding as and when required.

118. The Project Document will be signed by GOM and UNDP. Assistance for the project will be provided only if the pre-requisites stipulated above have been fulfilled or are likely to be fulfilled. When anticipated fulfilment of one or more prerequisites fails to materialise, UNDP-GEF may, at its discretion, either suspend or terminate its assistance**.**

119. According to the established mechanisms of UNDP, the GOM will contribute the counterpart funding needed for the project's implementation once the project has been approved.

7. H. PROJECT REVIEW, REPORTING AND EVALUATION

120. After the detailed work plan has been prepared, it shall be subject to an independent review. The purpose of such review shall be to identify, at the very outset of the project, potential gaps, overlaps, and other risks to successful implementation, potential partners and sources of information from which the project stands to benefit.

121. UNDP together with the PSC, shall be responsible for monitoring the project on a continuous basis. The PM and his collaborating staff shall be responsible for co-ordinating and supporting the monitoring process. Monitoring activities shall include regular visits of project sites, regular meetings of project staff, and biannual meetings between project staff and PSC. In order to facilitate the PSC meetings, the PM, with the assistance of his collaborating staff, shall prepare and submit to PSC biannual reports on the progress of the project including the sub-tasks.

122. The project shall be subject to two kinds of evaluations. A Tripartite Review (joint meeting of the representatives of GOM, UNDP-Malawi, UNDP-GEF and the co-financiers) at least once every 12 months. The first such review shall be held within the first 12 months of the start of the full project implementation. The PM shall prepare and submit to each joint review meeting a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if necessary, during the project. A mid-term evaluation at the half-way point and a terminal evaluation at the end of the project must also be undertaken.

123. A Project Terminal Report (PTR) shall be prepared by the TSG in collaboration with the PM for consideration at the terminal annual review. The PTR shall be prepared in draft in advance to allow its preview and technical clearance before final tabling.

124. In the end of the project, the Project Leader and the GOM Department of Energy will prepare and present to UNDP the final report on the activities and results of the project.

125. The Project will be monitored by the DEP experts selected by UNDP/GEF working with the Co-ordination of the Programme or by a contracted supervising firm. UNDP’s extensive experience in monitoring large projects will be drawn upon to ensure that the project activities are monitored and properly documented. In this programme, the repayment records of end-users etc., is of particular importance. This is essential for sustainability of the PV Systems, and for future expansion of the programme. The project-planning matrix with the monitoring indicators is presented in Annex II.

8. I. LEGAL CONTEXT

126. This project document shall be the instrument referred to as such in Article 1 of the Standard Basic Assistance Agreement (SBAA) between the GOM and the UNDP, signed by the parties on July 15, 1977. The host-country implementing agency shall, for the purpose of the SBAA, refer to the Government co-operating agency described in that Agreement.

127. The following types of revisions may be made to this project document with the signature of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the project document have no objections to the proposed changes.

128. Revisions in, or addition of, any of the annexes of the project document (with the exception of the Standard Legal Text for non-SBAA countries which may not be altered and the agreement to which is a pre-condition for UNDP assistance);

129. Revisions to the project will be permitted through agreement with the PSC are allowed which; i) do not involve significant changes in the immediate objectives, outputs or activities of a project, but are caused by rearrangement of inputs agreed to or by cost increases due to inflation; and, ii) mandatory annual revisions, which rephase the delivery of agreed project inputs or increased expert or other costs due to inflation or which take into account agency expenditure flexibility.

130. The Government will provide the Resident Representative with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNDP (including GEF) funds according to the procedures set out in Section 30503 of the UNDP Policies and Procedures Manual (PPM) and Section 10404 of the UNDP Finance Manual. The Audit will be conducted by the legally recognized auditor of the Government, or by a commercial auditor engaged by the Government.

9. J. BUDGET

130.J.1 TABLE 2: Project budget

Component	GEF	UNDP	SOBO	GOM	DANIDA	Total
1. Capacity building and institutional strengthening						
1.1 PV Industry	282	50			303	**635**
1.2 Government	953	303			941	**2197**
1.3 NGOs/CBOs	200	50			300	**550**
Renewable Energy Resource Centre		246				**246**
Sub-total	1435	649			1544	**3628**
2. Creating pubic awareness						
• Publicity and promotion	330	45				**375**
• Undertake seminars and workshops	100	185				**285**
• Organise Field Tours	100	200				**300**
Sub-total	530	430				**960**
3. PV Regulatory framework						
• Prepare and publish PV Testing Kit	50				138	**188**
• Prepare draft Codes of Practice etc.	86					**86**
• Prepare draft compliance protocols	86					**86**
• Negotiate Standards, Codes etc Protocols	104					**104**
Sub-total	326				138	**464**
4. Financial barrier removal						
• Undertake feasibility studies	58					**58**
• Undertake Import Tax analysis	85	50				**135**
• Establish special purpose/financial vehicle	173					**173**
• Design incentive targeting strategies	54					**54**
• Prepare and publish a PV Guide	65					**65**
• Undertake financial engineering courses		70				**70**
• Network with financiers	54					**54**
• Extend financial instruments	29					**29**
Sub-total	518	120				**638**
5. PV demonstration projects						
• Development of demo approach protocols	58					**58**
• Facilitate the implementation of PV demos			2000	1855	568	**4423**
• Publicise lessons learned from demos	78					**78**
Sub-total	136		2000	1855	568	**4559**
• Project Monitoring & Evaluation	100					**100**
• Project Support Services (3%)	308					**308**
Sub- total	408					**408**
TOTAL Costs (USD)	**3353**	**1199**	**2000**	**1855**	**2250**	**10657**

note 1: Figures are in 1000s US$s valued as in November 1998. (i.e.MK42=US$1)
note 2: The project does not include the purchase of demonstration equipment by end-users (excluding GOM and SOBO contributions). This amounts to an additional US$7.29 million.
note 3: The budget is based on contributions by Danida which are specified for the first two years. In this period Danida is funding and implementing for US$600,000 to PV and has allocated US$540,000 for capacity development - to be specified during inception in January 2000. The US$ 540,000 has been distributed to various stakeholders. The US$540,000 will (be) used for the PMU and co-fund, compliment or supplement UNDP/GEF funding. The money will not be given to PMU as a lump sum but will be used according to a Danida approved work plan (specified by M. L. Christensen personal correspondence 23/11/99)
note 4: This is the FIRST contribution and second phase is planned for – if found feasible- A budget for the next phase has not been work out but could be in the order 1,5 to 3,0 million US. (specified by M. L. Christensen personal correspondence 23/11/99). The second phase will coincide with the GEF project years 3 onwards
note 5: The budget does not reflect the US$64,000 for development of the project brief and document.

The project budget is presented below in UNDP format:

J.2 TABLE 3: Project budget (UNDP format)

Page 1 of budget

Sbln	Description	Implementing		Total	2000	2001	2002	2003	2004	2005
10	PROJECT PERSONNEL									
11	International Experts & Consultants									
1101	International Advisor	UNOPS	Net Amount	412,500	37,500	150,000	150,000	75,000		
			W/M	33	3	12	12	6	0	0
			AOS	33,000	3,000	12,000	12,000	6,000		
			Total	445,500	40,500	162,000	162,000	81,000		
1197	International Expert & Consultants	UNOPS	Net Amount	387,500	75,000	75,000	75,000	75,000	50,000	37,500
			W/M	31	6	6	6	6	4	3
			AOS	31,000	6,000	6,000	6,000	6,000	4,000	3,000
			Total	418,500	81,000	81,000	81,000	81,000	54,000	40,500
1199	Line Total	----------	Net Amount	800,000	112,500	225,000	225,000	150,000	50,000	37,500
			W/M	64	9	18	18	12	4	3
			AOS	64,000	9,000	18,000	18,000	12,000	4,000	3,000
			Total	864,000	121,500	243,000	243,000	162,000	54,000	40,500
13	Admin. Support Personnel									
1301	Administration secretary	NEX	Net Amount	18,300	1,200	3,600	3,600	3,600	3,600	2,700
			W/M	72	3	24	12	12	12	9
			Total	18,300	1,200	3,600	3,600	3,600	3,600	2,700
1302	2 Drivers	NEX	Net Amount	26,000	1,000	6,000	6,000	6,000	6,000	1,000
			W/M	104	4	24	24	24	24	4
			Total	26,000	1,000	6,000	6,000	6,000	6,000	1,000
1303	Account Clerk	NEX	Net Amount	12,000	600	2,400	2,400	2,400	2,400	1,800
			W/M	60	3	12	12	12	12	9
			Total	12,000	600	2,400	2,400	2,400	2,400	1,800
1304	Secretary for TCA	NEX	Net Amount	18,000	900	3,600	3,600	3,600	3,600	2,700
			W/M	60	3	12	12	12	12	9
			Total	18,000	900	3,600	3,600	3,600	3,600	2,700
1305	PR Assistant	NEX	Net Amount	30,000	1,500	6,000	6,000	6,000	6,000	4,500
			W/M	60	3	12	12	12	12	9
			Total	30,000	1,500	6,000	6,000	6,000	6,000	4,500
1399	Line Total	----------	Net Amount	104,300	5,200	21,600	21,600	21,600	21,600	12,700
			W/M	356	16	84	72	72	72	40
			Total	104,300	5,200	21,600	21,600	21,600	21,600	12,700
15	Duty Travel									
1502	Monitoring & Evaluation	NEX	Net Amount	160,000	10,000	30,000	30,000	30,000	30,000	30,000
			Total	160,000	10,000	30,000	30,000	30,000	30,000	30,000
1599	Line Total	----------	Net Amount	160,000	10,000	30,000	30,000	30,000	30,000	30,000
			Total	160,000	10,000	30,000	30,000	30,000	30,000	30,000
16	Mission Costs									
1601	Mission Costs	UNOPS	Net Amount	100,000	10,000	20,000	20,000	20,000	20,000	10,000
			AOS	8,000	800	1,600	1,600	1,600	1,600	800
			Total	108,000	10,800	21,600	21,600	21,600	21,600	10,800
1699	Line Total	----------	Net Amount	100,000	10,000	20,000	20,000	20,000	20,000	10,000
			AOS	8,000	800	1,600	1,600	1,600	1,600	800
			Total	108,000	10,800	21,600	21,600	21,600	21,600	10,800

17 National Professionals									
1701 Project Manager	NEX	Net Amount	84,000	6,000	18,000	18,000	18,000	18,000	6,000
		W/M	56	4	12	12	12	12	4
		Total	84,000	6,000	18,000	18,000	18,000	18,000	6,000
1702 Assistant Project Manager	NEX	Net Amount	70,000	5,000	15,000	15,000	15,000	15,000	5,000
		W/M	56	4	12	12	12	12	4
		Total	70,000	5,000	15,000	15,000	15,000	15,000	5,000
1704 Management Consultants	NEX	Net Amount	23,100	3,300	6,600	6,600	6,600		
		W/M	10.5	1.5	3	3	3	0	0
		Total	23,100	3,300	6,600	6,600	6,600		
1705 Trainers and Training Consultants	NEX	Net Amount	267,600	19,000	57,400	57,400	57,400	57,400	19,000
		W/M	122	9	26	26	26	26	9
		Total	267,600	19,000	57,400	57,400	57,400	57,400	19,000
1706 Economist -consultatnt	NEX	Net Amount	148,000	10,600	31,700	31,700	31,700	31,700	10,600
		W/M	74	5	16	16	16	16	5
		Total	148,000	10,600	31,700	31,700	31,700	31,700	10,600
1707 Finance Specialist -consultant	NEX	Net Amount	74,500	3,890	11,680	11,680	31,680	11,680	3,890
		W/M	27	1.5	6	6	6	6	1.5
		Total	74,500	3,890	11,680	11,680	31,680	11,680	3,890
1708 Legal Adviser	NEX	Net Amount	85,000	10,000	15,000	15,000	15,000	15,000	15,000
		W/M	42.5	5	7.5	7.5	7.5	7.5	7.5
		Total	85,000	10,000	15,000	15,000	15,000	15,000	15,000
1751 National Professionals	NEX	Net Amount	295,400	21,100	63,300	63,300	63,300	63,300	21,100
		W/M	140	10	30	30	30	30	10
		Total	295,400	21,100	63,300	63,300	63,300	63,300	21,100
1799 Line Total	----------	Net Amount	1,047,600	78,890	218,680	218,680	238,680	212,080	80,590
		W/M	528	40	112.5	112.5	112.5	109.5	41
		Total	1,047,600	78,890	218,680	218,680	238,680	212,080	80,590
19 PROJECT PERSONNEL TOTAL	----------	Net Amount	2,211,900	216,590	515,280	515,280	460,280	333,680	170,790
		W/M	948	65	214.5	202.5	196.5	185.5	84
		AOS	72,000	9,800	19,600	19,600	13,600	5,600	3,800
		Total	2,283,900	226,390	534,880	534,880	473,880	339,280	174,590
20 SUBCONTRACTS									
21 Subcontract A									
2101 Capacity Building - Local companies	NEX	Net Amount	120,955	11,000	28,955	27,000	25,000	24,000	5,000
		Total	120,955	11,000	28,955	27,000	25,000	24,000	5,000
2199 Line Total	----------	Net Amount	120,955	11,000	28,955	27,000	25,000	24,000	5,000
		Total	120,955	11,000	28,955	27,000	25,000	24,000	5,000
23 Sub-contract C									
2301 Renewable Energy Resource Centre	NEX	Net Amount	300,000	20,000	60,000	60,000	60,000	60,000	40,000
		Total	300,000	20,000	60,000	60,000	60,000	60,000	40,000
2399 Line Total	----------	Net Amount	300,000	20,000	60,000	60,000	60,000	60,000	40,000
		Total	300,000	20,000	60,000	60,000	60,000	60,000	40,000
29 SUBCONTRACTS TOTAL	----------	Net Amount	420,955	31,000	88,955	87,000	85,000	84,000	45,000
		Total	420,955	31,000	88,955	87,000	85,000	84,000	45,000

30 TRAINING									
31 Fellowships									
3101 Short Courses	NEX	Net Amount	108,000	10,000	22,000	22,000	22,000	22,000	10,000
		Total	108,000	10,000	22,000	22,000	22,000	22,000	10,000
3102 Scholarships	NEX	Net Amount	150,000		30,000	30,000	30,000	30,000	30,000
		Total	150,000		30,000	30,000	30,000	30,000	30,000
3199 Line Total	----------	Net Amount	258,000	10,000	52,000	52,000	52,000	52,000	40,000
		Total	258,000	10,000	52,000	52,000	52,000	52,000	40,000
32 Group Training									
3201 Study Tours	NEX	Net Amount	100,000	10,000	20,000	20,000	20,000	20,000	10,000
		Total	100,000	10,000	20,000	20,000	20,000	20,000	10,000
3299 Line Total	----------	Net Amount	100,000	10,000	20,000	20,000	20,000	20,000	10,000
		Total	100,000	10,000	20,000	20,000	20,000	20,000	10,000
39 TRAINING TOTAL	----------	Net Amount	358,000	20,000	72,000	72,000	72,000	72,000	50,000
		Total	358,000	20,000	72,000	72,000	72,000	72,000	50,000
50 MISCELLANEOUS									
52 Reporting Costs									
5201 Communications	NEX	Net Amount	114,000	13,000	22,000	22,000	22,000	22,000	13,000
		Total	114,000	13,000	22,000	22,000	22,000	22,000	13,000
5299 Line Total	----------	Net Amount	114,000	13,000	22,000	22,000	22,000	22,000	13,000
		Total	114,000	13,000	22,000	22,000	22,000	22,000	13,000
53 Sundries									
5301 Sundries	NEX	Net Amount	107,000	15,000	20,000	20,000	20,000	20,000	12,000
		Total	107,000	15,000	20,000	20,000	20,000	20,000	12,000
5399 Line Total	----------	Net Amount	107,000	15,000	20,000	20,000	20,000	20,000	12,000
		Total	107,000	15,000	20,000	20,000	20,000	20,000	12,000
54 Direct Costs (not for OPS)									
5401 CO Services (UNDP-MLW)	NEX	Net Amount	69,145	4,899	14,024	13,965	14,685	14,097	7,475
		Total	69,145	4,899	14,024	13,965	14,685	14,097	7,475
5499 Line Total	----------	Net Amount	69,145	4,899	14,024	13,965	14,685	14,097	7,475
		Total	69,145	4,899	14,024	13,965	14,685	14,097	7,475
59 MISCELLANEOUS TOTAL	----------	Net Amount	290,145	32,899	56,024	55,965	56,685	56,097	32,475
		Total	290,145	32,899	56,024	55,965	56,685	56,097	32,475
99 BUDGET TOTAL	----------	Net Amount	3,281,000	300,489	732,259	730,245	673,965	545,777	298,265
		W/M	948	65	214.5	202.5	196.5	185.5	84
		AOS	72,000	9,800	19,600	19,600	13,600	5,600	3,800
		Total	3,353,000	310,289	751,859	749,845	687,565	551,377	302,065

ANNEXES

ANNEX I: Incremental Costs

1. Broad Development Goal

The development goal being addressed by the project is the provision of basic energy and electricity services to Malawian households, rural institutions, tobacco farmers and beverage retailers.

2. Baseline

If Malawi had an efficient market for renewable energy, there would be numerous potential win-win investment possibilities in renewable energy technologies that would be undertaken in the absence of this project. However, different barriers related to human resources, institutional capacity, available information, technical skills and financing possibilities hinder the development of these opportunities.

Throughout peri-urban and rural Malawi, lighting is primarily delivered using kerosene and candles. This service is costly to households and could be delivered at better quality to those who could afford it through the use of PV lighting systems. Under the baseline, households will continue to use kerosene, battery-powered torches, and open fires for lighting. For tobacco farmers, no draft control will continue to be the norm for tobacco curing. Rural institutions, such as schools and clinics, are assumed to use kerosene for lighting and LPG and kerosene for refrigeration under the baseline. Finally, commercial sector beverage vendors will expand the use of kerosene and LPG for lighting and refrigeration as part of SOBO's market development initiative.

There are currently some 5000 installed PV systems in different uses in Malawi. Half of them are considered inoperable due to poor installations and limited maintenance capacity. The sales of PV system are estimated at 250 systems per annum and this rate is expected to continue for the foreseeable future. Under the baseline scenario, it is estimated that there will be around 7000 PV systems operating in the year 2015 in the absence of the proposed project. These will result from the proposed DANIDA project, as well as from projected current sales trends.

3. Global Environmental Objectives

The global objectives are related to GEF Operational Program 6: Promoting the adoption of renewable energy by removing barriers and reducing implementation costs. By expanding the market for renewable energy in Malawi, not only will there be immediate short-term GHG emission gains, but there will also be the collective benefit of expanded PV usage.

4. GEF project activities

Project activities aim at removing barriers to the implementation of solar PV technology in Malawi. The increase in the use of PV systems will reduce the amount of CO_2 emitted in providing lighting, combustion control and refrigeration. At the end of the project, it is anticipated that there will be a vibrant and growing PV market in Malawi.

The barriers identified relate to limited institutional capacity, lack of public awareness of both the potential and feasibility of PV's in Malawi, lack of commercially-oriented demonstrations of selected PV applications, and immense financial barriers to the commercial financing of PV systems. The first set of project activities is designed to strengthen Malawian institutions to be able to manage, maintain and oversee PV installations as well as the project. Capacity building activities will be aimed at the PV industry, Government of Malawi, NGO's, and the project management unit. The second set of project activities aims at creating public awareness of electrification possibilities using PV's. The third set of project activities seeks to strengthen the regulatory

framework for PV's and to ensure that internationally acceptable standards are adopted for local PV systems and installations. The fourth set of activities is designed to create capacity within the financial sector to attract, process and approve loans to consumers and private sector entities wishing to either purchase of sell PV systems. The final project activity seeks to provide a number of successful demonstrations of PV applications. For these demonstrations, GEF resources will largely be used for establishing a monitoring and information system to disseminate lessons. All GEF project activities are summarized in the Incremental Cost Matrix, Table AI.1.

5. System boundary

The system being considered in this project is the Malawi energy system, particularly peri-urban and rural areas. The four principal sub-markets considered are: household use for lighting and radio/TV use in both urban and rural households; institutional use in schools and health posts; PV-driven fans to tobacco curing; and PV refrigerators and lighting for beverage retailers. The barriers removed by the project will also facilitate market creation for other possible stand-alone PV applications. No changes in project design could be expected to occur with reasonable shifts in the system boundary.

6. Additional benefits

Additional benefits attributable to project activities can be expected to take several forms. First, employment will be created amongst installers and maintainers of the PV systems. Those consumers investing in PV systems for lighting will receive substantially higher quality lighting at virtually the same cost as in the baseline. Tobacco farmers will have greater control of combustion of wood in tobacco curing barns and thus improved efficiency and reduced costs. In addition, local, particularly indoor air quality will improve due to reduced reduced CO and particle emissions from kerosene use.

7. Project Costs

The entire project costs US$10.6 million of which GEF is being asked to grant US$3.3 million over 5 years for the barrier removal activities defined in the project. It is anticipated that at the end of the project, the PV market in Malawi will continue to grow at rates summarized elsewhere in the brief. In addition to the domestic benefits, global benefits will include reduction of 578,395 tons of C by 2015 implying a unit abatement cost of US$5.70/ton of C over the life of the PV systems (using the GEF contribution as the numerator).

ANNEX Ia.: Incremental Cost Matrix

Table 1 Incremental Cost Matrix

Components	Cost category	Costs (in US$1000s)	Domestic benefits	Global Environmental benefits
1. Capacity building and institutional strengthening among PV industry, Government, NGOs/CBOs and PMU	Baseline	2193 (total) UNDP (649) Danida (1544)	Capacity to develop, design and monitor PV technologies not available in Malawi, renewable energy center established with support from UNDP	None
	Alternative	3628 (total) GEF (1435) UNDP (649) Danida (1544)	PV industry, Government officials and NGO/CBO workers appropriately trained; PMU trained to undertake project activities, renewable energy center established	PV technical cadre increased
	Increment (Alternative – Baseline)	1435 GEF	Increased human and institutional capacity to sustain a PV programme in Malawi developed	PV technical cadre increased
2. Creating public awareness	Baseline	430 UNDP	Public unaware of PV electrification possibilities, where to source PV systems and how to finance them	None
	Alternative	960 (total) UNDP (430) GEF (530)	Public aware of PV electrification possibilities, where to source PV systems and how to finance them	Increased awareness of the PV applications
	Increment (Alternative – Baseline)	530 GEF	Malawi public aware of PV electrification, where to source and how to finance them	Increased awareness of the PV applications
3. PV Regulatory framework	Baseline	138 Danida	Lack of standards increase O & M costs and reduce credibility of PV system reliance	None
	Alternative	464(total) Danida (138) GEF (326)	Standards, installation codes of practice, anti-theft protocols and compliance regimes established and applied	Improved PV systems installed and maintained
	Increment (Alternative – Baseline)	326 GEF	Higher consumer confidence in PV systems, suppliers, installers and maintainers	Improved profits for PV industry, reduction in cross border trafficking of stolen systems
4. Financial barriers overcome	Baseline	120 UNDP	Financial institutions unable to process loans for PV systems	None
	Alternative	638 (total) UNDP (120) GEF (518)	Financial institutions process loans for PV systems	PV market opened to credit sales
	Increment (Alternative – Baseline)	518 GEF	Financing available for PV systems	PV market expands, demonstrable PV electrification progress
5. PV Demonstration projects (see other incremental cost matrix)	Baseline	4423 (total) Danida (568) GoM (1855) SOBO (2000)	SOBO provides retailers with LPG refrigerators, households and educational facilities remain unlit or lit with kerosene/candles; DANIDA uses US$0.568 million to cover the incremental costs for PV systems, and GoM contributes US$1.855 for rural electrification	3350 Privately Disseminated PV systems plus 1200 PV household systems supported by Danida avoid 13,995 tons of carbon emissions (t_c) during their lifetime
	Alternative	4559(total) Danida (568) GoM (1855) SOBO (2000) GEF (136)	SOBO provides retailers with PV refrigerators, households and educational facilities are lit with PV systems; GEF develops protocols for demos and disseminates lessons about experiences and learning	9290 PV demonstration systems avoid 116,780 tons of carbon emissions (t_c) during their lifetime
	Increment (Alternative – Baseline)	136 GEF	Better quality of light in PV-lit buildings, reduction of CO and particulate emissions, improved efficiency in tobacco curing and refrigeration	4740 additional PV systems avoid 102,785 tons of carbon emissions (t_c) during their lifetime

Table 1 Incremental Cost Matrix (continued)

TOTAL	Baseline	7304 (total) SOBO (2000) Danida (2250 UNDP (1199) GoM (1855)	SOBO installs LPG refrigerators. Limited number of PV systems demonstrated; GoM spends money on grid-connected electrification	Barriers prevent the increased penetration of PV systems in Malawi.; only 7000 systems installed by 2015 avoiding 21,532 tons of carbon emissions (t_c) during their lifetime
	Alternative	10657 (total) SOBO (2000) Danida (2250 UNDP (1199) GoM (1855) GEF (3353)	DANIDA, GEF, UNDP (TRAC), SOBO and GOM join forces to address barrier removal for PV technologies; 6790 PV systems in 4 sub-sectors demonstrated	Barriers to PV electric lighting, PV powered refrigeration, and PV control fans for tobacco curing are removed. 33,532 systems installed between 2000 and 2015 avoid 599,927 tons of carbon emissions (t_c) during their lifetime
	Increment (Alternative – Baseline)	3353 GEF	New and growing renewable energy industry springs up; a precedent is achieved for the widespread use of other renewable energy technologies; socio-economic improvements for Malawi people	Barriers to PV electric lighting, PV powered refrigeration, and PV control fans for tobacco curing are removed. 23,000 additional systems installed between 2000 and 2015 avoid 578,395 tons of carbon emissions (t_c) during their lifetime

ANNEX II: Project Planning Matrix

0. Summary	Objectively Verifiable Indicators	Means of Verification	Critical Assu
1. **Global Objective:** 2. **Market development for PVs through barrier. Removals which contribute to Climate stabilisation by reducing CO_2 emissions**	Widespread adoption of PVs and Quantified CO_2 emission reductions	National GHG inventories and reports to UNFCCC	Consistency
3. **Specific Objective:** 4. **Remove barriers to increase PV energy service delivery to the household, institutional, commercial and agro-industrial sectors (including process control in flue-cured tobacco curing and electrification of beverage retail outlets).**	Identified barriers to Solar PV energy service delivery removed	Evaluation reports	GOM policy investments i service delive
Output 1: Capacity building and institutional strengthening in government,. PV industry, NGO/CBOs and the establishment of PMU.	1.1 Assessment of PV industry size, structure and capacity; training needs assessment; preparation of training material; training programme development and delivery to qualified PV industry staff.	1.1 Review and Evaluation reports; PV industry sub-sector institutional structure identified; expression of interest by PV industry operators; increased capacity to develop renewable energy projects	1.1 PV indus industrial co- of financial a expanded PV opportunities
	1.2 Assessment of energy sector institutions and policy structure as how they affect renewables; energy policy articulation and ratification; training needs assessment; establishment of a renewable energy outfit.	1.2 National energy institutional structure and policy attributes identified; Review and evaluation reports; expression of interest by DOE and other public sector link; increased capacity to collect RE data, develop and manage renewable energy projects	1.2 GOM pa of financial re energy becon among GOM
	1.3 Assessment of NGO/CBO structures and activities; operational needs assessment; and training needs assessment.	1.3 NGO/CBO institutional structure and operational attributes identified; Review and evaluation reports; expression of interest by NGOs/CBOs; increased NGO/CBO capacity to develop, manage and evaluate renewable energy applications	1.3 NGO/CB availability o renewable en priority amor
	1.4 PMU staff engaged and PMU offices established	1.4 Establishment of PMU	Trained pers the project; P role in the fo and replicabl projects
	1.4 PMU staff engaged and PMU offices established	Establishment of PMU	

Output 2: ncreased public awareness of the efficacy of PV technologies and services	2.1 Energy use assessment and issues packaging; media promotional campaigns, advertisement and workshopping	2.1 Content and delivery evaluation reports; Number of enquiries and actual PV installations; number of operating systems over time	2.1 Consume one or all for Consumer pu understand m to change; G
Output 3: PV regulatory framework developed and unctional	3.1 Guide on technical standards for PV systems to be installed; comprehensive operational codes of practice among PV industry; compliance regime	3.1 Progress and evaluation reports; Publication and adoption of standards and codes	3.1 Favourab participation trained perso standards and with regional standards aut
Output 4: Financial barriers overcome	4.1 Financial mechanisms developed and made operational	4.1 Progress and evaluation reports	4.1 Favourab
	4.2 ……Feasibility studies completed in accordance with sound economic and financial engineering principles	4.2 Evaluation; studies completed with international standards; trained GOM and NGO technicians participate	4.2 Qualified technical, ecc environmenta Commitment institutions a
Output 5: PV demonstration projects undertaken	5.1 PV projects and project sites identified; 10 projects identified	5.1 ….demo projects selected	5.1 Commitn industry, GO financial insti appropriate l renewable en
	5.2 Criteria for demo target areas identified; demo areas selected; demo planning protocols developed and approved by GOM; implementation plans outlined	5.2 Demo selection criteria endorsed by GOM; demo sites selected	5.2.1 Non pa
			5.2.2 Industr preparation w work; Retail financing is n project result success/failu critical mass replication

ANNEX III: STAP Roster Technical Review - (Dr. Mark Trexler)
Barrier Removal to Malawi Renewable Energy Programme

Overall Impression: This project can be expected to build on the successful GEF experience with solar PV projects elsewhere in Africa. Malawi would appear an ideal candidate for a barrier removals project of this type, and the project itself is comprehensive and well designed.

Relevance and Priority: Solar rural electrification efforts are an accepted GEF strategy for climate change mitigation, and is clearly relevant to achievement of current FCCC objectives. Although the direct project costs of solar rural electrification are relatively high from a CO2 standpoint, the potential long term payoffs are high.

Background and Justification: The background information and data are clearly presented. The document has effectively integrated GEF experience from around the region into the justification of the project and the project approach. It would be interesting to have solar power's potential climate change benefits in Malawi put in the context of Malawi's overall greenhouse gas emissions, even though it would likely suggest a modest change in the country's immediate emissions. The project would likely facilitate the acceptance and deployment of other renewable technologies, including commercial biomass energy, which could add significantly to the net impact on the country's GHG emissions.

Scientific and Technical Soundness: The project approach is technically sound.

Objectives: The project objectives are clearly delineated. Successful achievement of the project's objectives would be expected to set the stage for a marketplace that is sufficiently functional that the private sector will be able to step in and pick up where the project leaves off, as has occurred in similar projects elsewhere in Africa.

Activities: Project components and activities range across the full set of outcomes needed to address the range of RET barriers documented as facing the project. The full range of stakeholder needs and interests are now incorporated into the project's objectives. The set of activities is ambitious, but appear achievable. In many cases these activities are clearly linked to activities that took place and were successful in other country contexts, and a significant effort has been made in the project document to build upon this parallel experience.

Participatory Aspects: The project lays out a highly participatory approach, with all key stakeholders being represented. The reviewer would suggest that supporting and emphasizing the participation of the fledgling private sector PV industry will significantly contribute to achieve the project's longer-term objectives. Depending who is managing implementation of the project, it might be very beneficial to have formal participation from representatives of some of the previously implemented solar projects in the region.

Global Benefits: The direct global benefits are identified. While relatively small, it is to be hoped that the larger barrier-removal objectives of the project will facilitate the achievement of additional global benefits as well.

GEF Strategies and Plans: The Project clearly fits within GEF strategies.

Replicability: Solar rural electrification is a highly replicable approach to climate change mitigation efforts.

Capacity Building: The capacity building element of the project is emphasized, as is appropriate. While capacity building in the public sector is important, however, project implementation needs to bear in mind that capacity building within the private sector is the long term objective of the project's market development efforts. Because the private sector is so nascent at this time, it would be easy to overlook its importance in the near term.

Project Funding: Proposed funding levels are appropriate, although additional funding allocation detail as the project moves forward will be important.

Time Frame: The overall time frame for the project is reasonable. To facilitate guiding the implementation of the project, a more detailed time frame, in which the timing of sub-tasks are more specifically delineated, would be a valuable future addition to the project's documentation.

Secondary Issues: A range of linkages to other projects in the region and extra-regionally are made in the project documentation. The project has no direct link to the other GEF focal areas of biodiversity and international waters.

Additional Comments: NA

ANNEX III (a) Response to STAP Reviewer's Comments

The original brief was revised based on a STAP Roster reviewer's comments and sent back again for a second review. The review is attached as Annex III. The following discreet changes were made in the revised draft in response to reviewer's comment.

- First, reference has been made to the regional experience such as Zimbabwe, Namibia and South Africa.
- Secondly, information on the potential market for Photovoltaics in Malawi has been provided.
- Thirdly, efforts have been made to link the solar market and existing government policy.
- Fourthly, the potential for utility (ESCOM) to implement a delivery mode in the future has been included.

ANNEX IV: Preliminary Project Schedule

COMPONENTS	PROJECT MONTHS										
Completion of project activities:	**0**	**6**	**12**	**18**	**24**	**30**	**36**	**42**	**48**	**54**	**60**
1. Capacity building and institutional strengthening among PV industry, Government, NGOs/CBOs, institutional strengthening within PMU.	X	X	X	X	X	X	X	X	X	X	X
2. Creating pubic awareness		X	X	X	X	X	X	X	X	X	
3. PV Regulatory framework		X	X	X	X	X					
4. Financial barriers overcome		X	X	X	X	X	X	X	X	X	
5. PV Demonstration projects				X	X	X	X	X	X	X	

ANNEX V: Terms of Reference: Project Manager / Co-ordinator

JOB DESCRIPTION

TITLE : Project Manager
ORGANISATION : Project Management Unit
CONTRACTING PARTY : Malawi Government
REPORTS TO : Director of Energy
DURATION : Five Years (renewable)
DUTY STATION : Lilongwe, Malawi
REMUNERATION : Commensurate with qualifications, skills and experience
REQUIREMENTS : Applicants mus t have post-graduate training in any one of the following fields of study:

- development economics with a strong energy systems planning and management component; and/or
- engineering with energy systems planning bias and/or economics background.

In either case, candidates must also fulfil a combination of at least the following conditions:

- Work experience with alternative energy technologies, mainly renewable energy systems;
- At least five years experience in the energy field at the household, small-scale commercial, agro-industrial and institutional level in public or private sector;
- At least five years work experience at senior management level with demonstrable project level management skills and ability to coordinate activities involving a large contingent of professional consultants drawn around the country and/or internationally;
- Working knowledge of the Malawi energy sector.

RESPONSIBILITIES

Directing activities of the PMU covering:

- day to day management and co-ordination;
- budgeting;
- forward planning;
- advise on policy direction;
- liasing with project participants and stakeholders;
- preparation and presentation of project status reports to the steering committee;
- preparing subcontractors terms of reference and contracts;
- supervision of contracts;
- technical assistance; and
- project execution of all tasks identified under the project specified in this Project Document.

DUTIES

- Lead, manage and coordinate the day to day management of the PMU to be established in Lilongwe including administration, accounting, technical expertise, and actual project implementation and reporting;
- Lead the development of detailed project design including preparation of subcontractors terms of reference, identification and selection of national, regional

and international subcontractors, cost estimation, time scheduling, contracting, and reporting on forward planning of project activities and budget (list of subcontractors is provided below);

- Coordinate activities of consultants including contract management, direction and supervision of field operations, logistical support, review of technical outputs/reports, measurement/assessment of project achievements and cost control;
- Supervise the selection of demonstration sites and actual installation and follow-up evaluation of demonstration facilities identified in this project Document;

Assist in the design, supervision and where possible delivery of the training and outreach activities of the project;

- Provide technical assistance in renewable energy policy discussions and development;
- Plan and coordinate various workshops identified in this Project Document;
- Assist in developing institutional delivery modes for renewable energy services for different end use sectors in Malawi;
- Assist in developing Special Purpose Financing Vehicle for renewable energy industry and end users;
- Serve as Secretary to the PSC and maintain records/minutes of proceedings of this Committee;
- Take responsibility for the quality and timing of project outputs;
- Assist in overall project monitoring and evaluation; and
- Undertake other management duties that contribute to the effective functioning of the project.

LIST OF SUBCONTRACTs/ORs:

Subcontract 1: PV systems standards and codes of practice (COP)
Subcontract 2: Training needs assessment
Subcontract 3: PV Trainers
Subcontract 4: ARET
Subcontract 5: Public media/advertising experts
Subcontract 6: Workshop leader/designer
Subcontract 7: Management/Financial consultants/Market researchers
Subcontract 8: Legal expert
Subcontract 9: Renewable Energy Policy expert
Subcontract 10: Renewable Energy Planning expert
Subcontract 11: Technical Support Group expert/s

Subcontractors will be contracted to undertake specific project tasks according to the final project schedule. Subcontractors may be individuals and/or organizations, whichever is appropriate for a given task. When subcontractors are in the employment of the project, they form part of the PMU and benefit from the support of the PMU support staff.

ANNEX VI: Terms of Reference: Project Management Unit

See section B7. In the text of the Prodoc text.

The PMU's function is to manage the project on a day-to-day basis in a flexible manner. The main output of the PMU is to assist the sub-contractors in executing projects and recording the methodology, successes and failures of these components of the overall project.

The chief executive officer of the PMU, the Project Manager (PM), provides strategic direction to the PMU and takes ultimate responsibility for the scheduling and quality of all project outputs. The PM has final responsibility for advising the PSC on the members of the PMU. The job description/TOR of the PM is a component of the project document (See Annex V).

The PMU has access to core professional staff when required that include:

- a project manager;
- a policy research and advocacy expert;
- an energy planner;
- an economist;
- a legal expert; and
- a management consultant.

The PMU will also include a member of the DOE who is seconded and whose salary will be augmented as the budget allows. The DOE staff member will be seconded to the project to work alongside the policy research and advocacy PMU member. This person will be seen as a link between the PMU and DOE whose TOR will be negotiated between the PM and the DOE prior to selection and secondment.

In addition to the staff that embodies the professional skills associated with the outputs of the project, core administrative staff will be required with skills that are:

- a middle management personal assistant and understudy to the PM;
- secretarial;
- accounting; and
- support staff with skills in language and information interpretation and draft editing.

The PMU is comprised as far as possible of Malawian private/non-governmental expert consultants. Attached to each of the core functionaries are young professionals whose capacity will be built through on-the-job training. The trainees can be drawn from government, non-government and private sectors. The professional staff of the PMU should apply gender sensitivity in selection .

ANNEX VII: Details on the estimation of number of PV systems in a mature market

This project aims to remove barriers to the expanded use of PV systems in four principal sub-markets where solar PV systems have greatest potential to be the least-cost alternative. These are household use for lighting and communications/entertainment (both rural and urban), institutional market basically for lightning, tobacco farms for PV forced draft combustion and beverage retailers for PV refrigeration/lighting.
It is important to note that the PV demonstration projects in all these sub-markets have implications for the other sub-markets, as well. For instance, the demonstrations in educational institutions are very important to create general awareness, even if the direct market potential in these institutions can be relatively low. Similarly the beverage refrigeration demonstration can result in increased PV use in vaccine refrigeration in health posts.

Baseline case or market development without project

In all these uses there are presently some 5000 solar PV systems installed in Malawi, half of which are not operational due to poor installations and lack of maintenance. The annual sales of PV system are about 250 units. In the absence of the proposed project, the annual sales are not expected to grow significantly. The DANIDA project currently underway could finance the incremental cost for some 1,200 systems and maybe improve slightly the track record of the systems once installed. However it does not have the resources to remove all the barriers for effective PV market development. Thus the number of installed operational PV systems in 2015 in the absence of the proposed project is estimated at 7,000.

Project Case

Household Sub-market

The current population of Malawi is estimated at 12 million and is growing at 3.2% per year. For the year 2015 the estimated population is 16.1 million people. The share of the urban population is expected to grow from about 13% today to over 22% in 2015. The actual number of rural households is about 1.5 million and urban households 270,000. In 2015 the number of rural households is estimated to be around 2 million and the number of urban households about 590,000.
At present only 4% of the population has access to electricity; in urban areas 30% of the population has access to electricity. The number of rural households currently without electricity is about 1.5 million (there are only few thousand rural households with electricity) and that of urban households 189,000. Because of the high population growth, the number of unelectrified households in 2015 will be at least equal to and probably higher than today. This is true even if a massive electrification program were implemented. For example: if the number of households that have access to electricity was doubled in 15 years (corresponding to 4.7% annual growth), there would still be about 1.2 million rural and more than 400,000 urban households without access to electricity in 2015. In practice the electrification will most probably be faster in urban than in rural areas. This is because of lower investment need per household resulting from higher population density.
To estimate the number of households that could afford PV lighting systems, consider as an example a 45 W PV system priced at US$ 716 (the current retail price less surcharges and duties). That would cost households between US$ 17.80 and US$ 26.13 per month

(in 1999 US$) if financing were available at 15% real rate over 5 and 3 years respectively. 55 Ah batteries would then have to be purchased including any maintenance. In their review of the Zimbabwe GEF project Coopers & Lybrand recommend a 30% to 35% of monthly household income repayment ceiling for PV systems.

Among the urban households, between 20 and 30% earn more than US$135 per month [1]. 30% of the urban population has access to electricity and it is logical to expect the electrified households to be those with the highest income. Thus, it is expected that in urban areas the high-income families will be electrified through grid extensions. The potential market for PV would thus be the income segment between US$68 and 135 per month (12 to 24% of urban population). The penetration in a mature market for urban households was taken to be 18% of the actual urban population, which means 48,600 households.

In the rural areas between 5 and 7% of the households consume more than US$135 per month, which means there are 75,000 to 105,000 households in this segment. As very few households have access to electricity in rural areas, PV systems would be a perfect choice for this market segment. The market penetration is estimated to be 5% of the actual rural population, which means 75,000 households. The estimate is very conservative, as there will probably be households in lower income segments that would be willing to acquire a PV system if the market barriers were removed.

The estimate for the combined rural and urban household PV market would then be about 123,000 systems. The proposed project would install 4000 household demonstrations in 5 years (500/year the first two years and 1000/year the last three years). When the barriers are removed 8000 systems could be expected to be installed between 2005 and 2010 (starting with 1000/year and ending up to 1610/year) and 10,000 between 2011 and 2015 (starting with 1771/year and ending up to 2593/year). This will add up to 22,000 systems installed between 2000 and 2015. The estimate is based on an average annual growth of 10% in installations, and is well below the global PV industry's long-term average growth of sales estimated to be 20% annually.

Institutional Sub-market

According to the Department of Education, 600 educational institutions (schools and distance learning facilities) are currently without lighting or are to be built within time span of the project. They are to be considered for PV system co-financing by the Department. Successful implementation of these 600 demonstrations could be further expanded to other institutions (e.g. remote health facilities that could use PV systems both for lighting and vaccine refrigeration). The total number of institutional installations for PV in 2015 is conservatively estimated at 900.

Tobacco Curing Sub-market

There are 3800 tobacco farmers in Malawi. Based on the information supplied by ARET, half of them could find it feasible to invest in PV-based combustion control equipment. 50% penetration rate (1900 units) is therefore considered a reasonable estimate for the technology in a mature market. The proposed project would install 190 PV systems in five years (approximately 38 per year). It is estimated that by removing the barriers and demonstrating the commercial attractiveness of this technology, the total number of

[1] Urban Household Energy Demand Side Strategy, Josephine Arpaillange 1996.

installed systems could reach about 1000 units in 2015 (starting from 50 installations/year in 2005 and ending up to 142 installations/year in 2015; 10% annual growth of sales).

Beverage Retailers Sub-market

SOBO suggest that over the project life they will typically replace 2000 refrigerator systems amongst their retailers. A successful implementation of the project in the beverage market would imply a sustained replacement of PV refrigeration/lighting systems at an average rate of 400 per annum. This implies that in 2015 there would be 6400 PV refrigeration systems installed assuming a zero growth for the annual installations.

Conclusions

The total market for PV installations in Malawi can be estimated at more than 130,000 units. The proposed project will directly install 6790 PV systems and result in at least 33,000 installed systems by 2015. This compares favourably to the baseline case, where only 7000 systems would be installed in 2015. The global impact of the project in 2015 would thus be the reduction of 578,395 t_C (1,811,000 t_{CO2}). The GEF is asked to grant US$3.3 million for the barrier removal activities, which implies a cost-effectiveness of US$5.70/$t_C$ for the investment.

Table 1 Scenario of Project Outputs from GEF Intervention

	Baseline case, no project intervention	Alternative case with GEF intervention
Operational PV systems in 1999	5000 – 2500 = 2500	2500
Operational PV systems in 2004 (project ends)	2500 + 1250 – 400 = 3350 (private) 1200 (Danida) Households 4,550 Institutions 0 Tobacco farms 0 Retailers 0 **TOTAL 4,550**	2500+ 6790 (Danida+GEF demonstrations) Households 4,000 Institutions 600 Tobacco farms 190 Beverage retailers 2,000 **TOTAL 9,290**
Operational PV systems in 2010	Households 5,750 Institutions 0 Tobacco farms 0 Retailers 0 **TOTAL 5,750**	Households 14,215 Institutions 750 Tobacco farms 612 Beverage retailers 4,400 **TOTAL 19,977**
Operational PV systems in 2015	Households 7,000 Institutions 0 Tobacco farms 0 Retailers 0 **TOTAL 7,000**	Households 25,028 Institutions 900 Tobacco farms 1,204 Beverage retailers 6,400 **TOTAL 33,532**
Avoided Carbon emissions during the lifetime of the systems installed by 2015	Households 7,000 x 3.076 = 21,532 tC **TOTAL 21,532 tC**	Households 25,028 x 3.076 = 69,296 tC Institutions 900 x 6.152 = 5,536 tC Tobacco farms 1,204 x 368.29 = 443,421 tC Retailers 6,400 x 11.56 = 73,984 tC **TOTAL 599,927 tC**

15. Detailed Calculations for Tonnes of Carbon Per Intervention: Malawi Project

Households: Each Household is Assumed to use 2 Kerosene Lamps, 4 Hours per Day, 365 days per year
kg C/hh = 365 days/yr*2 lamps/hh*4 hrs/day*15 years * 0.081 lt kero/hr * 3.18 kg CO2 /lt kero * 12 kg C/44 kg CO2
kg C/hh = 3076.91 kg C/ hh

Institutions: Each School is assumed to use 4 kerosene lamps, 4 hrs per day, 365 days per year

kg C/school = 365 days/yr*4 lamps/school*4 hrs/day*15 years *0.081 lt kero/hr *3.18kg CO2/lt kero*12 g C/44 g CO2
kg C/school = 6153.8 kg C/ school

Tobacco Farmers: Each farmer uses 12.3 kg wood / kg tobacco, under baseline
With PV controlled flue barn, farmers will use 10.3 kg wood/kg tobacco Savings is 2 kg wood/kg tobacco.

kg C/farmer =2 kg wood/kg tobacco*1.7 kg CO2/kg wood *12 kg C/ 44 kg CO2 *26,500 kg tobacco/farmer/yr * 15 yrs
kg C/farmer = 368,590 kg C/farmer

Beverage Retailers: Refrigeration and Lighting, Assumes LPG refrigeration and 2 kerosene lamps for 4 hours per day, 365 days per year.

kg C/retailer refrigeration = 2.96 kg CO2/kg LPG * 12 kg C/44 kg CO2 * 24 hrs/day * 0.08 kg/hr *365 days/yr * 15 yrs
kg C/retailer for refrigeration = 565.74 kg C/retailer/year * 15 yrs = 8,486.05 kg C/retailer for refrigeration

kg C/ retailer lighting = 3076 kg C/ hh

kg C/ retailer total = 11,562 kg C/retailer

Basic assumptions:

Lifetime of a PV system is 15 years. The emissions avoided by a household PV system during its lifetime are 3.076 tC and by an institutional (double the size) 6.152 tC. Using PV combustion control in tobacco curing reduces emissions in one farm 368.29 tC during the lifetime of the system. A Beverage retailer avoids 11.56 tC emissions using a PV system for refrigeration and lighting in 15 years.

Baseline: all the systems installed are for household use. 250 additional systems are installed every year. 400 installed systems stop operating between 2000 and 2004 and 300 between 2005 and 2010. After that, it is expected that 100% of the installed systems are operational.

Project case: The annual sales for households as well as for tobacco curing are estimated to grow by 10% each year once the project is over. In the case of household PV systems, the annual sales are expected to be 1000 units in 2005, 1610 units in 2010 and 2593 units in 2015. In the case of tobacco curing sub-market the sales in 2005 are 55, in 2010 88 and in 2015 142 units. For public institutions once the demonstration phase is over, 150 systems are expected to be installed between 2005 and 2010 and another 150 between 2011 and 2015. The sub-market for beverage retailers sells 400 unit each year.

ANNEX VIII: Table 1 Projection of PV System Dissemination Following Project Conclusion

	Household		Institutional		Tobacco Curing		Beverage Retailers	
Year	Sales	Cumulative installations	Sales	Cumulative installations	Sales	Cumulative installations	Sales	Cumulative installations
2004	*	6500	*	600	*	190	*	200
2005	1000	7500	25	625	55	245	400	240
2006	1100	8600	25	650	61	306	400	280
2007	1210	9810	25	675	67	372	400	320
2008	1331	11141	25	700	73	445	400	360
2009	1464	12605	25	725	81	526	400	400
2010	1611	14215	25	750	89	614	400	440
2011	1772	15987	30	780	97	712	400	480
2012	1949	17936	30	810	107	819	400	520
2013	2144	20079	30	840	118	937	400	560
2014	2358	22437	30	870	130	1067	400	600
2015	2594	25028	30	900	143	1209	400	640

ANNEX IX: DELIVERY MODALITIES

Table IX.1 presents sectors targeted under the project, energy services to be offered to each sector and modalities to be applied in the provision of such services. Schematic diagrams showing the flow of project funds (i.e.⟹) and PV systems (i.e ⟶) for each target are presented in Figures IX.1 to IX.4. Commentary on the mechanics of each delivery mode is also provided.

TABLE IX.1: Delivery modes

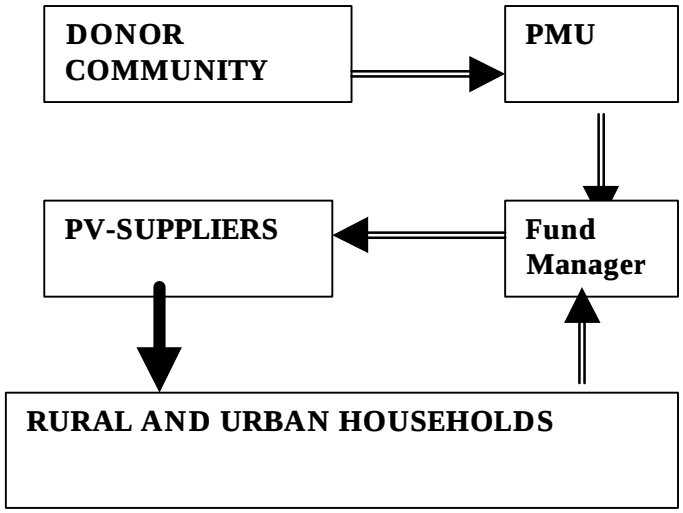
No.	SECTOR	PV ENERGY SERVICE	DELIVERY MODE
1	HOUSEHOLDS Non-electrified Rural Non-electrified Urban	 Lighting & Entertainment Lighting & Entertainment	 Commercial Commercial
2	AGRO-INDUSTRIAL (Non-elect Flue Cured Tobacco)	Energy for Draft Control	NGO/Commercial
3	COMMERCIAL (Non-electrified Beverage Outlets)	Lighting, Refrigeration, Entertainment	Industry (SOBO)
4	INSTITUTIONAL Non-electrified Schools Non-electrified Clinics	 Lighting & Entertainment Lighting & Entertainment	 Government Government

EXPLANATORY NOTES ON DELIVERY MODES

1. Commercial Delivery Mode for Households:

Players in this modality are: Project Donors who provide 30% grant funds; Fund Manager (SPV) who manages grant funds and makes available own funds on credit to end-users and PV-suppliers for warehousing etc; PV-suppliers who source systems, install and maintain the same under contract; and end-users who in this case are non-electrified rural and urban HH. Mechanics of this modality require that grant funds lined up under the project be deposited with a Fund Manager identified under the SPV. PV Suppliers shall identify households to participate in the Demonstration Project component. Once interest by Households is secured, a PV Supplier shall prepare a Business Plan on behalf of the household for submission to the SPV for funding consideration. The SPV will appraise the BP for its creditworthiness while PMU will appraise it for its technical merits and advise the SPV accordingly. The approved BP will be passed on to the PV Supplier (by the household) to undertake under contract, PV installations at the household in question. Payment to the PV Supplier will be made by the SPV after certification of installation by PMU Inspectors. Critical to this modality is the avoidance of passing on cash to the households. Households will repay loans to the SPV at agreed terms (on interest rates and grace periods).

FIGURE IX:1 Commercial Delivery Mode

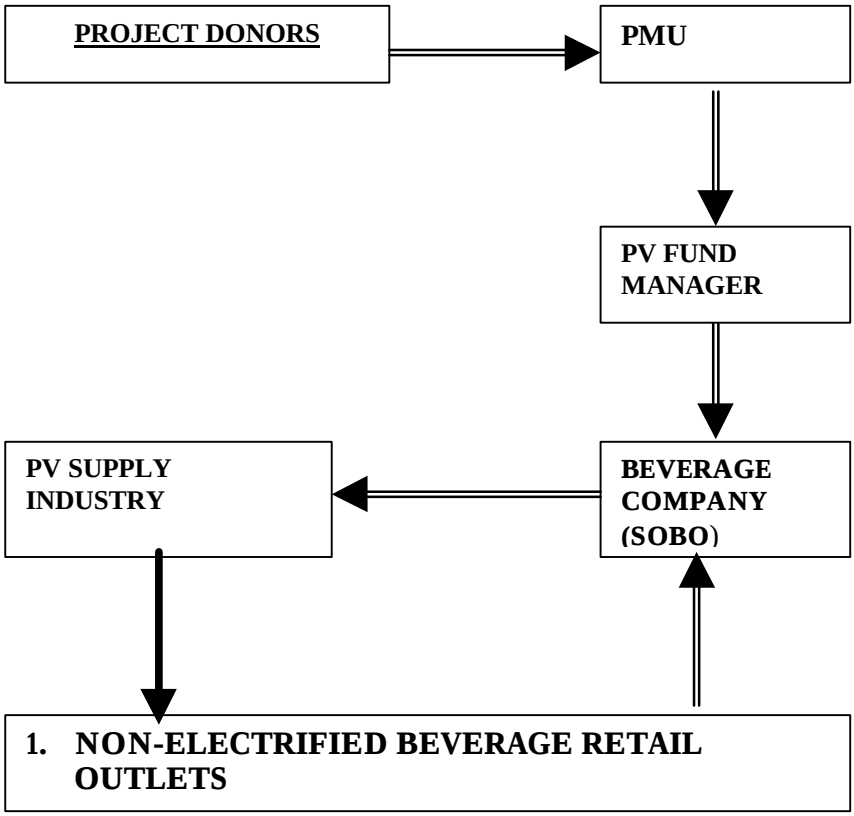


2. Industry Delivery Mode

The main players in this delivery mode are: Project donors; SPV; SOBO; PV Supplier; and end-users. Project donors make available 30% grant funding. This grant is deposited with the Fund Manager. SOBO raises the remaining 70% from either its own internal resources (as currently done with LPG and paraffin coolers) or from a combination of own internal resources and Fund Manager-bulk-funding, or wholly from Fund Manager bulk-financing. Once SOBO has affirmed availability of its contribution, the Fund Manager releases the project's grant contribution for the purchase of equipment from a PV Supplier who in turn enters into an installation/maintenance contract with SOBO. SOBO identifies the outlets where PV systems are to be installed. SOBO's contribution can be passed on to the outlets as outright grant (as currently practised with low-turn-over outlets) or as loans (as practised with high turn-over-outlets), or even better still in combination of grant and loan. PMU provides technical backstopping in installation and maintenance inspections as per established standards and codes.

The beverage retailers will, where interest exists, be trained to work on commission as PV supply industry agents. This training can be seen as part of the component 1 Capacity Building and Institutional Strengthening amongst the PV Industry. Typically the retailers could target beverage clientele with PV system sales.

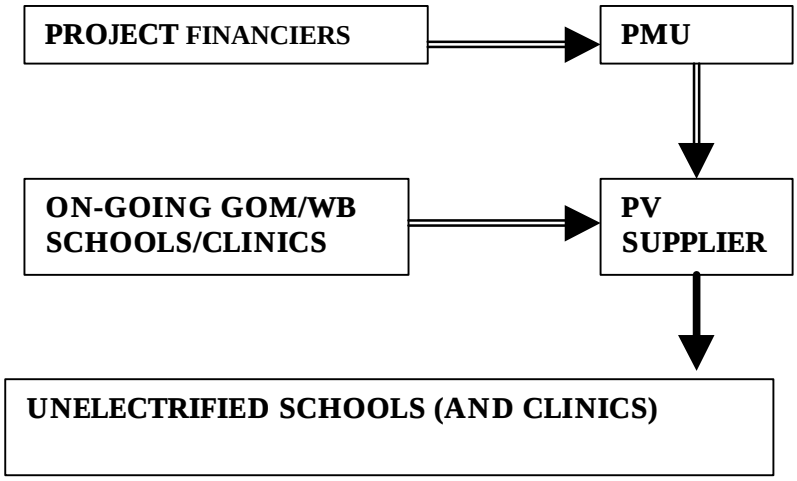
16. FIGURE IX.2: Industry Delivery Mode



3. Institutional Delivery Mode

GOM and World Bank have an on-going infrastructure development project where new schools and clinics to be built in remote areas away from the national electricity grid are to be supplied with PV lighting systems. The present project intends to work with this project to leverage more new systems and retrofits. Under this arrangement, Project Donors for the Barrier Removal Project shall make a 30% grant contribution to the cost of PV systems. This contribution shall be passed on to PV Suppliers working for the GOM/WB project. PMU shall provide technical backstopping by way of inspecting installations and arranging for maintenance contracts with PV Suppliers.

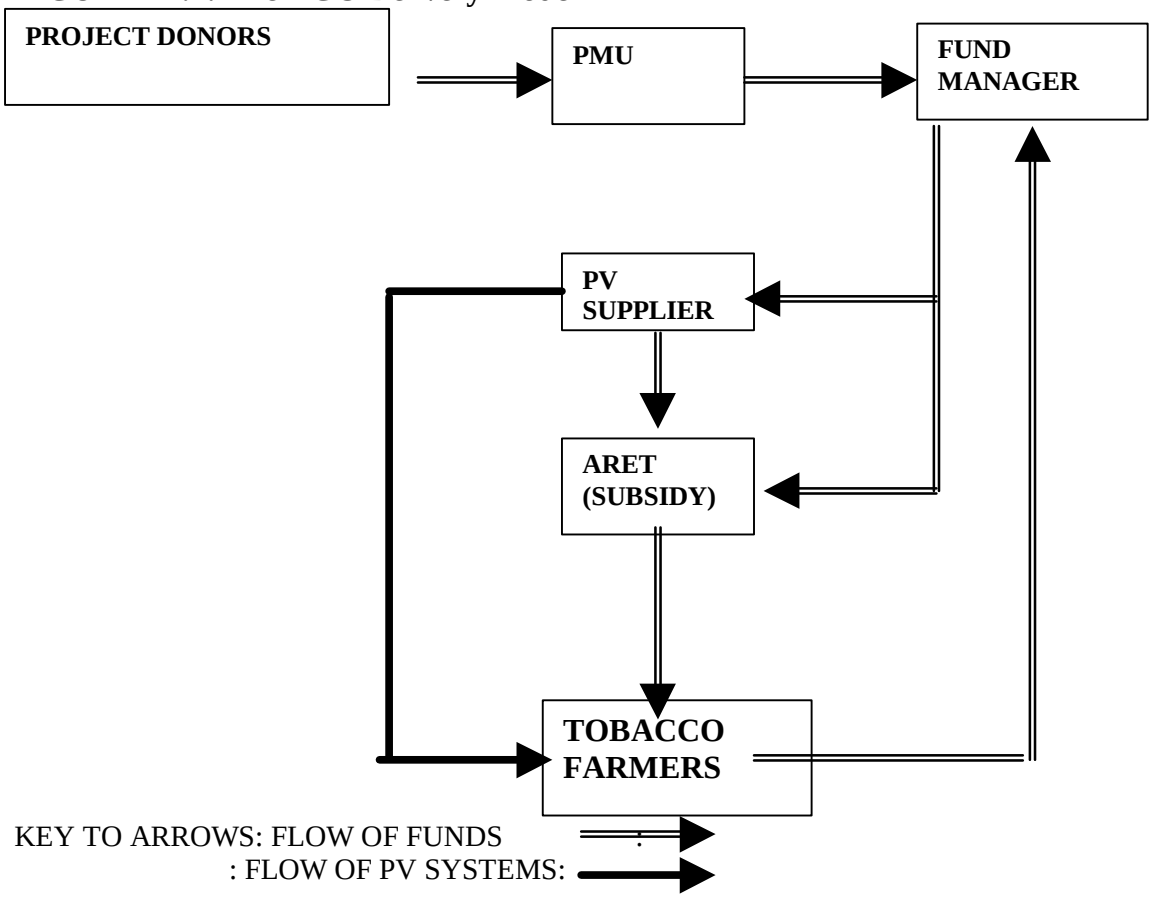
FIGURE IX.3: The Institutional Delivery Mode



4. NGO Delivery Mode

The NGO modality is a variant of the Commercial Delivery Mode applied in the household sector. While both rely on PV-Suppliers to prepare Business Plans, install and maintain PV-systems, the NGO modality relies on ARET as a conduit for passing on grant monies to the participating tobacco farmers. The advantage of involving ARET is that this is already a major player in the tobacco industry in Malawi. As a tobacco-farmer-based trust fund, ARET is responsible to tobacco farmers for all of their technology, RD&D and extension support requirements. ARET has agreed to participate in this manner. The possibility of the NGO delivery mode piggybacking the energy advisor network will be explored early in the project.

FIGURE IX.4: The NGO Delivery Mode



ANNEX X: Danida's Support to renewable energy in Malawi

Danish Ministry of Foreign Affairs

Danida

MALAWI

Final Project Document
for
SUPPORT TO RENEWABLE ENERGY IN MALAWI
(FAST-TRACK PROJECTS)

under the
ENVIRONMENT SECTOR PROGRAMME SUPPORT (ESPS)
Funded by the
ENVIRONMENT, PEACE AND STABILITY FUND (EPSF)

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official use only

Ref. No.104.Mal.1.MIKA.8 November 1999

PROJECT DESCRIPTION

Country: Malawi
Sector: Renewable Energy
Title of SPS Document: Environment Support Programme
Title of Project: Initial Fast-track Projects in Support of Renewable Energy in Malawi
National Agency: Department of Energy
Duration: Not exceeding two years
Starting date: 3 January 2000
Overall budget frame: USD 2.7 million

Description

The project consists of five renewable energy pilot or demonstration projects, two underpinning projects and one study tour. These projects are designed to be implemented on a fast-track basis so that they can support and feed into major up-coming renewable energy initiatives being supported by Danida and other donors. The budget for the projects themselves is USD 1.7 million, to be provided on a parallel funding basis, within an overall two-year budget of USD 2.7 million for the Renewable Energy Sector in Malawi.

The overall objective is develop reliable institutional models for the deployment and maintenance of renewable energy technologies on a sustainable basis in Malawi. These models will then be permanently available to Malawian stakeholders in the implementation of their own renewable energy initiatives. By approaching this on a pilot-project basis, the overall risks can be minimised and the opportunities for learning from experience and feeding the results into up-coming projects in which Danida and other donor agencies are involved can be maximised.

The activity related to health clinics will be particularly relevant to the rural poor; other activities will aim to make solar and wind energy technologies a viable proposition for deployment in the rural areas. Where lack of energy is a constraint to the realisation of poverty alleviation goals, the existence of the necessary resource base for the deployment of the appropriate renewable energy technologies can enable such constraints to be removed. Decision-making will involve all relevant stakeholders and will initially be focused on an Interim Support Unit, managed by a Danish consultant, but this will be phased out over a one to two year period.

The environmental impacts of the renewable energy activities being undertaken are minor and generally benign. The health clinic initiative will tend to ease the work of staff who are generally women; the provision of lighting in maternity units which presently depend on paraffin hurricane lamps will also particularly benefit women. The general long-term raising of living standards which will tend to come from the successful deployment of solar home systems and other technologies will be particularly felt at a household level. Major efforts are being made in the project to ensure that all relevant stakeholders are fully and democratically involved in the decision-making processes.

Signatures:

…… ……

For Government of Malawi Danida Representative

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ABBREVIATIONS AND CURRENCY

ac	alternating current
Ah	Ampere hour (battery capacity)
ARET	Agricultural Research and Extension Trust
CBNRM	Community-based Natural Resource Management
CHAM	Christian Health Association of Malawi
CTA	Chief Technical Adviser
DANCED	Danish Cooperation for Environment and Development
DEAP	District Environmental Action Plan
DESP	Danida's Environment Sector Programme
DoE	Department of Energy
DTI	Danish Technological Institute
EDRF	Environment and Disaster Relief Fund
EPSF	Environment, Peace and Stability Fund
ESCOM	Electricity Supply Comm ission of Malawi
ESMAP	Energy Sector Management Assistance Program (World Bank)
ESPS	Environment Sector Programme Support
FINESSE	Financing Energy Services for Small-scale Energy Users
GEF	Global Environment Facility
GDP	Gross Domestic Product
GTZ	Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
ISU	Interim Support Unit
JICA	Japan International Co-operation Agency
kWh	kilowatt hour
kWp	kilowatt peak (output of PV system)
LPG	liquid petroleum gas
MBoS	Malawi Bureau of Standards
MEET	Malawi Environmental Endowment Trust
MGYCS	Ministry of Gender, Youth and Community Services
MIRTDC	Malawi Industrial Research and Technology Development Centre
MOEM	Ministry of Energy and Mining
MOHP	Ministry of Health and Population
m/s	metres per second
NASFAM	National Smallholder Farmers' Association of Malawi
NEAP	National Environmental Action Plan
NSREP	National and Sustainable Renewable Energy Programme
NGO	Non-governmental Organisation
PAP	Process Action Plan
PMU	Project Management Unit
PSD	Project Support Document
RETC	Rural Electrification Technical Committee
PV	photovoltaic
SADC	Southern Africa Development Community
SOER	State of Environment Reporting
SPS	Sector Programme Support

SHS(s)	solar home system(s)
TAMA	Tobacco Association of Malawi
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
V	volt
Wh	Watt hour
WHO	World Health Organisat ion
Wp	Watt peak (output of PV system)

CURRENCY

The national currency is the Malawi Kwacha (MK)

US$1.0 = 17.5 MK (October 1997)
US$1.0 = 42.0MK (August 1999)

EXECUTIVE SUMMARY

The project described in this document has been designed to be implemented as part of Danida's Environment Sector Programme (DESP) in Malawi. The major emphasis of the DESP is on assistance to environmental actions at the district level in order to benefit local rural and urban communities. Activities under the DESP are taking place in 11 out of the country's 25 districts. The project comes within the Development of Renewable Energy Resources Component of the DESP.

The project consists of eight activities:

- PV electrification at 15 health clinics - pilot project;
- Dissemination of 200 SHSs - pilot project;
- Installation of 6 wind-pumps - pilot project;
- Micro-hydro feasibility study;
- Small-scale biogas initiative;
- Support for development of renewable energy standards in Malawi;
- Preparation of a wind-atlas for Malawi;
- Start-up study tour of Danish institutions for key Malawian personnel.

The first three of these activities and the bulk of the biogas initiative will be concentrated in the Lakeshore Districts within the DESP. The overall objective of the project is to develop reliable institutional models for the deployment and maintenance of renewable energy technologies on a sustainable basis in Malawi. To ensure that these models are available for use in the major up-coming UNDP/GEF project and other initiatives, a fast-track approach is being adopted for the pilot and demonstration activities to be carried out under the project. The same applies to the provision of support for renewable energy activities under the development of renewable energy standards and the preparation of a wind atlas.

Organisation, management and administration

The primary responsibility for the detailed implementation of the eight activities comprising the project will rest with an Interim Support Unit (ISU). This will be established and run by a Danish consultant. The consultant will implement an agreement for effective collaboration with a Malawian counterpart organisation from the beginning of the work on the project.

The duties and responsibilities of the ISU will include, but will not necessarily be limited to the following:

- Overall coordination of the eight activities;
- Detailed design of each activity;
- Appointment of suppliers and subcontractors, both Danish and local, for each activity;
- Supervising the implementation of each activity;
- Monitoring, reporting and providing feedback on each activity into the relevant channels so that upcoming projects can benefit;
- Management and disbursal of Danida funds to partner organisations and others, in accordance with agreed workplans, activities and budgets;
- Agreeing and overseeing the arrangements for the collection, deposit and disbursement of maintenance or purchase contributions received from project beneficiaries;
- Agreeing the list of invitations, co-ordinating and conducting the start-up study tour of Danish institutions for key Malawian personnel.

Bearing in mind the pilot nature of the various projects, the ISU will be expected to take a flexible attitude, adjusting or fine-tuning individual activities as required to ensure they are as effective and informative as possible.

The interim nature of the ISU needs to be stressed. It is intended as temporary expedient providing the necessary initial management for the fast track projects. As the longer-term management structures for the implementation of the DESP are established, the ISU will initially act in parallel with these. Ultimately, and in a manner to be discussed and agreed, full responsibility will be transferred to these structures and the ISU will be wound up or merged with them. This will ensure that the experience and institutional memory, built up during the initial functioning of the ISU, is transferred to and remains with the relevant Malawian structures and institutions. The need to achieve this transfer in the optimum manner places a premium on the effective liaison and communication between the various organisations involved, in particular, the three District Project Offices of the DESP. [2]

Timing and budget

The intention is that the ISU will be put in place from the beginning of March 2000 with an interim project review about twelve months later.

The project will start with a one-month Inception Period during which the Team Leader of the ISU, working with the relevant local counterparts, will develop detailed work plans, agree on distribution of roles and responsibilities and on the detailed ToR for any work-groups and committees established to take forward the work and ensure that lessons are learned and disseminated and fed into the appropriate decision-making mechanisms as the projects are implemented.

18. INTRODUCTION

Since 1992, the UN Conference on Environment and Development (UNCED) and its Action Plan, Agenda 21, have formed the basis of a variety of initiatives and activities on environmental issues in and between a number of countries. In 1993, Denmark took action to follow up on the UNCED Conference by establishing an Environment and Disaster Relief Fund (EDRF) now known as the Environment, Peace and Stability Fund (EPSF) to increase the Danish contribution to solving global environmental problems.

Support for environmental activities is channelled partly through the Danish Co-operation for Environmental Development (DANCED), under the Danish Ministry of Environment and Energy, and partly through the Danish Ministry of Foreign Affairs (Danida).

The first set of policy guidelines for the EDRF was issued by the Danish government in 1993. In 1995, a joint Danida-DANCED strategy for Danish environmental assistance to Southern Africa was prepared and a number of possible target areas were selected. These target areas include

- urban development and industrialisation;
- sustainable use of energy;
- agriculture;
- water resources;
- forests and wood resources;
- biological diversity;
- coastal zones.

The policy guidelines for the EDRF give a broad outline of the basic principles of Danish support to the countries in the Southern African region in the implementation of sustainable

[2] A diagram showing the various linkages is included in Chapter 7.

environmental projects and programmes at regional and national levels in accordance with the UNCED principles and the development priorities of the countries in the region. In this context, Danida is supporting the development of environmental support activities at a national level in Tanzania, Zimbabwe, Zambia, Malawi, Mozambique and Angola. Danida is also supporting regional co-operation, including co-operation with regional institutions, in the field of the environment.

Danida's Environment Sector Programme (DESP) in Malawi

Danida's Environment Sector Programme (DESP) is intended to contribute to the Government of Malawi's on-going efforts to implement the country's National Environmental Action Plan (NEAP) The major emphasis of the DESP is on assistance to environmental actions at the district level in order to benefit local rural and urban communities. Activities under the DESP are taking place in 11 out of the country's 25 districts.

The DESP has four main components developed to varying degrees in collaboration with the Government and other Malawian stakeholders. These consist of an over arching component covering Capacity Development in Environment designed to provide overall support to improved environmental management across different sectors in Malawi, and three components which cover specific activities in the 11 districts covered by the DESP. These components are:

- Community-based Natural Resource Management (CBNRM);
- Development of Renewable Energy Resources;
- Urban Environment and Industry:

Phase 1 of the DESP will encompass specific support to the 11 districts at both national level, under the auspices of the Environmental Affairs Department (EAD) and at the district level as follows:

National-Level:

- Guidelines and management information systems for State of the Environment Reporting (SOER) and District SOER;
- Preparation of a Parliamentary District SOER in the year 1999/2000;
- A National Environmental Information System on national and district indicators.

District-Level:

- Recruitment, training and deployment of Environment District Officers (EDOs)
- Comprehensive baseline district environmental surveys to be conducted by EAD supported by short-term technical assistance from Denmark
- Preparation of District Environmental Profiles (DEPs), District Institutional Profiles (DIPs) and District Environmental Action Plans (DEAPs)
- Supporting 'micro-projects' in perceived enviro nmental 'hot-spots' through an interim district environmental fund facility to assist local communities and other intermediary implementing organisations
- Developing a community-based environmental monitoring and evaluation system including verifiable indicators for economic, social and environmental objectives
- Preparing operational guidelines for the integration of DEPs, DIPs and DEAPs within the Government of Malawi's District Development Planning System.

The necessary institutional structures for the implementation of the DESP are in the process of being established. It is intended that planning, implementation, follow- up and funding of environmental activities and micro-projects in the 11 districts will be supported by 3 Project Offices located in Zomba, Karonga and Nkhotakota districts. A national level Chief Technical Advisor (CTA) located in the EAD will support the whole programme.

The three district Project Offices are the cornerstone of the DESP. During the planning, implementation and follow-up of projects under the CBNRM, Urban Environment and Industry, and Renewable Energy components, the three project offices will provide management and co-ordination support. This institutional arrangement will harmonise and standardise reporting, funding, accounting and supervision and will provide an uncomplicated management structure for ongoing and future projects.

Each project carried out under the DESP will stand on its own in terms of funding, physical and financial management, subcontracting of services and reporting. The EAD will co-ordinate and facilitate the planning of the projects in accordance with resolutions adopted at the Danida DESP Co-ordination Committee meetings.

The Malawi Environmental Endowment Trust (MEET)

MEET was formally registered as a trust in March 1999. This is the culmination of a process in which three broad-based working groups representing the Government, the private sector, NGOs, and research and academic institutions have participated. A Board of Trustees with four members has been selected and a Board of Governors representing similar stakeholders to the working groups is soon to be elected. A small secretariat and management team will be established.

The formal objectives of MEET are to establish, develop and manage an endowment fund to provide sustainable financing for environmental activities in Malawi; to provide support for the empowerment of communities towards achieving sustainable management of their local environment and natural resources; to provide support to institutions involved in appropriate management, research and educational activities addressing key environmental and natural resource issues; and to foster partnership amongst different stakeholders.

The fundamental understanding is that the capital invested in this trust will remain intact thereby providing a permanent source of financing for MEET independent of government and donor funding. The income from the fund will be used by MEET to provide grants to environmental micro projects but MEET will not implement projects itself. Projects funded by it be implemented by a variety of agencies including NGOs, community-based organisations, research organisations and other entities, including individuals and companies.

USAID has strongly supported the setting up of MEET and is expected to make an contribution of US$10 million to its initial capital fund. The Danish Embassy has provided operational funds and covered the cost of a co-ordinator for the first half of 1999. Danida has commissioned a broad study of its overall support for environmental funding in Malawi and possible support for MEET was among the issues considered. A draft background report of the study was made available to the mission. [3]

MEET, when it is fully functioning, will be able to provide a conduit for Danida funding for selected environmental projects. If the renewable energy pilot projects recommended by the present mission are successfully implemented, MEET will also provide an additional mechanism for the disbursement of funds for the support of selected follow-up and dissemination activities. This may become relevant before the completion of the present projects.

The Renewable Energy Component of the DESP

The Government of Malawi approached Danida in January 1996 for possible support to its environment programme. Following this, Danida fielded an identification mission in May/June 1996. An assessment of the potential for the utilisation of renewable energy sources was one of

[3] Feasibility Studies and Formulation of Proposal to Support Environmental Funds (Draft Background Report) July 1999.

the environmental projects agreed upon by Malawi and Denmark as a result of this mission. The main rationale for prioritising this project for Danida's support was that the use of biomass as a source of energy was perceived to be implicated in the heavy and increasing deforestation taking place in Malawi. It was also felt necessary to identify the most appropriate renewable energy technologies for Malawi and to assess their financial and economic sustainability.

A renewable energy study was accordingly undertaken by the Danish consulting firm COWI Consult, beginning in April 1997. The long term objective was to provide support to the development of an efficient and sustainable energy supply in Malawi based on increasing use of renewable energy technologies. The immediate objective was to promote the development of self-sustaining markets in renewable energy technologies. The implementation of the project was planned for two phases. Phase I, planned to last 12 months, was the study phase and was completed in March 1999. Phase II was planned to cover demonstrations and pilot (18 months) and training and promotion (24 months).

Concurrent developments have also taken place in Malawi outside the framework of Danida's renewable energy support. In 1997, the DoE prepared the National and Sustainable Renewable Energy Programme (NSREP), the primary objective of which is to increase improve to renewable energy technologies and increase their efficiency in use in Malawi. A Programme Support Document (PSD) has been prepared with support from UNDP and Danida, which aims to provide a strategic framework for the realisation of the NSREP. At the same time, a Final Project Brief has been prepared for a UNDP/GEF initiative which is intended to remove barriers to the dissemination of renewable energy technologies in Malawi. In parallel with these activities in the renewable energy area, an overall energy policy for the country is being prepared with support from the World Bank.

These and other developments have raised the question of how Danida's support could best be merged with activities within the PSD framework and in the provision of support, in accordance with the Government's request, to the renewable energy activities to be undertaken in the UNDP/GEF initiative. Given the number of players, donors and local stakeholders, involved in these activities, it was also felt necessary to ascertain the optimal institutional arrangements for anchoring Danida support and for the efficient channelling of Danida funds.

A mission was therefore undertaken in May 1999 with the following objectives:

- To identify and assess the modalities of merging the current Danida-supported renewable energy technologies project within the PSD with the activities to be undertaken under the UNDP/GEF initiative:
- To assess the institutional and financial arrangements for implementing a parallel-funded Danida project with the PSD and UNDP/GEF activities and to recommend the optimal option;
- To finalise a project document, in conformity with the 1998 SPS Guidelines (Annex 5), based on the output of the 1997 renewable energy study, leading to a proposal for a clearly identified and evaluated activity-programme which included institutional strengthening, capacity-building and pilot activities.

The currently-agreed solution to the first of the above issues is that there will be a joint Project Management Unit (PMU) which will manage and co-ordinate activities under the PSD and the UNDP/GEF project. This will also provide a mechanism for absorbing and co-ordinating the activities of other donors within the renewable energy area. It has also been agreed that Danida's

contributions to project activities under the UNDP/GEF will be under parallel funding arrangements.

The third objective could not, however, be met because of the absence of workable proposals for an activity programme in the renewable energy study initiated in 1997. The team therefore decided to carry out a rapid identification of new proposals and made a series of recommendations for an activity programme in support of the PSD and UNDP/GEF activities.

Objective of the August 1999 Feasibility and Pre-appraisal Mission

A mission to Malawi was fielded in August 1999 to review and assess the feasibility of those interventions recommended in the Draft Report of the May 1999 Mission which had been approved for action by Danida and to recommend the necessary measures to take forward those interventions found feasible.

The interventions approved by Danida and set out in the ToR for review by the August 1999 Feasibility and Pre-appraisal Mission were as follows:

- PV electrification of 12 public buildings which do not have any opportunity of being connected to the grid in the near future. This proposal could provide a suitable demonstration-window for PV applications and develop some synergy with the development programme supported by Danida under the DESP in the 11 districts. Public and private health clinics are seen as suitable candidates.
- Investigation of the feasibility of establishing a demonstration of household electrification using PV Solar Home systems (SHSs). This proposal, if feasible, will contribute to highlighting the potential and barriers for SHS deployment in Malawi, a main issue in the proposed UNDP/GEF intervention. In effect, this Danida intervention could act as a laboratory for the subsequent much larger scale activities.
- Development of a framework addressing the issues of norms, standards, performance and quality insurance for renewable energy technologies and for skilled artisans involved with their installations and maintenance.
- Investigation of the feasibility of the use of wind-roses for pumping and irrigation within the 11 DESP districts. This proposal, if feasible, will sustain the objective of food self-sufficiency and the creation of local income for farmers. The preparation of a wind atlas for Malawi is also considered.
- Definition of a possible window for small-scale biogas plants in Malawi located in the 11 DESP districts. Biogas plants could be part of existing agro-industries located in the districts or in connection with farms.
- Assessment of the potential for mini-micro hydro in Malawi.

For each of the above activities found feasible, and recommended for taking forward, the team was expected to:

- Identify and describe interfaces to the ongoing DESP activities in the 11 districts and at national level;
- Prepare a project budget, flow of fund procedures, project organisation and other institutional arrangement for the implementation of each activity;
- Identify arrangements for tender procedures for the implementation of the project by a Danish consultancy firm as part of the parallel funding system;
- Prepare a Final Draft Project Document according to Danida SPS guidelines (MIKA) ready for desk appraisal by TSA.

Mission Activities

The team[4] arrived in Malawi on 1 August 1999. Following an inception meeting at the Danish Embassy, an initial stakeholders' meeting was held, also at the Danish Embassy, at which the ToR and proposed activities of the mission were outlined and discussed.

Subsequent meetings were held with representatives of the Department of Energy (DoE), the Ministry of Health and Population (MOHP), the Ministry of Gender, Youth and Community Services (MGYCS), the National Smallholder Farmers' Association of Malawi (NASFAM), UNDP, Malawi Industrial Research and Technology Development Centre (MIRTDC), the Electricity Supply Commission of Malawi (ESCOM), the Christian Health Association of Malawi (CHAM), the Tobacco Association of Malawi (TAMA), the Agricultural Research and Extension Trust (ARET), the Malawi Bureau of Standards (MBoS), and representatives of solar energy companies and potential suppliers of wind pumping equipment.

Visits were made to an electrified and an non-electrified health clinic in the Salima area. A visit was made to micro-hydro installations on the Lujeri tea estate in Mulanji District, to the ESCOM small hydro installation in Zomba and to a no longer functioning hydro installation at the Neno Trading Centre at Matandani in Mwanza District. Visits were made to three reputedly working wind-pump installations at only one of which the equipment still exists but has not been working for about ten years.

A Debriefing Note was prepared and its main conclusions and recommendations were presented and discussed at meeting with stakeholders at the Danish Embassy on 12 August. The comments and suggestions made at this meeting were taken into account in the preparation of a final version of the Debriefing Note which was immediately circulated for further detailed comment and feedback by the stakeholders. Final comments from Malawi were received on 24 August 1999 and incorporated in the draft Final Report of the mission which was submitted to Danida at the beginning of September 1999. Comments from Danida, received at the end of October 1999 are incorporated in this Project Document.

A final Project Report has been prepared at the same time in accordance with the ToR of the mission.

[4] The members of the team were Gerald Foley (team leader), Peter Ahm (solar energy and wind), Emmanuel Fundira (wind pumping) and Alf J. Lyngra (micro-hydro), all acting as external consultants to Danida.

19. CONTEXT

Malawi is a long narrow landlocked country in southern Africa. It is surrounded by Tanzania in the north, Zambia to the north-west and Mozambique in the east and south-west. Lake Malawi forms the eastern boundary for over half its length and water bodies comprise 2.4 million hectares out of a total country area of 11.8 million hectares.

Most of the country is situated on a plateau with a height of 800-1500 metres above sea level, occupying the southern part of the East Africa Rift Valley. The average annual rainfall is about 1,000 mm, falling in one rainy season.

About a third of the land area is given over to relatively intensive agriculture. This is mainly carried out on small farms with an average size of just over 1 hectare but also includes significant areas of large tobacco and tea estates. The next largest land use is extensive agriculture which is carried out in wooded or partly wooded areas. Forests and woodlands are the third largest land use, occupying about 26% of the land area Details of the land use breakdown are given in the table below.

Malawi 1996: Area by Land Use Type

units: '000 hectares

Land Use category	Area	Percentage
Intensive agriculture	3,273	34.8
Extensive agriculture	2,668	28.4
Forest and woodland	2,478	26.4
Grassland	762	8.1
Miscellaneous	218	2.3
Total land area	**9,399**	**100.0**
Water	2,423	
Total area	**11,822**	

Source. World Bank ESMAP 1998 (draft)

Administratively, the country is divided into three regions, Southern, Central and Northern. These regions are further subdivided into twenty five districts. The country has an estimated total population of 9.6 million of whom 87% live in the rural areas. The Southern Region has a population of about 5.4 million; the Central Region has about 4.2 million people; and the Northern Region about 1.2 million people.

Malawi's fertility rate, at 6.7%, is among the highest in the world and the population growth rate is estimated to be about 3.2% per year. Half the population is expected to be below the age of 15.5 years by the year 2000.

Socio-economic context

Malawi's natural resource base is modest. It consists of moderately fertile soil, large areas of natural forest and lake, and a relatively rich flora and fauna. Agriculture is the backbone of the Malawian economy, accounting for more than 40% of the Gross Domestic Product (GDP) and 90% of its export earnings. In 1996, smallholder agriculture accounted for about 75 % of the agriculture contribution to the GDP.

The population is largely dependent on subsistence agriculture with over 55% of farmers cultivating less than a hectare of arable land. About half the population live in the Lake Malawi basin, and some 75% of the annual animal protein consumed in Malawi is from fish mainly coming from Lake Malawi. About half the population have access to safe drinking water within a distance of one 1 km.

Almost half of the population in Malawi are affected by severe poverty. The most vulnerable groups include smallholder farmers, estate workers and tenant farmers, the urban poor, female-headed households and children. Female-headed households comprise about 25% of households nationally. Gender discrimination under customary law, in spite of the provisions of the Constitution and statutory law, is widespread and women in Malawi have a much lower socio-economic status than men. The government has a strong and fairly explicit national policy for the advancement of women, but this has not yet been sufficiently translated into gender-oriented sector policies.

Until mid-1994, when free multi-party elections ended three decades of authoritarian single-party rule, Malawi's development strategy was primarily aimed at maintaining macroeconomic stability and promoting growth through the expansion of estate agriculture and investments in supporting infrastructure. Domestic manufacturing and broad-based rural and urban development were deemed less important for achieving that growth, as was the development of the human resource base.

In response to the shocks which badly affected the economy in the early 1990s, the government embarked on a programme of reforms which was and continues to be implemented in phases with the support of the IMF and the World Bank. Under the programme, which was aimed at restoring macroeconomic stability, the currency, the Malawi Kwacha (MK) was floated in 1994. In spite of Structural Adjustment Lending totalling US$920 million during the period 1981-1996, the structure of the economy continues to be dominated by the three main export crops, tobacco, tea and cotton. The average economic growth rate between 1980-1993 was -1.3%. The average annual inflation rate was 22% in the decade 1985-1995 and in the late 1990s it has been above 50%. Privatisation, public service retrenchment and other structural adjustment measures, such as the removal of subsidies on fertiliser and maize, have resulted in most Malawians now being poorer than they were in the early 1980's.

Malawi, in fact, remains among the world's poorest countries. The GDP in 1996 was just US$180 per head. Income distribution is one of the most unequal in the world. The infrastructure is poorly developed and major investments are required in health and education. Life expectancy at birth was estimated at 41 years in 1996 and infant mortality per 1000 life births is 134. Adult illiteracy is 28% among men and 58% among women. Malawi's secondary school enrolment rate is at 7% with a further 11% in low-quality distance education, well below the average for sub-Saharan Africa.

Description of the present energy situation

The predominant source of energy in Malawi is fuelwood which is estimated to supply 93% of the energy consumed for all purposes. The remaining sources of energy are petroleum (3.5%), electricity which comes almost entirely from hydro power (2.3%), coal (1%) and other biomass (0.2%).

Paraffin wick lamps are the most common source of lighting in the urban areas. In the rural areas, candles and flashlights are used though many families rely only on the light from wood fires. Paraffin hurricane lamps are the only source of illumination in many health clinics, even those with maternity facilities. Car batteries are commonly used to provide electricity for stereos and other equipment with charging costs of up to 75 MK.

Hydrocarbons

No hydrocarbon resources have been discovered and all petroleum products have to be imported. Supply sources include refineries in South Africa and Zambia and refined products imported via ports in Tanzania, Mozambique and South Africa. ESMAP reports that the transport cost of

imported petroleum products to the major market in Blantyre is at least US$60 per tonne for liquid products and US$100 per tonne for LPG.

Fuelwood

In the rural areas fuelwood is universally used as a cooking fuel. It is also used in the urban areas where charcoal is also commonly used. In addition to meeting the bulk of rural and urban people's energy needs, the commercial fuelwood business is a relative large generator of rural employment, representing some 3.5% of the total GDP.

Although widely blamed for deforestation, fuelwood consumption appears to be a relatively minor cause of the widespread loss of forest cover taking place in Malawi. It is now widely accepted that the main cause of deforestation is permanent clearing of natural woodlands as the area of arable agriculture expands to meet the needs of the fast growing population.

According to a World Bank ESMAP study in 1998, the present total demand for fuelwood is about a third of the country's estimated annual yield. There is, thus, no immediate prospect of significant fuelwood shortages. Prices may, however, rise in some urban areas as a result of greater transport costs when nearby resources are no longer available because of clearing for agriculture.

This complex issue was outside the scope of the mission but it is clear that even if all fuelwood consumption were to cease, deforestation due to agricultural expansion would still continue. The use of renewable energy sources, although sometimes cited as having a role in preventing deforestation, is therefore not relevant to the issue.

Electricity Supply

The national power utility is the Electricity Supply Commission of Malawi (ESCOM). The statutory provisions under which ESCOM was established, in principle, provide it with substantial autonomy from the government. It is also statutorily obliged to operate in a financially disciplined manner and on a sound commercial footing. In reality, government intervention has prevented ESCOM from operating as an autonomous and efficient organisation and decisions on tariff setting, investments, and borrowings are all controlled by the government.

ESCOM's backbone transmission lines of 132 kV and 66 kV cover most of the country and around 50 towns are served by this grid. Few populated areas are more than 60-30 km away from an existing 66 kV line. In total ESCOM has about 65,000 customers. A breakdown of the distribution of consumers between the country's three regions, and the proportions electrified, in 1996 are given in the table below and present figures are little different.

Breakdown of population and proportions electrified 1996

Region	Northern	Central	Southern	Total
Rural population	1,070,600	3,668,000	4,571,000	9,309,60(]
Urban population	149,000	512,000	781,000	1,442,000
Total Population	1,219,600	4,180,000	5,352,000	10,751,600
ESCOM consumers in 1996	5,808	21,546	34,099	61,453
Percent of total regional population electrified	0.476%	0.515%	0.637%	0.5720%
Percent of urban population electrified in region	3.90%	4.21%	4.37%	4.26%

Source: ESMAP Draft Report 1998

It can be seen that the overall level of supply in the urban areas is about 4%, though this rises to about 25% in major cities such as Blantyre and Lilongwe. The proportion served in the rural areas is below 1% and falling as a result of population growth.

Responsibility for rural electrification was reassigned from ESCOM to the MOEM in May 1995 in order to provide new opportunities for accessing international funds for rural electrification and ESCOM now only undertakes rural electrification schemes if requested and funded by the

DoE. The government has put a small levy on petrol (0.04 MK/litre), in order to create a fund, the Rural Electrification Fund, for rural electrification and the promotion of renewable energy technologies. In mid-1999, the fund was said to amount to MK1 6-18 million but little, if any, rural electrification activity appears to be under way at present.

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The present tariff system is heavily subsidised, with electricity being sold at around 40% of its long run marginal cost. In October 1997, the government announced that there would be no charge for the first 30 kWh of domestic consumption. The justification for this is to allow the poor to use it for lighting. Since only about 20% of the urban population and less than 1% of the rural population have an electricity supply, this means that only a small minority of people, who are generally among the better-off, are able to benefit. The subsidy has also led to heavy consumption by those with a supply and electricity is, in fact, the cheapest cooking fuel in the country.

The operational performance of ESCOM is presently relatively poor and there are frequent supply interruptions and brown-outs. The system is almost entirely dependent on a series of cascading hydro plants on the Shire River for its power supplies. These have a total rated output of 220 MW and account for about 90% of ESCOM's generating capacity. The remainder of its electricity output comes a number of small thermal stations. The generation capacity of the Shire River is reduced because of increased sifting, which is attributed to deforestation and soil erosion and ESCOM has incurred considerable expense in silt-removal.

Of even greater concern is the fact that the water level in Lake Malawi is presently dropping which is causing a reduced flow in the Shire River. This has happened in the past and the river was completely dry between 1915 and 1935 due to low lake levels. Present fears are that water flows at the power station intakes may fall to about 100 cubic meters per second with a resulting fall of 50% in electricity generation. This translates to a reduction in capacity of about 100 MW. Plans are being made to interconnect Malawi's grid system with those of Mozambique and Zambia.

Solar Energy

Solar energy is abundant in Malawi and, although local data may be sketchy, internationally available databases provide sufficient data for design purposes. Maximum irradiation of 6.5-7.0 kWh/day/m² occurs in September-October and the minimum of 4.3-4.6 kWh/day/m² occurs in January-February or in June-July according to location. The seasonal variation is thus 30-40% which can be reduced to 15-20% by selecting an appropriate orientation of the PV panel or the solar collector. The solar energy resource is thus well within the limits normally considered to represent technical and commercial exploitability.

The present market for PVs in Malawi is, however, limited. The two main companies active in the field are Ecolectric and International Power Control Systems (IPCS). Ecolectric has been operating in Malawi for about ten years. Their main activity is in general electrical and telecommunications engineering supply and contracting. They are appointed agents for Siemens and supply solar products from a range of manufacturers. IPCS was set up in 1997 and is

primarily concerned with the supply and installation of radio communication systems. They are appointed agents for BP Solar and offer a full range of that company's solar products and accessories. The estimated total market for solar energy equipment in Malawi, including that used for telecommunications, is estimated to be in the range US$250,000-400,000, corresponding to the installation of approximately 25-30 kWp per year.

The major part of these commercial activities consists of the supply of equipment to the institutional market, that is PV lighting and refrigeration for private and public health clinics, and PV water-pumping installations. These initiatives are all funded by the donor community and NGOs. In the private sector, duties and taxes add significantly to the cost and selling price of PV equipment. There is a 10% duty and a 20% tax, for example, on PV modules, charge controllers and lights and there is a 62% duty on batteries. It can, however, be said that, although the commercial market for SHSs is still small, and the existing technical resource-base is relatively narrow, it provides an adequate foundation for the initial steps to be taken in the development of a sustainable commercial PV market.

The use of PVs in the telecommunications sector is highly specialised. These professional uses, where the overwhelming need is for security of supply, tend to involve far higher cost installations than could normally be contemplated for domestic and normal public uses. The existence of these PV activities in the telecommunications sector, however, contributes to the growing awareness of PV technology and its potential in Malawi.

Solar thermal hot water systems are known in Malawi, mostly in the context of NGO -supported installations at health clinics and schools. No commercial market in the technology exists and the prospects of any immediate developments in the this area are low. The present low electricity tariff, averaging about US$0.04/kWh, with the initial free block of 30 kWh, means there is no incentive to use solar hot water systems instead of electric geysers in the medium to high income urban areas, in which a sustainable commercial market might otherwise be developed.

Wind Energy

The Malawi Meteorological Department, since its inception in the late 1930s, has recorded wind data at several stations. These measurements, however, have been made for agricultural and water resource management purposes at the height of 2 metres, and for aviation purposes at a height of 10 metres. These are of little direct use for assessing the wind energy potential in the country.

A recent Danida-supported study of the wind energy potential in Malawi has failed to arrive at any overall conclusions as to the wind energy resource but, in general terms, it appears that averages speeds are less than 4 m/s, and in many areas are much less. The wind energy resource is not utilisable for electricity generation on a significant scale but traditional multi-blade wind-mills (wind-roses) for water pumping and small scale wind-chargers are likely to be technically feasible in favourable areas.

A certain number of wind-pumps have been installed in the past but none appear to working at present. No commercial suppliers or manufacturers of wind-pumps presently exist in the country but the technology is relatively simple and a number of steel fabricators and drilling contractors provide a basis for initial activities, possibly using designs and components imported from Zimbabwe or elsewhere.

Biogas

Biogas is a combustible mixture of methane and carbon dioxide which is formed when organic matter is fermented, or digested, in the absence of air. Biogas has about half the calorific value of

natural gas and can be used for cooking or with a gas-mantle lamp for lighting. The residual slurry from biogas digestion is a useful fertiliser which can be spread on crops.

Experience from countries such as Nepal, China and India, where small-scale biogas has been deployed on a significant scale, shows that it is technically complex and demanding; it is sensitive to factors such as temperature and the exact composition of the feedstock; it also requires substantial quantities of water. The utilisation of human wastes, which is an integral part of the Chinese approach, can also raise social questions.

The context within which biogas technology can be successfully deployed appears to be relatively restricted. The digester requires a substantial amount of water during the digestion process. Temperature conditions need to be relatively stable and warm; the digestion proceeds best at around 35ºC. A 10ºC fall in operating temperature can reduce the yield by half. A study in Zimbabwe found that although the temperature variation was only 10ºC the output of a Chinese-type digester was three times as high in the summer months as in the winter. [5]

The number of cattle required to keep a digester operating is a function of the yield of dung, the productivity of the digester, and the gas requirements of the household. In all cases, the dung has to be readily available which normally means close confinement of the animals, if not stall feeding. Collecting the dung from free-range grazing animals is normally not a feasible option. Arrangements also need to be made to ensure that dung-collection is possible during the rainy season.

The technical skills required for the construction of effective digesters are relatively high. They involve an ability to construct leak-proof masonry or concrete. The plumbing arrangements, by which the gas is taken from the digester to the household, also need to be carried out carefully. Where these skills are not locally available, construction costs are likely to be high and long-term maintenance may prove to be a problem.

Some development work on biogas has been carried out in Malawi. Two types of digester have been built, the Indian floating drum type and the Chinese fixed dome. The Indian type, in which the drum is made of steel which has to be imported, requires a substantial capital investment, putting it out of reach of the vast majority of rural families. The Chinese type of digester is built of bricks and concrete and is buried underground. A relatively high standard of construction is required as the digester operates under a slight pressure and leaks are a common and difficult problem. One of the major difficulties facing biogas promoters in Malawi is that appliances such as burners and lamps are presently unavailable in the country and have to imported from Tanzania.

The Ministry of Gender, Youth and Community Services (MGYCS) [6] has been the main proponent of biogas in the country and has worked on the technology with the MIRTDC. It introduced biogas technology at the Community Development Training College at Magomero in 1992 with funding provided by the World Bank under its support for Population, Health and Nutrition Sector Credit Project Women in Development Component. The fixed dome (Chinese) type of digester has been adopted and 11 have been constructed of which nine are in operation. The Ministry has established a biogas construction team of eight, a team leader, six technicians and a mason, who were trained in the construction and operation of biogas digesters by a specialist from India in 1996.

Attempts have been made to develop a communal approach to the construction and operation of digesters but without success. The main problem is disagreements on the sharing of work and

[5] Reported in Bioenergy Systems Report, Mahin (1985) p16

[6] Formerly the Ministry of Women, Youth and Community Services.

benefits between the households involved. Individual systems are therefore preferred. The Ministry has a list of 37 households which have expressed an interest in installing a digester.

Mini and micro-hydro

The classification of hydropower plants according to size varies but the following definitions are now generally accepted:

- Micro hydro: up to 100kW
- Mini-hydro: l00 kW to l,000 kW (l MW)
- Small hydro: 1 MW up to 5-10 MW

In existing studies and reports on Malawi, the term mini-hydro is sometimes used for plants larger than 1 MW.

Malawi is well-endowed with streams and river, mainly flowing into Lake Malawi and the Shire River valley. Although many of these are seasonal, it is probable that a significant number have year-round flows sufficient to provide power for a small hydro installation. This is reported to be particularly the case in the north of the country. Some 10 sites, with potential capacities up to 2.2 MW, were identified in a study carried out by the engineering consultants Kennedy and Donkin in 1988.

Some experience in the use of micro-hydro exists in Malawi and there are two well-functioning plants at the Lujeri tea estate near Mulanje in the south-east of the country. These are used to supply one of the estate factories with all its electric power. The total capacity between the two plants of just under one MW. The earliest unit dates from 1934 and the latest from 1958. All the equipment is running satisfactorily and the skills available at the factory are sufficient for plant maintenance. This installation provides a demonstration of the feasibility of micro hydro in Malawi and might be used for training visits but is unlikely to be of wide relevance among Danida's target groups in the immediate future.

The Zomba mini-hydro plant owned by ESCOM has two 300 kW units installed in 1953 and 1954. This was built before the town of Zomba was connected to the grid and operated for 35 years. It has not been in operation in recent years, reportedly due to lack of spare parts and insufficient water supply. It appears that the intake pond has filled with sediment over the years.

The Matandani plant near Neno Trading Centre in Mwanza district is now out of operation but could be rehabilitated and used a microhydro demonstration project and this is discussed in detail in Section 4.5.

Institutional arrangements in the energy sector

The Department of Energy (DOE)[7] has overall responsibility for the energy sector including renewable energy. Work on the development of an overall national energy policy has been under way for some years with assistance from the World Bank.

Up to the time of the mission, the DoE was in a rather undefined position in the government, and its budgetary framework was not clear. The Ministry of Energy and Mining (MOEM), to which it had previously belonged, appeared to have been dissolved and the DoE was attached to the Office of the President. In August 1999, it was reported that the DoE was to become part of the Ministry of Natural Resources.

A Rural Electrification Technical Committee (RETC) has been established to plan and coordinate rural electrification actions. The committee is chaired by the Acting Director of the DoE and has representatives form ESCOM, MGYCS, MIRTDC and the private sector. The RETC has identified almost 40 sites for grid-connected rural electrification, and has identified

[7] Also referred to as the Department of Energy Affairs

about 15 sites for off-grid electrification, primarily through renewable energy technologies, meeting the demand of rural health clinics, education centres and police stations. A number of critical issues not clear in this context are selection criteria, demand and affordability surveys, least cost technology analysis, economic analysis and financing arrangements. No significant action in the implementation of these proposals appears to be immediately in prospect.

The National Sustainable Renewable Energy Programme

In 1997, the DoE prepared the National and Sustainable Renewable Energy Programme NSREP). The primary objective of the NSREP is to increase access to and promote the efficient use of renewable energy sources in Malawi. A draft Programme Support Document (PSD) on renewable energy, with initial support from Danida and UNDP, has been prepared as part of the conceptualisation of the NSREP.

The PSD focuses on building capacity and carrying out demonstrations in the field of renewable energy. Out of an anticipated total budget of US$7.7 million, UNDP has initially set aside US$0.5 million for capacity building at the DoE and for awareness campaigns. Danida is expected to contribute almost US$0.5 million in the period 1999-2001, mainly for tangible activities to support the development of renewable energy technologies. It is anticipated that other donors will also contribute to these activities.

The Proposed UNDP/GEF Initiative

An initiative entitled "Barrier Removal to Malawi Renewable Energy Programme" has been proposed by UNDP for support under GEF. The final version of the Project Brief Proposal for this programme was made available to the team.

The total estimated project cost is US$10.72 million of which the GEF contribution is anticipated to be US$3.4 million. The anticipated Danida contribution is US$2.25 million through parallel financing under MIKA/EDRF funding. The UNDP is providing US$1.2 million and US$1.85 million is to come from the Government of Malawi. A further contribution of US$2.0 was anticipated from Southern Bottlers (Malawi) Ltd, a subsidiary of Carlsberg and Coca-Cola but this is now uncertain. Of the total budget, one third is allocated to capacity building activities.

According to the final Project Brief Proposal, the UNDP/GEF project will assist local stakeholders in building local capacities to promote, install and service PV applications; help to develop and implement favourable regulatory frameworks and facilitate the establishment of viable financial mechanisms for micro-lending in order to address up-front investment cost barriers and risk perceptions. The aim is to demonstrate the viability of investments in PVs and encourage widespread replication. The principal concrete objective of the programme to install at least 9,000 off-grid PV systems by its completion date in the year 2004.

The timing of the project is somewhat uncertain and some slippage has already occurred. The Project Brief Proposal was originally scheduled to be tabled for approval by the GEF Council in May 1999 and this has now been put back to early in December 1999. Final approval of the project at this meeting is not a foregone conclusion and a further cycle of amendment may be required, further delaying the implementation of the project. The earliest effective starting date for the project is likely to be around mid-2000. These uncertainties have been borne in mind in the development of the management structure for the initiatives described in this draft Project Document.

The PSD and UNDP/GEF Project Management Unit (PMU)

The PSD and the UNDP/GEF projects are the most important impending initiatives in the renewable energy area and both are being substantially supported by Danida. The management of these initiatives is thus a matter of concern to Danida and has a significant bearing on the initiatives described in this draft Project Document.

It has been agreed between the stakeholders that a Project Management Unit (PMU) will be established to manage the implementation of the PSD and the UNDP/GEF initiatives. The Steering Committee for the PMU is presently being established and is expected to hold its first meeting in August/September 1999. This is expected to authorise the appointment of a Project Manager who is expected to take office in the first half of the year 2000.

The Steering Committee, which will be composed of all the relevant stakeholders will meet once a year. A Management Committee will also be set up for the more direct oversight of the PMU. This will consist of the participating donors and key stakeholders. The Management Committee will meet quarterly.

Other Donor Activities in the Energy Sector

Other donor activity in the energy sector appears to be limited, with the main up coming project being the UNDP/GEF project described above.

The World Bank has committed a sum of US$160,000 for expert assistance to the DoE in drawing up a national energy policy but none of this had been expended at the time of the mission. A rural electrification advisor to the DoE is being funded by JICA assistance.

UNESCO is reported to have funded a "Solar Energy Demonstration Village" and may fund a similar activity in the near future. NGOs, primarily church-based relief organisations, have supported various PV applications for rural clinics, schools and for water pumping.

The SADC Technical and Administrative Unit, in co-operation with the UNDP's Energy and Atmosphere Programme is assisting Malawi in the identification and development of renewable energy uses and improving energy efficiency through the FINESSE programme. A draft study has been published but activity under the programme to date appears to be limited.

Gender, poverty-orientation and cross-cutting issues

Danida assistance policy requires that all activities considered for support be scrutinised in the light of its concerns with gender and poverty-alleviation, environmental issues, and human rights, democracy and good governance issues of relevance to the sector.

In Malawi, there are gender inequalities in all sectors of the economy. Women carry out about 70% of all farm work on traditional smallholdings but their rights to land and control over its use are highly restricted. Only 29% of women are literate and the drop-out rate among girls at school is 34%. They also have limited rights and control over issues affecting their reproductive functions and health. Women suffer disproportionately from the burden of poverty which afflicts the whole subsistence agriculture sector.

The room for manoeuvre or obtaining leverage on these issues through the promotion of renewable energy technologies is, however, heavily constrained by the fact that energy is a derived demand. The energy demands of women and poor people generally are a reflection of their poverty and position within the overall structures of society and the way in which access to financial and other resources and decision-making powers are allocated within it. Providing extremely poor people with access to renewable energy resources will not, in itself, alter their position within the overall scheme.

In looking for a role for renewable energy technologies in poverty alleviation or income generation, the essential prerequisite is that the income-generation or poverty-alleviation measures and the constraints to their implementation are clearly identified. In agriculture-based activities, for example, these constraints may include lack of easy access to markets; low prices for products; inability to afford seeds, fertilisers and other necessary inputs; and lack of water for irrigation.

Once the constraints to particular income-generating activities have been identified, it becomes possible to examine ways of developing an integrated strategy for overcoming them. Among

these, lack of energy in an appropriate form may be a significant barrier. Once this has been determined, it becomes possible to compare the technical characteristics and costs of the various available methods of supplying these energy needs.

The development of models for the effective and sustainable deployment of renewable energy technologies, in effect, provides additional tools which may be used in the process of poverty alleviation. Where lack of energy is a constraint to the realisation of poverty alleviation goals, the existence of the necessary resource base for the deployment of the appropriate renewable energy technologies can enable such constraints to be removed. In addition to meeting the energy needs of rural people, the development of renewable energy technologies will help stimulate and support the development of local manufacturing and maintenance skills which will have a variety of direct and indirect beneficial spin-off effects beyond renewable energy technologies themselves.

Gender issues do not usually emerge directly in the renewable energy context though the use of these technologies can bring some specific benefits for women. The effects of improved lighting in clinics, bring benefits to the staff who tend to be mainly women. The provision of PV lighting in maternity facilities is also a self-evident benefit to women. The management of biogas digesters, however, with its need to collect animal dung, feed and maintain the digester, and spread the resultant slurry on crops, can have significant implications for women's work and this needs to be considered in biogas projects.

Any direct connection between the issues of human rights, democracy and good governance with the proposed pilot projects is extremely tenuous. It is, however, important that management structures are designed to ensure the maximum degree of Malawian responsibility, coupled with transparency, in the implementation of projects and this has been borne in mind in setting up the management structures for the project.

Environmental issues

The environmental impacts of the proposed activities are minor and generally benign. The question of safe disposal of batteries from the future implementation of large solar energy programmes is, however, a potentially serious long term issue.

The batteries used in solar systems are of the lead-acid type. Although detailed designs vary, these batteries all include lead and various sulphuric compounds. Pollution of ground-water supplies with lead compounds is a particular danger and has wide-ranging implications for public health.

The only safe route for disposal of the lead is via recycling. Lead has a market value of about US$600 per ton which has the potential to make recycling an economically attractive option. Given that solar system batteries have a life-time in the range 4-5 years, the quantities of scrap lead coming from solar energy systems installed under the proposed activities in Malawi will, however, be negligible during the next few years and certainly will not be sufficient to support a formal recycling system.

This gives some time to devise an appropriate recycling system which, ideally, would include the much larger problem of car battery disposal. Even though the issue of long-term disposal of batteries from the solar energy activities will not arise within the project implementation time, the team recommends that this issue should begin to be addressed as part of the planning for the long term follow-up to these projects. A variety of institutional models can be developed for this purpose and Danida may wish to support research into the safe disposal of both lead and the sulphur compounds from batteries under the Renewable Energy or Urban Environment and Industry Components of the DESP.

Assessment of the Renewable Energy Sector in the Light of Danish Policy

Although modern renewable energy technologies are viewed favourably in Malawi and a NSREP has been formulated, the contribution to date by these technologies to the country's overall energy consumption is negligible. The renewable energy sector, in short, scarcely exists, in terms of actually realised projects, at present.

The renewable resource base is, however, clearly sufficient to support a variety of initiatives. Solar energy is abundant and there is a sufficient technical expertise to support a carefully programmed development of PV applications. Although wind speeds are not sufficient for electricity generation on a significant scale, there would appear to be opportunities for wind-pumping. There also appear to be opportunities for micro-hydro developments. Some biogas applications already exist and it is clearly worthwhile devoting to some effort to investigating the wider potential of the technology.

Malawi also has the opportunity to build on the renewable energy experience of other neighbouring countries as it begins to implement its own strategies under the NSREP. By starting with a series of carefully-programmed pilot initiatives, Malawi can lay a much sounder foundation for its renewable energy programme than many other countries.

20. VISIONS, OPPORTUNITIES AND OBSTACLES

Renewable energy experience in Malawi is still relatively limited. While this provides opportunities for innovative action, it also presents obstacles which need to be overcome.

Visions and opportunities

The long term aim of Danida's assistance under the Renewable Energy Component of the DESP is to provide support to the development of an efficient and sustainable energy supply in Malawi based on increasing use of renewable energy technologies. The route towards this objective involves the development of self-sustaining commercial markets in these technologies. Only in this way can the problems of long-term dependency on external funding, lack of replicability and general unsustainability which have undermined so many renewable energy projects and programmes in the past be resolved.

Although practical experience with renewable energy technologies is less in Malawi than some other countries in the region, this is likely to change in the near future. The NSREP provides a framework into which new activities, especially those funded by external donors, can fitted in a structured and coherent way. The impending UNDP/GEF initiative will also involve a considerable amount of activity in the renewable energy area ranging from the development of national-level management and co-ordination structures through to field installation of thousands of individual SHSs with their subsequent need for repair and maintenance. These up-coming initiatives create both a need and an opportunity.

The need is begin to gain practical experience with the various technologies involved, to develop relevant local skills, and to start putting the necessary institutional structures in place so that the implementation of the UNDP/GEF project can take place smoothly. The sooner these activities can be set in motion, the more secure the foundation will be for subsequent renewable energy activities.

The opportunity is gain experience in the planning, installation and maintenance of renewable energy installations in advance of the scale-scale implementation of the UNDP/GEF and other projects. At this stage, it is not necessary to demonstrate the technologies as such since this has been done many times in many other places. The urgent need is for effective implementation models and, above all, mechanisms which can provide the maintenance required for sustainability. Small well-designed and carefully monitored pilot projects provide an opportunity to devise and test such models and mechanisms. In effect, these proposed Danida pilot projects can be seen as a laboratory for the UNDP/GEF and other projects. This concept has been fully discussed with the DoE and UNDP and there is general agreement on its relevance and desirability.

While the time-scale for the UNDP/GEF project is still subject to some uncertainty, it is likely to begin towards the middle of the year 2000. This provides a narrow window of opportunity for the Danida projects described here. Provided they can be started in the beginning of the year 2000, it will be possible to feed valuable lessons into the preparations for the UNDP/GEF – and other donor projects. If, however, these Danida projects are significantly delayed, this opportunity will be lost.

Problems and obstacles

The greatest problem facing Malawi is poverty especially in the rural areas. The income levels of the majority of the rural population are too low to sustain a large commercial demand for renewable energy technologies. This problem will not be overcome by providing these technologies as gifts or at highly subsidised rates since the problem of maintenance will remain and the working life of installations will be short. Any benefits from investments in renewable energy technologies provided on a heavily subsidised basis will be small and short-lived.

The solution is to identify potential users with the ability and willingness to pay for renewable energy installations. Health clinics which do not have the funds for drugs, building repairs and equipment cannot maintain PV systems. Those with a reasonable income from patients may be able and willing to do so once the met their basic needs for medicines and other necessities. People whose only lighting source is the open fire are unlikely to be able or willing to purchase a SHS; those spending substantial amounts on disposable batteries and car battery recharging are much more likely to want to avail of the higher standards of service which an SHS can bring at little, if any, increase in expenditure.

It is therefore essential that initiatives are targeted on end-users who are able and willing to pay. If this is done, sustainable openings for the use of renewable energy technologies can be identified. This will help create the necessary infrastructure for routine installation and maintenance; it will also bring economies of scale and market competition leading to price reductions. In this way, access to renewable energy technologies will be widened and their benefits will become available at progressively lower levels in the rural income scale.

Malawian institutional capacities in the renewable energy area are still limited. The NSREP and the UNDP/GEF project are designed to address the issue of capacity building but their effects will not be felt for some time. It is therefore crucial that interim management arrangements are put in place not just for the implementation of the projects described in this draft Project Document but also to ensure that the lessons learned from them are effectively fed into the subsequent planning and implementation of the NSREP and the UNDP/GEF initiatives.

21. STRATEGIC CHOICE AND RISK ASSESSMENT

The proposed interventions listed in the ToR of the mission were the starting point for the team. These had already been identified by the May 1999 mission and preliminary discussions had been held with major stakeholders.

The projects finally agreed for implementation are each discussed in detail below under their own separate headings.

Options considered for the project

The options considered for project can be categorised into those which involve specific renewable energy technology installations and those which provide a broad underpinning for renewable energy developments in Malawi. Those involving specific installations can be summarised as follows:

- PV electrification at health clinics – pilot project;
- Household electrification using SHSs – pilot project;
- Use of wind-pumping for small scale irrigation – pilot project;
- Micro hydro – feasibility study for subsequent demonstration project;
- Small-scale biogas initiative.

The two underpinning initiatives are:

- Preparation of a wind atlas for Malawi;
- Support to the development of norms, standards, performance and quality assurance for renewable energy technologies.

In each case, the option of complete rejection of the proposed intervention was carefully considered. Each initiative was, however, judged to be viable provided it was carefully and narrowly targeted in areas and on groups which provided a reasonable chance of success.

Successful pilot projects provide a base on which further and broader initiatives can be built. The appraisal concluded that the selected projects can fulfil this function by providing workable models for the future wider deployment of renewable energy technologies in Malawi.

For the reasons outlined in the previous chapter, it was decided that a fast-track approach to the implementation of the projects was essential. The main utility of pilot and demonstration projects is that they can be used to develop and test implementation and management models for the technologies in question. This makes it essential that they are well under way by the time decisions have to be made on the subsequent initiatives such as the PSD and the UNDP/GEF project. It is equally necessary that underpinning initiatives are in place or well under way before such subsequent initiatives are undertaken. The same applies to the study tour for key personnel also included in the project.

PV electrification at health clinics – pilot project

There are 259 health care facilities in the 11 districts covered by the DESP. These are operated by a number of organisations including the Ministry of Health and Population (MOHP), individual religious organisations, various private concerns, the Malawi army and others.

The Christian Health Association of Malawi (CHAM) was established in 1966 as an umbrella organisation for all church-related health activities. It represents a total of 18 different churches and church organisations, covering all the main denominations; it also includes a total of 12 non-church associate members. It acts as a co-ordinating and advisory body which liases between the government and CHAM members but it has no authority over its members.

CHAM members operate a total of 148 health facilities. The facilities organised under its umbrella are reported to account for 19% of all the country's health facilities, 38% of beds, and

10% of out-patient visits. Most of these church-sponsored health facilities predate the government health system and provide training for nurses and other health personnel. [8]
Approximately 30% of the operating cost of these clinics is covered by the government, mainly in the form of salaries for local staff. The rest is covered by patient fees possibly supplemented by donations in some cases. There is a sliding scale for consultations, diagnostic tests and treatments but discretion is used so that poor patients are not denied treatment because of inability to pay. A study of outpatient paying patterns commissioned by UNICEF in 1995 indicated that 95% of all CHAM patients pay treatment fees. The resources obtained from these charges are used to purchase drugs and medicines and to improve the quality of care. In some areas, CHAM facilities are the only health care facilities available to the public. [9]
In contrast with CHAM facilities, the proportion of patients paying fees at MOHP facilities is negligible. The MOHP is, however, presently considering proposals for a gradual introduction of fees. The intention is that this will start at a central hospital level, working down to the district hospitals and finally to health centres and clinics. No timetable for this process appears to have been made as yet.
The most common type of health centre includes a Maternity and a Dispensary wing together with waiting areas, examination rooms and office space. Some rural health facilities now include wings for Child Spacing and Nutrition Education. Typically a health centre will also have five staff houses. The types of facilities found in the project districts and their distribution by district are presented on the table on the following page. This was taken from the final draft of a study of solar energy uses in the health facilities commissioned by Danish Embassy.
A detailed review of the state of all the health facilities in the country has also been carried out for the MOHP with finance from the European Development Fund in 1998. [10] This describes, for each facility, the location, operating organisation, buildings and their condition, facilities available, revenue generated, medical equipment and its functioning state, and whether or not the facility is connected to the grid.

Breakdown of health facilities by type in DESP districts in Malawi

District	Hospitals	Primary Centres	Dispensary/ Maternity	Maternity	Dispensary	Unclassified or Closed	Total
Chitipa	1	1	7		0		9
Rhumpi	2	3	16		6		27
Karonga	1	1	10		6		18
Nkhata Bay	1	2	12		11	3	29
Nkhotakota	2	2	10		8		22
Salima	1	0	11		3		15
Dada	2	3	21	1	7		34
Mango chi	3	0	24		11		38
Marching	1	0	12		5		18
Zomba	5	2	14	1	13	1	36
Holcombe	1	1	4	2	4	1	13
Total	20	15	141	4	74	5	259

[8] Malawi Health Expenditure Review, Draft (April 1999), Human Development Division, East and Southern Africa Division, World Bank.

[9] Development of a Health Care Financing Strategy, Visit Report, May 1999 produced by Liverpool Associates in Tropical Health under contract to UK Department for International Development

[10] Baseline Study of Physical Assets Providing Medical Services to the General Population prepared by Stuart W. Miller, April 1998.

Of the 259 health facilities in the area covered by the DESP, a total of 165, that is 64%, do not have a connection to the national electricity grid. Given the near-standstill of rural electrification activities in the country, the vast majority of these health facilities have no realistic prospect of obtaining a grid-based supply in the near to medium term future. In selecting facilities for potential solar applications, it is essential, however, that this is verified.

Within the districts covered by the DESP, a total of 45 health centres have, or have had, some form of PV-powered installation including lighting, refrigeration, water pumping and radio communications. In 1998 only 27 of those installations were working. Of the eighteen not working, the panels have been stolen from 3, the panels were reported as broken on 4, one had been struck by lightening, and ten were not functioning for unspecified reasons. As it is highly likely the position has worsened in the meantime, and it is therefore reasonable to assume a failure rate of at least 50% which is unacceptable for such costly installations.

The review states that the main causes of failure were as follows:

- Theft of the solar modules, although this is apparently now not so common;
- Removal of the battery to replace a vehicle battery;
- Use of the charge regulators or inverters to charge non-system batteries or to operate non-system appliances;
- Improper replacement of blown fuses;
- Inadequate monitoring and maintenance of the batteries;
- Lightning strikes (very infrequently);
- Intentional vandalism (also very infrequently);
- Lack of a budget for routine maintenance visits and to replace broken or inoperative components.

It can be seen from this list that deliberate misuse of batteries is an important factor, indicating a lack of a feeling of responsibility or involvement on the part of the staff. The other main causes are connected with inadequate maintenance and lack of replacement parts. Both these issues need to be addressed in any projects for the provision of PV systems in health care facilities.

Comparison between well-working electrified and non-electrified clinics shows that the availability of electricity can bring major benefits. This is particularly true of maternity facilities but also applies where emergency treatments involving, for example, suturing are carried out. Even small fluorescent lamps provide a far safer and more convenient environment for clinic staff and patients. The provision of electric power for lighting and as a replacement for radio and cassette batteries in staff houses is also a significant factor in maintaining the morale of clinic staff.

Although PV lighting technology is well-proven and reliable, it is clear from experience throughout the developing world, and borne out by that in Malawi, that systems require routine servicing every six months. In addition, short-life components, such as lamps, and on a scale of every 3-5 years, batteries need to be replaced. Without such maintenance and component replacement, the record clearly shows that the breakdown of PV systems within a few years is inevitable.

Danida would be prepared to consider covering the initial purchase and installation costs of the systems but would, ideally, like to see some initial contribution from the clinics as an assurance that installing a PV system is a genuine priority. The exact level of any such contribution, if it is made, will be a matter for discussion at the inception of the project.

Danida, however, cannot become involved in the long-term maintenance of systems. The provision of initial Danida funding for the systems will, therefore, depend on the development of a reliable long-term method of funding the maintenance requirements of the systems. Experience strongly indicates that any such funding system will need to be rooted in the individual clinics with the maintenance contract costs being shared between the staff and the clinic in proportion to the installation costs.

This obligation to pay a regular fee will ensure, firstly and most importantly, that obtaining a PV lighting system is a real priority for the clinic and its staff. It will help cultivate the necessary level of responsibility at the clinic level as staff will have a strong vested interest in ensuring that the system for which they are paying is looked after carefully. It will also mean that the maintenance of the systems is carried out to the satisfaction of the staff, thereby providing an important quality-assurance check on the work carried out.

The reforms being considered by the MOHP, once they have been instituted, will provide a measure of self-funding to clinics. This will enable them to obtain equipment and medicines, which is impossible for most clinics at present, and create the conditions under which PV lighting may become a relevant option. When these reforms are in place, it may be possible to bring a number of the clinics under the control of the MOHP into the later stage of the proposed pilot project - on the assumption that its results in the CHAM clinics are turning out to be positive.

An allowance has accordingly been made in the project budget for the installation of an additional five systems in MOHP clinics. It is therefore important that the Ministry of Health and Population is provided with a consultative role in the design, monitoring and assessment of the pilot project and the option to join the project is kept open.

It is estimated that a typical PV system, including lighting (15 lamps) and a radio communication system for a clinic, together with solar home systems for four staff houses would cost about US$9,000 (MK400,000). This excludes taxes and duties which will not apply to systems installed under the project. A routine maintenance contract, provided by a competent supplier and covering a group of, say, 15 clinics within reasonable distance of each other would be in the region of US$450 (MK20,000) per clinic per year. These estimates will need to be confirmed during the implementation of the project.

Description of the pilot project

The pilot project will be concentrated on clinics operating under the auspices of CHAM The pilot project will involve the installation of PV systems in 15 clinics in the Salima, Nkhotakota and Dedza Districts which come within the DESP. The reason for choosing these areas is that it provides a reasonably concentrated area for the pilot project thereby simplifying the implementation and supervision of the project and reducing the cost of maintenance. CHAM will act as the national level collaborating organisation for the pilot project and, if the project is a success, will be in a position to participate in the wider dissemination of the technology through the clinics operating under its auspices.

Each clinic will be provided with a PV system sufficient for about 15 lights and a separate supply system for a radio link with the nearest general hospital. A separate 50 Wp system will be provided for each staff house. Although relying on a common set of components, the systems will be individually tailored to each clinic.

Only well-functioning clinics whose equipment, medication, staffing and other needs are already being met will be chosen for the pilot project. PV systems can increase the effectiveness of a well-functioning clinic; they cannot substitute for other more basic requirements. The criteria for

the choice of clinics will therefore include the following but may be refined or modified in discussion with stakeholders during implementation:

- The clinic will be under the CHAM umbrella;
- The clinic buildings will be in a satisfactory state allowing it to function normally;
- The clinic will be adequately staffed for its role;
- The clinic will be charging a level of fees which enables it to meet its recurrent needs in medication and equipment;
- The clinic will not be connected to the ESCOM grid or have any immediate prospect of getting such a connection;
- The staff, having been informed of the costs to themselves and the clinic of the PV equipment, will signify their willingness to enter into an agreement to accept the equipment and pay for its maintenance. Failure to honour this agreement will lead to repossession of the system.

Detailed design and specification of the installations, selection of the clinics, negotiation of level of payments, making arrangements for collection and disbursement of payments, drawing up tender documents, invitation of bids from local PV suppliers, selection and appointment of suppliers, supervision of installations and arrangements for supervision, monitoring and feedback will be subject to agreement between stakeholders and will be carried out by the project Interim Support Unit (ISU).[11]

Solar Homes Systems (SHSs) Dissemination - Pilot Project

As SHS technology is now commercially proven and mature, this pilot project will primarily be concerned with piloting delivery and maintenance mechanisms. It has been agreed that this pilot-project will be seen as a laboratory, providing lessons for the up-coming large-scale UNDP/GEF project.

SHSs provide a major increase in living standards for rural families. Possession of an SHS means an end to the use of paraffin lamps, paying for disposable batteries for radios and cassettes and the labour and expense of carrying a car battery back and forth to a charging station. At the same time it is important to be realistic. SHSs cannot be used for cooking, ironing or water-heating.

As in the case of the clinic systems discussed above, SHSs must be maintained properly. If regular maintenance is not provided, world-wide experience demonstrates that premature failure of systems is inevitable. This maintenance must be carried out by professionally-competent and paid technicians; experience shows it cannot be handled on an amateur basis by local people. Establishing a commercially viable and sustainable maintenance service is only possible if there is a sufficiently large number of SHSs within a reasonably close proximity to each other.

SHSs can be installed in a range of sizes. Small units (20Wp) provide a minimum service sufficient for one or two small lamps and a radio for a few hours in the evening. The most common size (50Wp) can provide power for three or four lamps, a cassette player and even a small black and white TV for perhaps four hours. Larger units (l00Wp) are available and can provide a correspondingly higher level of service.

The installed cost of a conventional-size SHS (50Wp) is estimated to be about US$800 (MK36,000) in Malawi. This excludes taxes and duties which will not apply to systems installed under the project. It is clear that an investment of this size is outside the reach of a high proportion of Malawians at the present time. There are, nevertheless, many families and small businesses which are paying large sums of money for paraffin, disposable batteries, and car battery recharging which can cost MK75 per charge. Providing such people with access to SHSs,

[11] The ISU and its functioning and responsibilities are described in Section 7.1.

in addition to the benefits obtained by each user, will help establish a commercial basis for the technology in Malawi, opening the way to its wider dissemination throughout the country.

Description of the pilot project

The pilot project involves the installation of about 200 SHSs in the Salima, Nkhotakota and Dedza districts which come within the DESP. A range of sizes will be offered to households with prices varying according to installed capacity.

The Tobacco Farmers Association of Malawi (TAMA) will act as the national level collaborating organisation. TAMA was founded in 1929 and has its headquarters and secretariat in Lilongwe. The membership of TAMA in 1998 was made up of 46,265 burley tobacco growers and 3,968 flue tobacco growers. A high proportion of the burley tobacco growers are small-holders and their production accounted for almost half the total crop. Burley tobacco is air-cured by hanging it in racks in open-roofed or grass-thatched barns. A significant proportion of TAMA members grow around 5,000 kg of tobacco per year which, at present prices, provides an income of about US$7,500.

TAMA also runs a total of 16,613 growers clubs which enable small-holders to obtain fertiliser and other inputs on credit from the Malawi Rural Finance Company. There have, however, been serious problems over repayments of loans with the situation being described by the President of TAMA at the 1998 Annual Congress as being "in a shambles" and seriously tainting TAMA's credibility. [12] Because of the increasing uncertainty over the long-term future of tobacco, TAMA also supports diversification into other crops. TAMA funds and controls the Agricultural Research and Extension Trust (ARET) which carries out research and provides technical support to tobacco growers.

As a market-priming mechanism, Danida will provide funds for the purchase and installation of about 200 SHSs. As this is a pilot project, intended as a first step in establishing a self-sustaining commercial market in SHSs in Malawi, it is essential that users pay a realistic price for the installations and their maintenance. The recovery of these costs will provide a revolving fund and financial cushion for dealing with establishment costs, teething troubles and the further extension of the scheme among the TAMA membership. NASFAM were consulted on possible participation in the project but felt their direct involvement at this stage was premature. They stated, however, that they wished to kept informed of progress with a view to possible involvement later.

The selection of households to participate in the pilot project will be carried out by a method to be agreed after detailed discussion between TAMA and the ISU. The selection procedure will be designed to ensure the maximum degree of transparency in the choice of participating households. The need to ensure a reasonably compact distribution of installations in order to keep installation and maintenance costs as low as possible will also be taken into account in making the selection.

A wide variety of cost recovery methods can be used, depending on the financial means of the household, the actual cost of the system and other factors. One possible method could be the use of a hire-purchase/rental agreement to overcome any entry-barrier caused by the relatively high initial cost of systems. Households entering such a scheme would pay the equivalent of a monthly fee of about MK750 (adjustable for inflation); payment might, for example, be made in a single instalment after the tobacco crop has been sold. These payments would entitle the household to the installation of a system and its maintenance for five years. Failure to keep up

[12] Memories of the Tenth Annual Congress, TAMA (1998)

payments would lead to the repossession of the system. After this period the ownership of the system, and responsibility for its further maintenance would pass to the household.

Detailed specification of the installations, selection of the households, calculation and negotiation of the level and modalities of payments, drawing up tender documents, invitation of bids from local PV suppliers, selection and appointment of suppliers and supervision of installation, and arrangements for supervision, monitoring and feedback will be subject to detailed agreement between stakeholders and will be carried out by the ISU.

Wind-power for Small-scale Irrigation - Pilot Project

The use of wind-power for water-pumping is well-established in the southern African region. In Zimbabwe, for example, it is widely used by commercial farmers to provide water for household uses and animal watering. It has also been used in the past, though to a lesser extent in Malawi, but presently appears to have disappeared more or less completely.

A typical wind-pumping installation consists of a multi-blade rotor, often called a wind-rose, mounted on top of a 9-12 meters-high lattice steel tower set in place over a water borehole with a depth of anything from several meters to 200 meters. The rotation of the wind-rose drives a pump which extracts water from the borehole. Usually the water is pumped to a storage tank from which it is taken when required. The rate at which water is extracted depends on the size of the rose, the depth of the borehole and the windspeed. Windspeed is a particularly critical factor, making careful siting of the installation vitally important.

In an area with an average windspeed of 3.5 meters/second and a water-table depth of 70 meters, a typical wind-rose installation could be expected to deliver a daily total of 20,000 litres of water and would cost around US$10,000. This could be used to irrigate a market garden plot or plant-nursery of perhaps 0.75 hectares. Given the lack of windspeed data and recent experience with wind-pumping in Malawi, such figures need, however, to treated as purely indicative and subject to confirmation in each particular case.

Wind-rose installations, provided the equipment is built with good materials by a knowledgeable and reputable manufacturer, and properly installed, are generally durable. Many machines in the southern African region are still working well after fifty years service. Adequate maintenance is, however, essential. Valves, seals, bearings and other components need to be inspected, replaced or lubricated as required on an annual basis; blades and towers need to be painted every few years. Annual maintenance costs depend heavily on the travelling time of the technicians carrying out the service. Given say six installations within easy reach of each other, an annual service fee, including spare parts, of US$300 per installation could be expected.

The pilot project is intended to establish a working model for a delivery and maintenance system for wind-rose pumping in Malawi. Although the technology has been used in the past, all practical working knowledge has been lost at both supplier and user levels. It is therefore essential that the project framework is chosen to optimise the prospects of success and maximise the learning opportunities at both user and producer levels.

This requires that farmers can earn a sufficient income from the installation to make a significant contribution to the installation cost and cover routine maintenance costs. The majority of farmers likely to be able to do this are presently engaged in tobacco farming. The mounting uncertainties in the world tobacco trade are, however, making it increasingly necessary to explore means of crop diversification into market gardening and other cash crops for these farmers. Irrigation of tobacco plant nurseries can also help reduce costs and risks as plants are at their most vulnerable when they are young. There is thus an incentive for farmers to invest in wind-pumping.

If wind-rose technology can be deployed under these relatively favourable conditions, there is a realistic possibility that a self-sustaining Malawian capability can be established in the

technology. With reduced costs and increasing familiarity, the prospects of extending the use of the technology among, for example, NASFAM small-holders will improve. Successful diversification efforts will also be of relevance to the wider farming community.

Description of the pilot project

The pilot project involves the installation of six wind-rose installations in the Salima, Nkhotakota and Dedza districts which come within the DESP. The Tobacco Farmers Association of Malawi (TAMA), with technical support from the Agricultural Research and Extension Trust (ARET), will act as the national level collaborating organisation. As in the case of SHSs, direct involvement by NASFAM in the project at this stage is premature but NASFAM should be kept informed of progress with a view to possible involvement later.

As a market priming mechanism, Danida will provide funds for the purchase and installation of the six wind-rose installations. Users will be required to contribute about 50% of the investment cost and cover the full maintenance costs. The recovery of these costs will provide a revolving fund and financial cushion for dealing with establishment costs, teething troubles and the further extension of the scheme among the TAMA membership.

Participating households will be drawn from the TAMA membership. The selection of households will be carried out by a method to be agreed after detailed discussion between TAMA and the ISU. The selection procedure will be designed to ensure the maximum degree of transparency in the choice of participating households. The need to ensure a reasonably compact distribution of installations in order to keep installation and maintenance costs as low as possible will also be taken into account in making the selection.

A wide variety of cost recovery methods can be used, depending on the financial means of the household, the actual cost of the installation and other factors. The use of a hire-purchase/rental agreement on the lines suggested in the SHS proposal above should be among the cost recovery methods considered as it provides a means of overcoming the initial entry-barrier caused by the relatively high initial cost of installations. Farmers entering the scheme would pay an annual fee of US$800 (adjustable for inflation) entitling them to the installation of a system and its maintenance for 10 years. After this period the ownership of the system, and responsibility for its further maintenance would pass to the farmer. Failure to honour the payments will lead to repossession of the system.

Detailed design and specification of the installations, selection of the farming households, calculation and negotiation of the level and modalities of payments, drawing up tender documents, invitation of bids from local wind-pump suppliers, selection and appointment of suppliers and supervision of installation, and arrangements for supervision, monitoring and feedback will be subject to detailed agreement between stakeholders and will be carried out by the ISU.

Micro-hydro - feasibility study of possible demonstration project

The presently non-operational Neno micro-hydro scheme provides a relevant example of the type of micro-hydro installation likely to applicable within the DESP areas. The plant is situated at the Seventh Day Adventist Mission about 8 km from Neno Trading Centre, about 70 km from Mwanza town.

The plant was built by missionaries, apparently in the 1950s and operated for more than 30 years. It has a head of about 40 metres driving a turbine connected to a 28 kW alternator by a belt drive. During its working life, it provided electricity for a primary and secondary school, with a total of about 700 pupils and staff, and a maize mill and carpentry workshops at the school. It also served the Neno Trading Centre which now has a rural hospital, police station, post office, and government offices for agriculture, forestry, health, education and social welfare.

With the departure of the missionaries, apparently during the 1980s, the system gradually fell into disrepair and the water from the plant is now used for water supply and is fed into a storage tank using two hydraulic rams. The only electricity supply in the area now comes from a 27 kW diesel plant which is operated for three hours each evening.

The basic civil engineering infrastructure for the plant is in place, though in need of repair in some areas. There are water-gauge readings for almost thirty years which indicate that the water flow could support a considerably larger plant. A prefeasibility study has already been carried out by an engineer from MIRTDC with assistance from the University of Malawi and an outline project proposal for the installation of a micro-hydro system with an output of 120 kW has been prepared by MIRTDC. The proposal also suggests a possible local management structure.

This is potentially a worthwhile project and if it were successfully implemented, in addition to the substantial benefits it would provide to the local schools, community, hospital and other users, it could provide a useful model which might be relevant to the wider use of micro-hydro technology, particularly in the northern areas covered by the DESP.

Description of the project

The project will consist of detailed feasibility study of the rehabilitation and expansion, or replacement, of the existing plant. The counterpart technical organisations taking part in the study will include MIRTDC and the University of Malawi. A local committee should be established to draw up management and funding arrangements.

When the plant was operational, no charges were made for the electricity supplied and the same is true of the existing diesel installation. The absence of any revenue flow means that no funds are available for management or maintenance of the plant and has clearly been a major factor in its collapse. This issue has not been satisfactorily addressed in the existing pre-feasibility study and will need to be a major focus of the feasibility study.

Small-scale biogas initiative

The Ministry of Gender, Youth and Community Services (MGYCS) has been running a small-scale biogas programme aimed at farming families with sufficient livestock to provide the necessary feedstock. A total of nine systems have been installed of which eight are working. There is a waiting list of 37 families. One of the obstacles to providing them with digesters is the lack of burners and lamps which have to be obtained from Tanzania. A total funding of about US$20,000 is required to construct these digesters.

The basic technology of biogas is not in doubt. The questions regarding its possible deployment in Malawi are practical and related to the operation and maintenance of digesters, and whether people find the long term balance of effort against benefits worthwhile. The extent to which biogas is a relevant technology in Malawi is thus a socio-economic question rather than simply the theoretical availability of cattle dung as a feedstock.

Description of the project

The ISU will invite a formal proposal for funding the construction of 30 digesters from the MGYCS. This proposal should include a short review of each of the existing installations and a detailed proposal for the implementation of the 30 plants in which interest has been expressed. A supporting role should be allocated to the MIRTDC in the proposal.

The ISU should discuss and agree with the MGYCS and MIRTDC the detailed arrangements for implementation, supervision, monitoring and feedback from the project. In addition to the digesters themselves, the output of the project should be a report which covers the following:

- A description of each installation including photographs, type of construction; whether functioning well, moderately, or poorly; whether experimental, serving an institution, or household; type of feedstock and arrangements for supply;

arrangements for operation and maintenance; uses to which biogas is put and whether waste slurry is used for agricultural fertiliser;

- Where digesters are functioning poorly, clearly identified causes as these constitute obstacles which will need to be overcome in future biogas programmes;
- Where digesters are well-functioning, the critical success factors should be identified by interviewing key persons connected with operating, maintaining and using the output of the digesters;
- On the basis of the experience with well-functioning digesters, an evaluation of the financial and other costs of biogas against the alternative means of providing equivalent supplies of energy to households or institutions.

With these results it will be possible to assess the role which biogas should play in the future implementation of the NSREP.

Development of Renewable Energy Standards in Malawi

The Malawi Bureau of Standards (MBoS) was legally established in 1972. It is a member of the International Organisation for Standardisation (ISO) and works in close collaboration with other Standards Bureaux in the region, especially those of Zimbabwe and Zambia. It receives approximately half its funding in fees, with the remainder coming from the government. Approximately 300 companies are now participating in its product-certification schemes.

The Malawi Industrial Research and Development Centre (MIRTDC) was established in 1991 and began functioning in 1993 as an off-shoot of the MBoS. Its purpose is to provide technical support, advice and research for medium and small scale industries in Malawi. In carrying out its mandate, it continues to work in collaboration with the MBoS.

At present, there are few standards relevant to renewable energy technologies. This is a serious weakness at a time when attempts are being made to develop sustainable commercial activities in the renewable energy area. It means, for example, that purchasers of solar energy equipment have no means of comparing the quality or output of systems produced by different manufacturers or vendors which undermines true competition in the market. Neither is there any means of coordinating the technical standards used in various donor projects. This may well give rise to serious long-term repair and maintenance problems as a result of the incompatibility of systems and components.

Description of the project

The project will consist of support to the MBoS and MIRTDC in developing the necessary standards for renewable energy components and systems and for developing the relevant standards and certification procedures for installers. The immediate focus of these activities will be on PV and solar thermal technologies. These standards and procedures should be developed in full collaboration with local industry and other interested parties. It is important that this project is co-ordinated with the Physical Asset Management project, supported by the EU and GTZ, which is addressing the same issue of standards for equipment, including solar energy systems, in the health sector.

It is not intended that the standards drawn up under the proposed project should be compulsory or involve the development of inspection mechanisms. The objective is to provide a system of voluntary certification of components and systems and for the licensing of qualified installers. It is, however, expected that the government will ensure that the relevant standards apply to all government and donor initiatives.

The support for the development of these standards will be provided by the Danish Solar Energy Center (Solenergi Center Danmark) with appropriate inputs from Risø National Laboratory, the

Danish Bureau of Standards and the Danish Technical University. The potential for longer-term twinning arrangements will also be investigated. Danida is also supporting a similar project for the development of renewable energy standards in Zimbabwe relying on the same Danish supporting agencies and a high degree of collaboration will be expected between the two projects. The exact modalities of the support for the MBoS will be discussed and agreed between the ISU, the MBoS and other stakeholders.

Preparation of a Wind Atlas for Malawi

The available wind speed information in Malawi is relatively scarce and fragmented. The indications are that annual mean wind speeds are generally in the range 2-4 metres/second. This is not sufficient for electricity generation, except possibly on a very small scale for battery charging. Such wind speeds are, however, sufficient for wind-pumping to provide water for small-scale irrigation or other uses in suitable locations.

Under a previous Danida contract, wind speed readings have been taken at three locations in the country. The data obtained under this contract have, however, not been analysed and the information on wind speeds are consequently unavailable for general use.

Description of the project

Risø National Laboratory will be commissioned to use these unprocessed figures and other available wind speed data to carry out a national wind-energy mapping exercise in conjunction with the Malawian Meteorological Office, the Department of Energy and other relevant institutions in Malawi. Risø has extensive experience in such studies in other developing countries and is well-qualified to carry out a similar exercise in Malawi. The exact modalities of this work will be based on a plan of action to be discussed between the stakeholders and agreed with the ISU at the beginning of the project in Malawi.

Start-up study tour

It is essential that the key personnel involved in the implementation of the above fast track proposals on the Malawian side should have an early opportunity to learn from Danish experience. A total of eight key Malawian personnel from the various projects will therefore be provided with the opportunity to visit and make contacts with relevant Danish organisations and institutions. The professional staff of ISU will participate also to the study tour (3 counterparts and the CTA)

These people will be chosen to represent the DoE, MIRTDC, MGYCS, MBoS, CHAM, TAMA, ARET and one representative of the commercial PV sector in Malawi. The institutions to be visited will include the Danish Energy Agency, the Danish Agency for Environment, the Danish Technological Institute, Risø National Laboratory and the electricity utility ENCON which has special expertise in PV and solar thermal technologies. The Folk-Centre for Renewable Energy, which focuses on research, development and deployment of small-scale renewable energy sources, including biogas, will also be visited.

The ISU will be responsible for organising and leading this study tour. The study tour is an integrated part of the capacity building matters, and the expenses required by this activity will be covered by the relevant budget allocation for capacity building and institutional strengthening.

Options considered for Danida support to the project

Danida is in the process of developing the detailed structures for its long-term support to Malawi under the DESP. The available options for Danida support are therefore constrained by the need to underpin and reinforce these institutional developments. Within this framework, the basic options available for Danida support to these projects consist of a separate structure for each initiative or a unified approach in which all the projects are grouped within a single management structure.

The option of a series of separate projects is complex, time consuming and extremely demanding in overall management, supervision and, above all, in obtaining useful feedback from project experience. This has led to the development of a single management unit, the ISU, as the best option for ensuring a well-co-ordinated and tightly-scheduled set of pilot projects.

It is also recognised that early decisions on the implementation of the above fast-track proposals should not pre-empt discussions on the optimum future structures for Danida assistance under the DESP. This means that the interim nature of the ISU is fundamental. It is essential that it is seen as a temporary measure merging into the longer term structures for the management of the DESP.

Justification for strategic choice

The justification for the overall strategic choice is the need for immediate activity under the Renewable Energy Component. The failure of the 1997 study to propose any activity programme meant that no actions were available for immediate implementation under the component. This lack of momentum brought the danger of demoralisation of stakeholders and the establishment of a bad precedent in relation to implementation schedules. The programme of activities described in the draft Project Document is intended to create immediate momentum and demonstrate in practical terms the commitment of Danida to the Renewable Energy Component.

The need to adopt a fast-track approach to the projects has been discussed earlier. The pilot and demonstration projects must be implemented in a timely manner if the lessons to be learned from them are to be incorporated in upcoming projects such as the UNDP/GEF and in the realisation of the NSREP.

The individual justifications for each of the separate projects are discussed above under their own headings.

Uncertainties and risks related to the situation

The deployment of renewable energy technologies in Malawi is at an early stage. Little is known about market conditions, the ability of the existing resource base to implement and subsequently maintain installations, the capacity of existing institutions to handle maintenance funds and a variety of other critical factors which can determine the success or failure of projects.

The purpose of each of the pilot and demonstration initiatives is to explore these questions and find solutions to any problems which may arise. Although every care has been taken in specifying the initiatives in ways which optimise the chances of success, the purpose in launching them as pilot projects is to test to validity of the various assumptions and decisions on which they are based. This is why it is important that a flexible approach is adopted in the management of each initiative so that it can be adjusted or fine-tuned as experience suggests.

The spread of expenditure across the initiatives, and their relatively small scale, ensures that the overall financial risks are kept within acceptable bounds. Even if a number of the initiatives fail, the lessons learned will be extremely valuable in the design of the much larger scale UNDP/GEF project which Danida is also supporting. Even though there are substantial uncertainties surrounding each initiative, the strategic approach is to minimise the overall risks to the Renewable Energy Component of the DESP.

In assessing the project risks, the possibility that the UNDP/GEF project might be seriously delayed, or even cancelled, has also been taken into consideration. The project components, as proposed, would not be affected in such an eventuality. The operational models developed and the experience gained within each component would remain available to the Malawian institutions and structures concerned, including private sector participants, and to future donor initiatives. The Japanese technical assistance agency (JICA), for example, expressed its interest in the outcome to the pilot projects to the team. Any benefits accruing to clinics, farmers, or

others from the project components are independent of any follow-up and would remain in existence.

Summary of projects

The eight activities for implementation under the project and described in this chapter are summarised below:

- PV electrification at 15 health clinics - pilot project;
- Dissemination of 200 SHSs - pilot project;
- Installation of 6 wind-pumps - pilot project;
- Micro-hydro feasibility study;
- Small-scale biogas initiative;
- Support for development of renewable energy standards in Malawi;
- Preparation of a wind-atlas for Malawi;
- Start-up study tour of Danish institutions for key Malawian personnel.

22. INPUTS TO AND MANAGEMENT OF THE PROJECT

The set of eight fast-track renewable energy activities to be implemented under the project covers a wide range of organisations and stakeholders. This poses some complex timing and management questions.

Given the up-coming UNDP/GEF project, and on-going work on the NSREP, it is essential that the pilot projects are set in motion quickly. Otherwise any lessons learned cannot be fed into the planning and implementation of these larger initiatives, which would defeat the purpose of having pilot projects.

The Interim Support Unit (ISU)

In order to deal with these issues a unified approach to the management of the eight projects, based on an Interim Support Unit (ISU), will be adopted. The ISU will provide a unified management for all the initiatives described in this Project Document.

The interim nature of this unit needs to be stressed. It is intended as temporary expedient providing the necessary initial management for the fast track projects. As the PMU comes into action it will parallel the activities of the ISU though contractual responsibility will remain with the ISU. Ultimately, and in a manner to be discussed and agreed, full responsibility will be transferred to the PMU and the ISU will be wound up or merged with the PMU.

The duties and responsibilities of the ISU are described in detail in Chapter 7.

23. LOGICAL FRAMEWORK ANALYSIS FOR DANIDA'S ASSISTANCE

Development objective of Danida's support
Immediate objectives of Danida's support
Outputs
Activity outline
Inputs by Danida
Proposed budget

6 LOGICAL FRAMEWORK ANALYSIS FOR DANIDA'S ASSISTANCE

6.1 Development Objective of Danida's Support

Development Objective of Danida's Support:	*Indicators:*	*Means of verification:*	*Assumptions and preconditions:*
- to develop and demonstrate institutional models for the deployment and maintenance of renewable energy technologies on a sustainable basis. 4 pilot & demonstration projects, one feasibility study and 2 under-pinning projects are designed for fast track implementation and so they can support and feed into major upcoming renewable energy initiatives supported by Danida and other donors	PV Clinics (pilot) - penetration of PV installations at clinics in off-grid areas in three districts - service level of clinics - increase of staff motivation PV Households (pilot) - penetration of PV SHSs at households in off-grid areas in three districts - increase in living standards - decrease in household smoke & smells and in associated diseases and discomforts - less burning and fire accidents in households Windpumps (pilot) - penetration of wind pumps in three districts - increase in income generation - stimulation of crop diversification Biogas for Households (pilot) - penetration of biogas digesters in three districts - increase in living standards - decrease in household smoke & smells and in associated diseases and discomforts - less burning and fire accidents in households Minihydro (feasibility study) - sustainability of rehabilitation of 1 plant Standards (underpinning) - increase in standards, certifications and good practices in the field of RE Wind Atlas (underpinning) - establishment of a wind atlas useful in the design of small scale wind power applications	PV Clinics - number of installations - increase of clinic revenue - number of defaults of payment by clinic & staff - interviews with patients & staff PV SHSs - number of installations - number of defaults of payment - interviews with households Windpumps - number of installations - number of defaults of payment - value of water provided - interviews with households Biogas for Households - number of installations - level of household financial contribution - interviews with households Minihydro - decision on rehabilitation Standards - number of standards etc. - usage of standards etc. by industry - usage of standards etc. by government and donors Windatlas - the wind atlas including ".lib" files for WASP tool analysis For all activities - periodic reports by the ISU and the three district Project Offices - outcome of reviews and evaluations - reports from international consultants	In General - the envisaged UNDP/GEF large scale RE actions materialises and sufficient donor support is secured - a single joint PMU is established inside two years (from 01.01.2000), and the PMU sets up and follows efficient, transparent and accountable procedures - GoM continues to prioritise sustainable energy usage including RE technologies - Danida is capable of providing technical, institutional and financial support as outlined The Pilots - the end-user interest will be reflected in the realisation and ongoing maintenance of the envisaged number of installations under the terms stated - collaboration between the main stakeholders in the RE field in Malawi can be further developed towards commercial sustainability The Minihydro Feasibility Study - none The Standards - a fruitful twinning arrangement can be set up The Wind Atlas - the existing data proves to be sufficient to create a wind atlas, which makes possible the use of the WASP tools to asses small scale wind energy applications such as wind pumps and wind chargers

6.2 Immediate Objectives of Danida's Support

Immediate Objectives of Danida's Support:	*Indicators:*	*Means of verification:*	*Assumptions and preconditions:*
- To provide a fast track package of technical, institutional and market stimulation support to the main stakeholders in the RE field in Malawi. The package is seen as a precursor and a laboratory for the envisaged large scale RE activities supported by Danida, UNDP, GEF and other donors, and will create momentum for and give credibility to the implementation of the NSREP	- implementation of 5 pilots, 1 feasibility study and 2 underpinnings - strengthening of the RE knowledge bank and resource base in Malawi	- interviews with industry, DoE and other stakeholders - interviews with households and other end-users - periodic reports by the ISU and the three district Project Offices - outcome of reviews and evaluations - reports from short term consultants	- Danida is able to provide the kind and amount of technical, institutional and financial support required for the realisation of the expected output in line with the RE component of the ESPS - DoE is committed and interested in cooperating with Danida and welcomes both short and long term input from international consultants and experts - GoM provides the necessary resources including DoE, MBoS and other staff - industry is willing and capable of participating in the pilots, in particular the maintenance activities - standards, certifications and good practicies can be established relatively quickly - a simple but effective recycling scheme for SHS batteries can be outlined with a view to a long term sustainable solution

6.3 Outputs

Outputs:	*Indicators:*	*Means of verification:*	*Assumptions and preconditions:*
- 5 pilots as defined providing data and experience on deployment of selected RE technologies in Malawi - 1 feasibility study - 2 underpinning projects, one envisaged to lead to a long term twinning arrangement (standards), the other to a workable wind atlas - data & experience for the PMU	- number of RE installations implemented in the course of the pilots - number of technical failures and default in payments in the field - number of standards, certifications and good practicies developed/published - a wind atlas for WASP tool assessment of small scale wind energy applicaitons	- periodic reports by the ISU and the three district Project Offices - outcome of reviews and evaluations - reports from short-term consultants	- GoM continues to prioritise sustainable energy usage including RE technologies - Danida is capable of providing technical, institutional and financial support as outlined - the main stakeholders including industry can form and execute an effective collaboration - industry can up-scale production and supply, improve quality and establish and run a battery recycling scheme

6.4 Activity Outline

Activity Outline:	*Indicators:*	*Means of verification:*	*Assumptions and preconditions:*
Detailed activity outlines to be developed by the ISU			

6.5 Inputs by Danida

Draft Inputs:	*Indicators:*	*Means of verification:*	*Assumptions and preconditions:*
Danida inputs - financial support to the ISU making possible the running of the ISU and the implementation of the package of fast track RE activities as defined - (detailed local inputs to be elaborated by the ISU in the initial stages of the project)			

6.6 Budget

Following the overall Malawi ESPS framework programme, that has been enforced by the bilateral agreement signed between GOM and GOD on 1999-01-19, a budget line of DKK 35 mill (US$ 7 mill) is provisionally created, with planned disbursements in 2000 (DKK 17 mill; US$ 2.43 mill) and in 2002 (DKK 18 mill; US$ 2.57 mill). In matter of fact, the ceiling for the RET component has floated around DKK 19 mill for the first disbursement. Thus, the indicative budget (below) is based on a total budget of DKK 19,9 mill (US$ 2.79 mill)

In USDx1000	Danida Parallel funding	GEF project	PSD project
1) Fast track activities within the GEF project			
- PV 15 primary health clinics (+ 5 MoH)	200	**200	
- Trial for 200 SHSs	200	**200	
- Twinning MIRTDC-BoS-DTI (2 years)	200	**200	
2) Capacity building and Institutional Strengthening	60	*480	
3) Support to a RET regulatory framework			300
4) Wind atlas	150		
5) Wind-pumping and irrigation (6 units)	90		
6) Feasibility study of rehabilitation of existing micro-hydro	50		
7) Unallocated funds for further demonstrations or dissemination activities within 1) 5) 6) 8)	110		**110
8) Biogas survey and dissemination of 30 units, Min. of Gender	25		
9) Study Tour (under 2))	(60)		
10) Interim Support Unit (max. 2 years)	676		
Total	1,761	(1,080)480	(410)300
Contingencies: (10 %)	254		
Grand total	**2,795**		

* distributed for actions at: GOM: 210
NGOs/CBOs 90
PMU: 180

** this support initially to be administrated by the Danida Interim Support Unit (ISU) as parallel financed components, but to be regarded as part of the PSD respectively GEF portfolio and to be transferred to the PMU when this is fully operational

Grand total: USD 2,795,000

Proposed disbursement: 1999: USD 0.2M
2000: USD 1.7M
2001: USD 0.8M

7 IMPLEMENTATION PROCEDURES

The primary responsibility for the detailed implementation of the eight activities comprising the project will rest with an Interim Support Unit. This will be established and run by a Danish consultant. The consultant will implement an agreement for effective collaboration with a Malawian counterpart organisation from the beginning of the work on the project.

The ISU will be expected to carry out the main body of its work from a district office, established in association with the DESP District Office in Nkhotakota town. In order to meet the needs of national and international liaison, a presence will also be required in Lilongwe. The exact details of these deployments will be agreed with Danida and the Danish Embassy in Lilongwe.

7.1 Organisation, management and administration

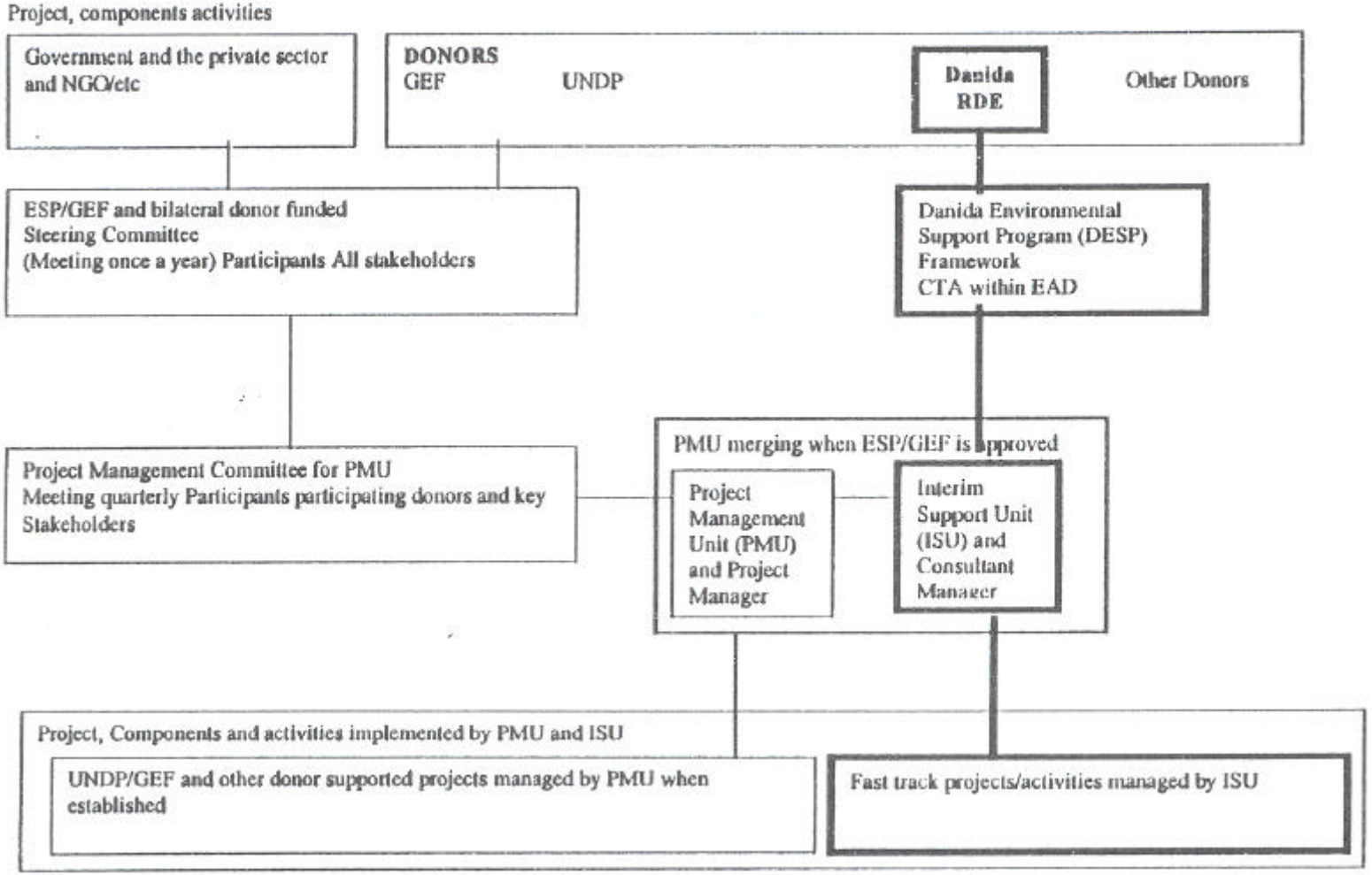
The duties and responsibilities of the ISU will include, but will not necessarily be limited to the following:

- Overall co-ordination of the eight activities;
- Detailed design of each activity;
- Appointment of suppliers and subcontractors, both Danish and local, for each activity;
- Supervising the implementation of each activity;
- Monitoring, reporting and providing feedback on each activity into the relevant channels so that upcoming projects can benefit;
- Management and disbursal of Danida funds to partners including the DoE, UNDP and others, in accordance with agreed workplans, activities and budgets;
- Agreeing and overseeing the arrangements for the collection, deposit and disbursement of maintenance or purchase contributions received from project beneficiaries;
- Agreeing the list of invitations, coordinating and conducting the start-up study tour of Danish institutions for key Malawian personnel.

Bearing in mind the pilot nature of the various projects, the ISU will be expected to take a flexible attitude, adjusting or fine-tuning individual activities as required to ensure they are as effective and informative as possible.

Until the PMU for the PSD and the UNDP/GEF is fully functional, the ISU will report to the Management Committee for implementation matters and for policy matters to the CTA for the DESP. A diagram showing the main linkages of the ISU to the various stakeholders and emerging management structures for the DESP is given on the following page.

MANAGEMENT STRUCTURE FOR DANIDAS RENEWABLE ENERGY PROJECT I MALAWI
Within the Energy Support Program (ESP) Framework



The ISU will be put in place in January 2000, in advance of the PMU for the PSD and the UNDP/GEF project. As the PMU comes into action, the ISU will closely co-ordinate its activities with those of the PMU and, in particular, will feed lessons learned from the various pilot projects into the advanced planning of the PMU. In particular, the ISU will be responsible for raising the long-term issue of battery disposal and ensuring that it is firmly on the follow-up agenda for the PMU.

The ISU shall further be staffed a Danish Project Manager assisted by a Malawian counterpart organisation in the management of the ISU.

The counterpart organisation shall be constituted of at least 3 professionals having preferably experience in Project Preparation and Management, overall knowledge of relevant renewable energy technologies and political flair in handling of all the many official and unofficial stakeholders. An accountant/administrator shall be appointed by ISU.

The intention is that the activities and responsibilities of the ISU will gradually merge into those of the PMU. It may, however, be appropriate for the ISU to be absorbed and act as a support unit within the PMU for a transition period depending upon circumstances and subject to agreement within the PMU Steering Committee. This decision will be taken following a review of the ISU activities approximately eight months before the anticipated completion of the fast-track activities. The expected life of the ISU is one year but given the overall timing uncertainties in the UNDP/GEF project, a contingency of a further year has been included in the proposed budget. No Danida funding for the ISU is envisaged beyond the two-year period.

ISU will have a presence both in Nkhotakota town, where ESPS CTA is located and in Lilongwe the administrative capital..

7.2 Monitoring and review, reporting and evaluation

The ISU will be responsible for monitoring, review, reporting and evaluation of each of the activities on a regular basis. This is particularly important in the case of pilot and demonstration activities, the results of which need to be fed into the advance planning for subsequent projects such as the UNDP/GEF.

This means that the information and co-ordination function of the ISU is of critical importance. The three district Project Offices of the DESP at Karonga, Lake Chilwa and Lake Malawi (Nkhotakota) will be anchor points for district involvement, monitoring and follow-up. By using these same Project Offices for all components of the DESP and projects within it, management will be facilitated and running costs and overheads will be reduced.[12] The ISU will also maintain close links with the CTA in the EAD, with the DoE, and with other stakeholders.

7.3 Financial management and accountability

The ISU will open the necessary bank accounts in Malawi to ensure the effective running of the project in a secure and transparent manner. The exact details of these accounts will be agreed in advance with Danida and the Danish Embassy in Lilongwe.

[12] The same management structure will be used for the Urban Environment and Industries component.

7.3.1 Maintenance fund management arrangements

Management of the arrangements for hire purchase and maintenance funds is a crucial part of the responsibilities of the ISU. The long term success of the project depends crucially on this issue. If adequate funds for maintenance cannot be secured and disbursed as required, there is no realistic prospect of the project reaching its goals.

In the case of the health clinics, individual maintenance accounts must be established into which regular payments are made. Disbursements from these accounts to the contractors carrying out routine repair and maintenance will only be made when approved by the clinic. Arrangements must be as streamlined as possible with authorisations kept as close as practicable to the local clinic level to avoid long delays.

Failure to keep up payments will be regarded as a breach of the agreement with the clinic and an indication that the PV system is not a priority. The lack of funds for routine maintenance will also inevitably result in the breakdown of the system. In such cases, at the instigation of the ISU, and with due notifications to the clinic, the District Project Office, CHAM and others as necessary, the installation will be removed and placed elsewhere. This will enable the capital investment in the PV system to be preserved for use in a more appropriate location. Any costs involved in the relocation should be drawn from the project contingencies.

Similar arrangements will be made in the case of the SHS and wind-pumping pilot projects. Failure to maintain regular payments will be regarded as a breach of the agreement by the user leading to the removal and relocation of the installation. In such cases, the costs incurred will be drawn from the respective revolving funds.

7.4 Project implementation plan (PAP)

The ISU will be put in place from the beginning of January 2000.

The project will start with a one-month Inception Period during which the Team Leader of the ISU, working with the relevant local counterparts, will develop detailed work plans, agree on distribution of roles and responsibilities and on the detailed ToR for any work-groups and committees established to take forward the work and ensure that lessons are learned and disseminated and fed into the appropriate decision-making mechanisms as the projects are implemented.

The workplans will be summarised in the form of a Project Implementation Plan which will be discussed and agreed at a meeting of the PMU Management Committee convened for this purpose.