

Barrier Removal to Renewable Energy in Malawi (MLW99G31)

Draft Mid Term Review Report

Draft version 1

Prepared for: UNDP Country Office
Malawi

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This mid-term evaluation of the UNDP-GEF project “Barrier Removal to Renewable Energy in Malawi (MLW99G31)” was undertaken in September 2005 (with report writing extending through to November).

The evaluation was conducted for the Malawi office of the UNDP. It was conducted by Dr Douglas Banks of RAPS Consulting (doug@rapsconsulting.co.za) and Kenneth Gondwe (kgondwe@poly.ac.mw). Assistance was provided by the UNDP Country staff, the BARREM project management unit and project stakeholders from several institutions, government and the private sector.

This version of the report has not yet been subjected to stakeholder review. It is recommended it be reviewed by BARREM, DoE, UNDP and other key stakeholders, and subject to a final revision once feedback has been received.

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List of Abbreviations

| | |
|--------|--|
| APR | Annual Project Report |
| AREED | African Rural Energy Enterprise Development |
| ARET | Agricultural Research and Extension Trust |
| BARREM | Barrier Removal to Renewable Energy in Malawi |
| CBO | Community Based Organisation |
| CCAP | Church of Central African Presbyterian |
| CDSS | Community Day Secondary School |
| CGF | Credit Guarantee Fund |
| CHAM | Christian Health Association of Malawi |
| COP | Code of Practice |
| CSC | Christian Service Committee |
| CSR | Centre for Social Research |
| DANIDA | Danish International Development Agency |
| DFID | Department for International Development |
| DoE | Department of Energy |
| EPA | Extension Programming Area |
| EPI | Extended Programme of Immunisation |
| ESCO | Energy Services Company |
| ESCOM | Electricity Supply Corporation of Malawi |
| GHG | Greenhouse Gases |
| GoM | Government of Malawi |
| HEP | Hydro Electric Power |
| IPCS | International Power Control Systems |
| ISP | Infrastructure Support Project |
| MAREP | Malawi Rural Electrification Programme |
| MASAF | Malawi Social Action Fund |
| MBS | Malawi Bureau of Standards |
| MDGs | Millennium Development Goals |
| MEET | Malawi Environmental Endowment Trust |
| MEGS | Malawi Economic Growth Strategy |
| MERA | Malawi Energy Regulatory Authority |
| MoH | Ministry of Health |
| MPRSP | Malawi Poverty Reduction Strategy Programme |
| MSB | Malawi Savings Bank |
| MT | Metric Ton (1000 kg) of Carbon, or of CO ₂ (as specified) |
| MTL | Malawi Telecommunications Limited |
| NBM | National Bank of Malawi |
| NEP | National Energy Policy |
| NGO | Non Governmental Organisation |
| NSREP | National Sustainable and Renewable Energy Programme |
| ORESSI | Other Renewable Supply and Service Industries |
| ORESRS | Other Renewable Energy Sector Reform Strategy |
| PAM | Physical Assets Management Unit |
| PMU | Project Management Unit |
| PSC | Project steering Committee |
| PV | Photo Voltaic |
| RE | Rural Electrification |
| REIAMA | Renewable Energy Industries Association of |

| | |
|-------------|---|
| | Malawi |
| RERS | Rural Electrification Reform Strategy |
| RETS | Renewable Energy Technologies |
| SACCO | Savings and Credit Cooperative |
| SHS | Solar Home Systems |
| SOBO | Southern Bottlers (Malawi) Limited (a soft drink beverage company) |
| SWAP | Sector Wide Approach |
| SWH | Solar Water Heater |
| TCRET | Test and Training Centre for Renewable Energy Technology |
| UNDP | United Nations Development Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNICEF | United Nations Children Emergency Fund |
| UPPPRE | Uganda Photovoltaic Pilot Project for Rural Electrification |
| UREA | Uganda Renewable Energy Association |
| VISION 2020 | ?Awaiting information on full name |
| WEHAB | Water, Energy Health, Agriculture and Biodiversity |
| WHO | World Health Organisation |

1 Executive Summary

1. The UNDP-GEF funded project, Barrier Removal to Renewable Energy in Malawi started in 2002, and was intended to run until February 2006. Utilizing GEF resources of 3.353 million USD, and planned co-funding from public and private sector resources (tot a total of 7.304 million USD) the project was aimed to contribute toward greenhouse gas emissions by catalysing the development of the Malawi solar market for households, public institutions, commercial and agro-processing sectors. The project tackles five main areas: capacity building and institutional strengthening, creating of an enabling environment, financing for renewable energy systems, promotion (and demonstration) of renewable energy technologies, and the support/creation of public awareness.
2. The project is executed the Department of Energy, and implemented by a dedicated Project Management Unit. Several subcontractors are also key service providers/participants in the project. It reports to a multi stakeholder project steering committee.
3. This mid-term evaluation aims to assess and document the experience to date with the design, implementation, impact and potential for success of the Barrier Removal to Renewable Energy in Malawi (BARREM) project and suggest improvements that can be made to the project. The evaluation also seeks to identify lessons learnt and other findings that may have relevance to UNDP/GEF activities more broadly. At a recent PSC meeting it was decided to extend the project unto February 2007. There are thus 14 months left on which this mid-term review can have a bearing.
4. *Project Relevance*
The project is relevant to Malawi development and energy service delivery priorities. This is partly articulated through the several strategy and policy documents developed in Malawi that are complementary to the project. Stakeholders around the project expressed significant interest in project activities, and the final services delivered through the project are well appreciated and contribute to improved quality of life/service delivery. The project has reasonable CO2 impact (few PV focused projects have high CO2 emissions reduction potential).
5. *Project Efficiency*
The project has had mixed efficiency in delivery. It is a complex project, with a range of different co-funders and stakeholders. In some cases expected resources have not been leveraged/become available. There have also been delays in decision making and implementation of some key activities. On the other hand, the project was given a strong initial start through being able to take over many of the activities of the DANIDA Fast-Track project. In some areas (particularly institutional service delivery) co-funding has materialized and the project has been able to facilitate renewable energy system delivery and market development.
6. *Project Effectiveness and Impact*
The project has been effective in achieving outputs in a number of key areas:
 - Awareness (radio jingles, panel discussions, sensitization activities),
 - demonstration of institutional models ,
 - training,
 - standards,
 - supporting policy development,
 - capacity development at DoE,
 - certification of industry role players,
 - building the number of PV suppliers/installers.
7. The project has been less effective regarding:
 - Establishment of sustainable household finance mechanisms

- Establishment of large scale household delivery
- Establishment of sustainable REIAMA model
- SOBO evaluation/decision making/roll out
- ARET testing/evaluation /decision making/rollout

8. *Sustainability*

There are reasonable options for sustainability of all the main project activities, although in some cases there are significant risks.

9. *Main recommendations*

- a) A detailed work plan is required for the next 14 months period. In order to achieve significant progress in the remaining areas the team will need to be highly productive and focused.
- b) Sustainability of key areas (BARREM tasks such as awareness, certification, market development, TCRET, REIAMA, MBS activities and consumer finance modalities) needs active work.
- c) Consumer Finance methods need significant work (both the credit guarantee fund and establishment of Micro-finance modalities)
- d) Household delivery modalities need further development, and in particular the ESCO model needs to be developed (although there is too little time left to implement)
- e) Publicity activities need to be rounded off, and in particular documents/brochures finalized
- f) In closing year, BARREM need to explore relationships with beneficiary Ministries and implementation agencies to ensure that delivery modalities are continued
- g) Project needs to make greater use of regional or international consultants to help make progress in key areas
- h) More attention needs to be given to documentation of lessons and experiences

2 Introduction

10. The UNDP Country Office has initiated this mid-term evaluation in compliance with provisions of the project document.

11. The evaluation is being undertaken in order to assess and document the experience to date with the design, implementation, impact and potential for success of the Barrier Removal to Renewable Energy in Malawi (BARREM) project and suggest improvements that can be made to the project. The evaluation also seeks to identify lessons learnt and other findings that may have relevance to UNDP/GEF activities more broadly

2.1 Purpose of the Evaluation

12. The key objectives of the evaluation (as indicated in the terms of reference (TOR) were) to:

- review progress towards the projects objectives and outputs,
- identify strengths and weaknesses in implementation,
- assess the likelihood of the project achieving its objectives and delivering its intended outputs,

- provide recommendations on modifications to increase the likelihood of success
13. Several additional requirements are specified in the Terms of reference (attached as Appendix A). The UNDP country and the Project Management Unit also raised particular requests during the evaluation mission, these relate primarily to:
 - The decision taken at the last Tripartite Review Meeting to extend the project by one year
 - The relevance of the project – taking into account Malawi’s broader development context and policies as well as the Millennium Development Goals.
 14. The TOR do not correspond directly with elements listed in GEF project evaluation guidelines (for example GEF: Guidelines for Implementing Agencies to conduct Terminal Evaluations dated 4 March) – however, in the opinion of the evaluation team, the salient points of the GEF guidelines are covered.

2.2 Background

15. The Barrier Removal to Renewable Energy in Malawi (BARREM) started as a concept document and was approved as GEF PDFB in 1997. It was approved as a Medium Scale Project by GEF Council in 2000, signed for funding in February 2001 and funds were eventually disbursed in October 2001. The project was officially launched in March 2002, followed by staff recruitment by June 2002.
16. BARREM’s global aim was to contribute to the reduction in greenhouse gas emissions by catalysing the development of a vibrant solar PV market targeting households, public institutions, commercial and agro-processing sectors. This was to be accomplished by the implementation of five components designed to address the key barriers identified during the project development phase.

| Project components | Barriers addressed |
|---|--|
| Capacity building and institutional strengthening | Institutional barriers Technical barriers |
| Creation of enabling environment | Normative |
| Development of financing mechanism | Financial |
| Promotion of renewable energy technologies | Information |
| Creating public awareness | Information |

17. BARREM was organised to operate as an autonomous project management unit (PMU) under the Department of Energy (DoE) and receiving policy guidance from a project steering committee (PSC). The PSC was the same committee which was also responsible for the National Sustainable and Renewable Energy Project (NSREP).
18. Initially the PMU was established with seconded staff from DoE, however UNDP procedures required that recruitment must take place if staff were to be paid project salaries. This led to some delay in getting the full PMU team in place, and also resulted in some changes of staff within the first 12 to 18 months. PMU’s role is to coordinate and implement activities under the project. At the time of the mid-term review it has four national professionals and several support staff (2 drivers, 1 office manager, and administrative assistance, and 4 security guards) and is headed by a Project Manager. The PMU is housed in buildings belonging to the DoE in an outlying area of Lilongwe.
19. The project took over many of its activities from a DANIDA funded Fast-Track project – (often referred to as the Interim Support Unit (ISU)) which had made good progress with several of the shared objectives. In the original design the DANIDA project and BARREM were intended to have a significant period of overlap.

20. The project was designed to include participation from several active role players including:
- Key potential private sector clients and co-funders including: Southern Bottlers (Malawi) Limited (SOBO)
 - Institutions such as Agricultural Research and Extension Trust (ARET), Malawi Environmental Endowment Trust (MEET),
21. Activities of the PMU are to be guided by the National Sustainable and Renewable Energy Programme (NSREP) Steering Committee (the PSC) which is intended to steer the implementation of the Project and ensure that results are disseminated to the relevant stakeholders.
22. The project funding and implementing arrangements were complex. In terms of funding, the largest part of BARREM funding was expected to come from GEF. But additional resources, in cash or kind, were expected to come from UNDP, Southern Bottlers (Malawi) Limited (SOBO) and Malawi Government. The project was expected to work with several implementing and collaborating institutions. The implementing institutions were:
- Malawi Bureau of Standards (MBS) to spearhead the development of PV standards and codes of practice,
 - Mzuzu University to contribute to the training and testing,
 - The private sector (as suppliers and also as active participants of a renewable energy industries association, REIAMA and contribute to identification of loan beneficiaries
 - Lending institutions to provide loans and refinement of funding mechanisms,
 - Malawi Environmental Endowment Trust (MEET) as fund managers to manage credit guarantee fund and refinement of funding mechanism.
 - Agricultural Research and Extension Trust (ARET) to work on PV assisted flue cured tobacco production methods.
 - The collaborating institutions Tobacco Association of Malawi, Council for the Non-governmental Organisations in Malawi (CONGOMA) and Christian Health Association in Malawi (CHAM) were expected to promote awareness amongst their members.
23. The original project design had the following key funding inputs (in USD).

| Component | GEF | UNDP | SOBO | GoM | DANIDA | Total |
|---|-------------|------------|-------------|-------------|-------------|---------------|
| 1 Capacity Building and institutional strengthening | 1435 | 649 | | | 1544 | 3628 |
| 2 Creating public Awareness | 530 | 430 | | | | 960 |
| 3 PV Regulatory Framework | 326 | | | | 138 | 464 |
| 4 Financial Barrier Removal | 518 | 120 | | | | 638 |
| 5 PV Demonstration projects | 136 | | 2000 | 1855 | 568 | 4559 |
| Monitoring, evaluation and support services | 408 | | | | | 408 |
| Total | 3353 | 119 | 2000 | 1855 | 2250 | 10 657 |

24. In addition, there should of course be listed contributions from consumers or client bases that purchase systems.

25. Key milestones related to project initiation and implementation are listed below:

| Milestone | Date |
|--|-------------------------------------|
| Concept note approval, PDFB approval | 1997 |
| GEF provisional approval | 1999 |
| ProcDoc signed | Feb 2001 |
| ProcDoc Reviewed in | July 2001 |
| Inception report prepared | 2002 (final version dated Oct 2002) |
| PMU established | June 2002 |
| Inception report formally endorsed at | 25 September 2003 |
| Tripartite Committee meeting although effective endorsement was much earlier | |
| Project extension agreed to Feb 2007 by | 28 June 2004 |
| Tripartite Review Meeting | |
| This evaluation | September/October 2005 |

26. BARREM was designed to have the normal project implementation, reporting, monitoring and evaluation tools that were to include: monthly financial reports, ad hoc UNDP-DoE-PMU technical meetings, annual project reports, financial audit reports, PSC meetings, tripartite review meetings, mid term and end of project evaluations.

2.3 Evaluation methodology

27. The data gathering component of the mid-term evaluation work was carried out during a two week mission in Malawi. The evaluation team comprised one international consultant and one national consultant. The team have experience in the design and implementation of renewable energy projects, technical standards for renewable energy systems, education and training. Members of the team have worked extensively on large scale solar home system (SHS) distribution as well as school and clinic electrification using photovoltaic (PV) energy systems.

28. The team reviewed an extensive range of documents related to the project (see list in Appendix D). They met with project management and UNDP staff at the beginning and end of the mission, and were accompanied by key PMU staff during much of the mission – affording good opportunity to debate issues. Meetings were held with stakeholders in the project (see **Error! Reference source not found.**). These were typically of one to two hours in duration and afforded a good opportunity to explore issues in some depth. Furthermore, the team visited ten renewable energy installation sites in Malawi (covering areas around or en route between Lilongwe, Mzuzu and Blantyre, for a listing see Appendix C), and where possible had discussions with beneficiaries. The team presented preliminary findings to a stakeholder meeting at the end of the mission, and provided opportunity for comment.

29. The international team member is currently engaged in an ex-post evaluation of a very similar project (Uganda Photovoltaic Pilot Project for Rural Electrification, UPPPRE) – this has afforded good opportunity for sharing of lessons learned.

30. Where possible the team have attempted to focus on an outcomes based evaluation approach. However, as input to the next phase of the project, we have also dealt from time to time with process-based issues.

2.3.1 Other monitoring and evaluation activities integral to the project

31. There are several monitoring processes integral to the project that have also been used by the management team and DoE, UNDP as well as this evaluation team. These include:

- Tri-partite Review Meetings (DoE, UNDP, GEF regional co-ordinator, key stakeholders)

- Annual Project Progress Reports (APR)
 - Monthly financial reports
 - Quarterly financial and technical reports with budget draw down requests
 - Annual audited financial reports
 - Project Steering Committee meetings (not held as often as intended)
32. In addition several reports on specific project activities were prepared by the project management unit or subcontracted parties.
33. Given the above level of financial monitoring, the mid-term evaluation team have not specifically looked for audit issues related to project financial management, but have relied on the above monitoring, and the financial audits to track and highlight potential problem areas and identify lessons learnt.

3 Evaluation Findings

34. Prior to commenting on the specific outcomes achieved (or not) by the project, we wish to note the following:
- The project is relatively complex with a range of key stakeholders
 - Key project implementing agencies are spread across Malawi and the relationship between these agencies and the PMU is not always straight forwards
 - The financial resources integral to the project are sourced from a number of different parties (DANIDA, GEF, UNDP, DoE, SOBO, communities and individuals/consumers)
 - Key financial resources originally included in the design have not been available directly to the project and have either flowed through indirect sources or not become available at all. This has compromised the ability to deliver certain outputs.
 - Significant delays in key formal approval processes, as well as in key procurement processes have led to significant project delays

3.1 Global Objective:

Reduce carbon dioxide emissions (1,209.4 Mt CO2 avoided per year due to PV installations starting in year 3 after project start. 0.19 MW installed over the lifetime of the project)

35. Appendix B.4 lists the key assumptions used to estimate the CO2 reductions achieved by the project. The targets, and achievements to date are:

Carbon Dioxide reduction - summary table

| | Baseline (2002) | Mid term | End of Project | Comment |
|--|------------------|-------------------------------------|--|---|
| Mt CO ₂ avoided per year due to PV installations starting in year 3 after project start | | | | |
| Project Document | - | - | 32 343 MT | Note- proj doc used 15 year life, and growth of systems after installation to achieve total savings of 1 811 000 Mt CO ₂ |
| Inception Report | | | | No CO ₂ indicator given |
| Revised Project Planning Matrix (GEF co-ordinator) | | 1 209.4 MT CO ₂ per year | 1 209.4 MT CO ₂ per year 0.19 MW to be installed | |
| APR 2005 targets | 221.81 MT (2002) | 3 275.99 MT (2004) | 6047.30 MT (2006) | |
| APR 2005 Measure | | 1 274.25 MT (2005) | | |
| Evaluation Team Estimate (total PV) | | 4 582 MT (2005) | | |
| Evaluation Team Estimate (BARREM contribution) | | 1 536 MT (2005) | | |
| Proposed revised targets | | | 5 600 MT | These are per annum, or 84 000 MT over 15 years |

36. The project has had relatively little impact on CO₂ so far – primarily because the key emissions reduction opportunity identified at the design stage has not yet materialised (reduction in coal or wood usage by farmers curing tobacco – see section 3.6.1.4). This has not yet been rolled out in a significant manner (only 6 demonstration sites, no uptake yet by farmers), and the original estimations were optimistic. At this stage it is unlikely that the tobacco curing intervention will take off on a significant scale. A second large scale intervention listed in the design, but not yet realised on is the supply of solar powered refrigerators to rural vendors. However, even if the project only achieves a more modest target of 5000 MT per annum, sustained over 15 years, this approximates to 75 000 MT CO₂, with an effective cost of 74 \$/MT. Assuming that the project contributes indirectly to further PV installations after project close, the effective cost per MT will be reduced further. In our opinion this is a good potential achievement for a project of this nature.
37. The second main area was related to the installation target of 190 kWp of PV modules (Revised Project Planning Matrix (GEF co-ordinator)). To date, the total PV installation base in Malawi is not well known (CSR report contested). Our estimate is that the total installed base in Malawi is of the order of 165 kWp, of which perhaps 100 kWp have been imported during the period 2003 to July 2005. (for details of estimate method, please see annex B.3). Provided that the industry continues to grow at the current rates, it is possible that this target of 190 kWp installed during the project may be achieved by March 2007.
38. The above data regrettably has to be qualified. As discussed in section 3.6.1.7 there is poor data available regarding installations in Malawi. Although there is now reasonable data on module imports to the country (as a result of the process to get duty free imports),

it was difficult to find consolidated reliable information on the number of different types of installations being done.

3.2 Development Objective:

Remove market barriers to increase PV energy service delivery

39. The project (building on the ISU supported work) has succeeded in partially (and in some cases more fully) removing the barriers to PV energy service delivery. Further barriers are in the process of being reduced, while some (such as affordability are still key problem areas). Details are discussed in more detail below.
40. The key measurable for the development objective are:
- Cost of PV systems reduced by 17,5% (\$3.35/wWh) by the end of the project compared to baseline year 2003
 - Number of PV systems installed and operating increased by 400% by project completion compared to baseline year 2003 (target: 4000 HH, 200 health clinics, 400 schools, 300 solar fridges, 190 tobacco fans)
41. The project APR (2005) notes that prices have basically remained constant in USD terms, and increased by about 50% in MK terms. (Data below is for 5-light system, equivalent to 210 Wh, from 2005 APR

| Date | USD\$ | MK |
|-----------------------|------------|-------------|
| Baseline (2002) | 5.31 \$/Wh | 428.6 MK/Wh |
| 2004 measure | 4.49 \$/Wh | 494 MK/Wh |
| 2005 measure | 5.3 \$/Wh | 636 MK/Wh |
| Mid term target | 3.5\$/Wh | 383 Mk/Wh |
| End of Project target | 3.38 \$/Wh | 353.6 Mk/Wh |

42. There are a number of reasons
- a) Malawi Kwacha has devalued relative to the USD, resulting in local price increases
 - b) There has been (and remains) an international shortage of PV modules, thus the prior trend of reducing module prices (internationally) has not been maintained. This situation should reverse/improve in the medium term.
 - c) The volume of installations is still relatively small
 - d) There is not significant 'batching' of installations.
43. On the other hand dealers do report some lowering of prices (in USD terms) for other components (batteries, lights, charge controllers).
44. There is greater availability of product in Malawi, primarily as a result of one or two key suppliers being able to build up stock holding/regular supply chain.
45. The DoE has been able to facilitate the removal of import duty on solar products (provided that they are imported by certified companies).
46. There is still significant potential for Malawi prices to reduce¹. However this will require a far larger scale of activities in targeted geographical regions, with predictable, medium to

¹ In a large scale SHS project in South Africa, the cost for installed SHS of similar capacity to the above is about 550 \$, yielding a \$/Wh cost of approximately 2.6 \$/Wp. This illustrates the significant potential for price reduction. However, it must be noted that these prices have only been achieved as a result of procurement of several thousand highly standardised SHS, as part of a large scale fee-for-service type roll out (with 400 to 500 installations per month being done in a specific geographical region in a structured manner under the control of a single service provider)

high volumes of installations per month. Given the current low number of installations per month being done by companies, it is not surprising that prices have remained fairly high.

The number of PV systems installed during the BARREM project has been fair to good for health centres, low for schools, moderate for households, and poor for beverage coolers and tobacco fans. The data on households is summarized in appendix B.3. Detailed discussion of the different delivery models follows below.

3.3 Immediate Objective 1: Strengthen public, private and civil society institutions

47. *Anticipated outcome:* The anticipated outcome of this initiative is that the public sector, private sector and civil society institutions would be better informed, operating sustainably, and strengthened in their capacity to deal with renewable energy (and specifically PV) delivery and support issues. The key measurable output is that the number of businesses dealing in PV increased by 300% by project completion compared to baseline year 2002 (Krause 2003). This has been done, and there are now 26 certified companies operating within Malawi.
48. No specific indicator was provided in the project planning matrix for public sector and civil society institutions. However, as noted below in the outputs sections, several key contributions have already been made.

3.3.1 Output 1.1: Test and Training Centre at Mzuzu University established and functioning

49. During the DANIDA Fast Track Project, Mzuzu University was identified as the host of the "Test and Training Centre for Renewable Energy Technology" (TCRET). A project document on TCRET was prepared. The Centre has now been established, with a Director. A classroom, laboratory/test room and furnished offices are in place. The Centre has now a total of five teaching members. Three are being supported within the BARREM project while the other two are supported by the University budget. There are a few critical things which are still outstanding. Only a few books have been received and no test and demonstration equipment has been received yet.
50. The Centre is currently running a Bachelor of Science degree in Renewable Energy, and so far there are two groups, 6 students in their third year, and 8 in the group completing their fourth year. The students join the programme as mature entry students in the third year.
51. The curriculum for the BSc course has been worked out to a moderate level of detail. This has been briefly reviewed:
 - o The course seems to cover the main topics relevant to renewable energy
 - o The outline does not given enough information to judge whether the taught material will be directly relevant to the Malawi situation (emphasis on decentralized systems, or on generation technologies that are likely to be used in Malawi)
 - o The course does not in our opinion place sufficient emphasis on finance modalities, or on business models for renewable energy technology delivery.
 - o There may be some benefit to including a course on rural development issues and practice.
 - o As far as we could determine, the course was primarily developed by Malawians for Malawi. There may be some benefit in getting international or regional input during the next curriculum review. (TCRET is only now focussing on developing linkages)

52. In addition the Centre has been involved in the facilitation of short courses which included 'Photovoltaic Water Pumping', 'Design, Installation and Maintenance of SHS', and 'Advanced Course in PV Design, Planning and Installation Management'. See section 3.3.2. There has been virtually no participation of women in the technical training. A technician course for women has already been designed and is scheduled to take place in the near future.
53. Some aspects of TCRET establishment have lagged behind schedule. The facilities were planned to be in place by 2003. The procurement of equipment for installation, training and commissioning is unlikely to take place this year. This will affect the quality of training and practical expertise of the graduates². It also makes it impossible for TCRET to play a significant role in testing of RET technology.
54. TCRET has a good potential to sustain its operations as a Centre within Mzuzu University. Two new staff recruited to support the BSc in RET programme have their salaries paid for by the University. The critical issue affecting the Centre is the major delay in procurement of equipment and books. TCRET may not have reached its optimal operational level by the time all the equipment and books arrive, and the project closes. Thus project extension may be inevitable. It would be important to see whether the period extension will result in need for extra resources beyond what was budgeted for.
55. The TCRET is already charging the BSc RET and its short courses on commercial basis. This in a way shows some level of viability of their courses, although we feel their costs are on the high side. This is in part reflected in the low numbers of students in the BSc courses. It should also be noted that quite a few of the 4th years are supported by scholarships from BARREM/DoE (they are DoE staff). If these sponsorships were not available, numbers would be even lower.
56. We do not think it will be possible to commercialise the equipment/ components/ module testing in the near future, as the overall market size in Malawi is relatively small. If testing is to be a voluntary exercise, then very few would bother to send their products up to the North for testing. If it were compulsory, the client will eventually pay the extra costs incurred by the supplier. Thus removing one financial barrier only to create another. There is need for BARREM/DoE/MBS/TCRET to spend more time on the operationalisation if this activity.

3.3.2 Output 1.2: PV engineers, technicians and trainers trained

57. Through the BARREM project, a curriculum for BSc in Renewable Energy was developed and currently there are two groups in 3rd and 4th year. The course has attracted participants from the DoE, government parastatal, and self sponsored students. This has now been taken on board as one of the courses that Mzuzu University is offering on regular basis.

3.3.2.1 Planners/ Engineers Training

58. Table 1 shows participants of advanced engineers/planners training programmes. Three advanced training courses for planners and engineers were conducted. The total number of people trained as per the table below is 37 (inclusive of consultants). The 2005 APR indicates that 61 have been trained, close to the target of 68³.

² Trainees have been able to participate in actual installations in the area, which provides important practical experience.

³ This is an illustration of the monitoring and evaluation problems that result from the APR document being used as the main record- even though it is too brief. The performance matrix as developed in the inception report (see Appendix B.2) would have been a far better record of achievements.

Table 1 Attendance at short courses for engineers/planners

| Course Title | Duration (Days) | 2003 | 2004 | 2005 | No. of Trainees | | | | | |
|--|-----------------|------|------|------|--|------------|-------------|-----------|---------|-----------|
| | | | | | Govt | Parastatal | Consultants | Private | NGO/CBO | Total |
| | | | | | Advanced PV Design, Planning and Installation management | Not stated | | | | 1 |
| Advanced PV Design, Planning and Installation management for electrical/mechanical consultants | 5 | | | | 10 | 2 | 5 | | | 17 |
| SHS Planners/engineers course | 5 | | | | 1 | | | 11 | | 12 |
| TOTALS | | | | | 12 | 4 | 7 | 14 | | 37 |

59. There was good regional representation and all the key participating institutions were able to send their engineers to be trained. Very few female engineers participated in the training despite the fact that BARREM pledged to make a deliberate effort to ensure gender equity.

3.3.2.2 Technician Training

60. The Table 2 below shows the training programmes conducted for technician level skills. In total 171 technicians have been trained. The 2005 APR report indicates 136, as against a target of 143.

Table 2 Participation in technician level training courses

| Course Title | Duration (Days) | 2003 | 2004 | 2005 | No. of Trainees | | | | | |
|--|-----------------|------|------|------|-----------------|------------|-------------|-----------|-----------|------------|
| | | | | | Govt | Parastatal | Consultants | Private | NGO/CBO | Total |
| Design, installation and maintenance of Solar PV | 10 | | | | | 1 | | 11 | | 12 |
| PV installers technician course | | | | | | 5 | | 15 | | 20 |
| PV water pumping course | 10 | | | | 1 | 2 | | 10 | | 13 |
| SHS Installer technician course | 13 | | | | 2 | | | 22 | | 24 |
| Installation and maintenance of solar PV pumping and refrigeration systems | | | | | 6 | 2 | | 15 | 1 | 24 |
| Basic course in installation, operation and maintenance of solar refrigerators for District Cold Chain Technicians | 2 | | | | 50 | | | | | 50 |
| Maintenance of Solar PV for CHAM Clinic Technicians | | | | | | | | | 28 | 28 |
| TOTALS | | | | | 59 | 10 | | 73 | 29 | 171 |

61. Positive aspects of this component of training are the fact that some programmes were demand driven and co-sponsored. The programme on Cold Chain training (co-sponsored by UNICEF) and the CHAM technician training (co-sponsored by CHAM) were alone responsible for training of 78 technicians. During the review there was an indication of further demand for similar training from Ministry of Health (Physical Asset Management

unit). Our observation is that BARREM has the capacity and is keen to take these training programmes, but is reluctant to do so since TCRET is the training agency. On the other hand, TCRET schedule is very restrictive. They seem to have a training window only when the college is on recess. A proposed training programme for female technicians is being delayed because of the scheduling problem.

62. There are no clear indicators in the project monitoring/reports regarding the quality of training offered. The review team did ask installers, and received positive comments on the quality of training.
63. The target of 143 has been exceeded. The problem of gender is still there. There is a deliberate effort to conduct technician-training programme specifically for women. There has been an overwhelming response from potential participants when the course was advertised. It is planned to take place sometime next year.
64. The above training achievements are a significant contribution of the programme to renewable energy development in Malawi. There is however a risk that training demand may stagnate in the near future, unless the PV industry grows significantly, as the trained people will not be adequately utilized/employed.

3.3.3 Output 1.3 Government district planners, advisors and DoE staff trained

3.3.3.1 District Energy Advisors' Training

65. A total of 843 energy advisors have been trained from all the 28 districts.

Table 3 Participation in District Energy Advisor Training

| Course Title | Duration (Days) | No. of Trainees | 2003 | 2004 | 2005 |
|--|-----------------|-----------------|------|------|------|
| Community based energy advisors sensitisation/awareness training-Central and Northern Region | | 448 | | | |
| Community based energy advisors/DDC awareness training –Southern region | | 391 | | | |
| TOTALS | | 843 | | | |

66. With increased awareness at district level, it was envisaged that the district planning committees would be able to incorporate solar PV in their development plans and budgets. BARREM extended an offer to all district to co-finance electrification of one Community Day Secondary Schools per district. Only 13 districts have responded and contributed to this initiative, represented a response rate of only 46%. These CDSS were meant to also act as demonstration sites.
67. Note that local chiefs and members of district assembly and civil servants at the district level dominated the participation of district energy advisors. There was no representation of NGO/CBO in the awareness training at least from the figures available for the Southern Region. The report for the training in Central/ Northern regions did not include details of participants.
68. The longer-term impact of the district assembly/civil servant training should be monitored as the new Sector Wide Approach (SWAP) comes into play for public sector resource distribution. It is intended that local authorities will have a greater voice in determining budget allocations, and for this reason it is critical that these personnel be adequately informed about renewable energy technologies.

3.3.3.2 Long-term training (international) and Capacity development at DoE

69. Note that there is a discrepancy between the budgets and objectives as listed in the GEF regional co-ordinators 'project performance matrix' and the UNDP APR formats and the inception report (section 5.1.3.2). The Inception report has a far greater emphasis on support of the establishment of an active Alternative Energy Division within the DoE, and the establishment of a Renewable Energy Demonstration Centre. The APR and related documents only list the training elements.
70. Four Department of Energy staff members have benefited from the capacity building budget as far as long-term advanced training is concerned. While this ensures that DoE has the necessary capacity to take on the activities of BARREM at the end of the project cycle, it has limited opportunities for other implementation agencies such as Mzuzu University (TCRET) and Malawi Bureau of Standards (MBS) and industry members to acquire the necessary skills to meaningfully contribute to the BARREM programs considering the fact RETs in general and solar PV in particular is a relatively new area of specialisation in Malawi.
71. The Department has also sent five of its staff for the BSc course at Mzuzu University under the sponsorship of BARREM.
72. The inception report also refers specifically to the establishment of a Renewable Energy Demonstration Centre, as well as the purchasing of computers, a vehicle and inspection kits for the Alternative Energy Division (AED). The evaluation team were not able to follow up on all these elements. It is however clear that DoE staff have actively participated in several renewable energy activities, including certification of companies, inspections of systems, tender management and adjudication, sensitisation work, and of course policy development. This close involvement of the DoE staff in BARREM activities is a very positive element and bodes well for general sustainability of BARREM type activities.
73. The Inception report does not give details on the budget for the Renewable Energy Demonstration Centre. This initiative will involve the establishment of:
- o Large AC system for the main BARREM office block
 - o DC systems for the main BARREM office block
 - o DC system for the BARREM workshop
 - o DC System for the 'Shelter'
 - o DC System for refrigeration
 - o DC system for Water pumping facility at premises of the agricultural college adjacent to current BARREM offices
74. While there are strong arguments to justify the establishment of some PV demonstration facilities at BARREM offices, this of course assumes that the DoE will in future continue to use these offices (as the home for the Alternative Energy Division). The Director of Energy indicated that this is DoE current planning. The evaluation team has some concerns regarding the overall design of the systems for the demonstration centre. These are discussed further in paragraphs 205 ff.

3.3.4 Output 1.4: NGO/CBO practitioners sensitised and trained

3.3.4.1 NGOs, CBOs sensitised and trained

75. The participation of NGO's and CBO's is numerically illustrated in the above tables on training participation.
76. The NGOs' participation in the training programmes was relatively low, with only one organisation (CHAM) participating actively . One CHAM technician participated in the formal technician-training programme and 28 benefited from the co-sponsored training program. There is need for BARREM to reorient itself by getting more participation of

NGOs who are normally working directly with communities. NGOs are also an avenue to offer leverage in term of access to other sources of financing.

77. The PMU noted that there have been specific discussions with Action Aid/Fresh Water/Norwegian Church Aid/CCAP Livingstonia/Christian Service Committee/Nkhoma Mission Hospital. However, results/outcomes of this were not identified/observed.
78. The Council for the Non-governmental Organisations of Malawi (CONGOMA) is not an active participant of the BARREM project at PSC level or through its members. If CONGOMA was included in some of the programme, then it could have been possible for them to inform its members about the activities of BARREM.

3.3.5 Output 1.5: Industry association (REIAMA) strengthened

Development Objective(s): The long-term development objective is to catalyse the establishment of an organised formal RET industry through which technical standards and codes of practice can be reinforced to raise consumer confidence.

Immediate Objective(s): Provide support for operational costs to enable REIAMA undertake RETs industry coordination and advocacy activities.

79. REIAMA started as a voluntary organisation in 1999, and then was given operational support through the DANIDA Fast Track project (79 000\$ for 2 years ending 2003), and then through BARREM from 2003 onwards to December 2005(an amount of 80 000\$)⁴. The organisation has been able to rent offices (moving from Blantyre to Lilongwe in 2003), purchase office equipment and to cover the salary costs for an executive director, secretary, driver and office assistant. The organisation has access to a 'BARREM' vehicle (purchased by the DANIDA Fast Track Project). There are several technology specific sub-committees for wind, solar thermal, biomass, micro-hydro and PV, although the organisation does not have representative members working on all these technologies.

80. REIAMA membership has grown significantly during the project period:

- o 41 member by June 2005
- o 26 of the members were certified companies (although not all remained active, and it is also not necessary for a company to be a member of REIAMA in order to be certified)
- o only 17 companies had paid their dues by the time of the AGM (June 2005)
- o by September 2005, 35 were paid up

81. REIAMA have a sustainability strategy in place, and are currently in the process of revising this strategy. Key income streams being considered at present are:

- Membership fees
- Levy on sales (2%)
- Consultancy / research work
- Donor/ project support

The draft strategy identifies strengths and weaknesses appropriately, and is a useful document.

82. However, to date it seems that REIAMA has not been able to attract significant funding (apart from the BARREM funds). Membership contributions are unlikely to reach more than 350 000MK (about 3000 USD) The current BARREM operational support contract ends in December 2005. There is thus a significant risk that staffing and office space will fall away early in 2006.

83. In discussions with stakeholders some concerns were raised (apart from sustainability).

- a) Improper use of information about market opportunities (enquiries not circulated to all members)

⁴ According to the REIAMA presidents report at the AGM the BARREM funds are only to be used for solar activities

- b) Poor communication with members (not all members well informed about REIAMA activities)
 - c) There are also reports that some certified companies who are REIAMA members are performing poor quality installations, or may even be 'cheating' customers.
 - d) On the other hand there have been reports of 'demonizing' of certain companies based on inadequately corroborated facts. REIAMA has not been seen as a neutral body in such cases.
 - e) Inadequate business management skills in some companies
84. The REIAMA draft strategic plan is a fairly comprehensive document. Particular suggestions from this which should be explored further include:
- The option to try and get REIAMA enacted through parliament (in a similar way to the National Construction Industry Council) which would mean that membership could be compulsory for certain activities. (unlikely to occur, and possibly restrictive of free-market activities)
 - Proposals to run short courses (would need to collaborate with TCRET/others, to avoid duplication/competition)
 - Acknowledgement that REIAMA is primarily seen as a PV supplier/installer network, which has limitations.
 - Noted that there is a lack of independent consultants available, which may be able to give institutional/larger clients and donors more 'comfort' if involved on projects⁵.
 - The document has a detailed budget/activity plan for period up to 2010. Although this is ambitious (requiring a total of just over 700 000\$ over the 6 years)⁶, several of the activities proposed would be useful and should be explored with the donor community.
85. The document proposes three categories of membership: ordinary, associate and honorary. Only ordinary members have voting rights, and ordinary members must be engaged in the production, supply, importation, exportation, installation or servicing of RETs. This would thus exclude consultants, academics, policy makers, consumer representatives.

Evaluation comment:

86. In Uganda a similar organisation (UREA) was established through the UPPPRE project. Two and a half years after close of UPPPRE (and failure to secure ongoing funding support), UREA has reverted to being a members managed institution with far reduced overhead costs. Membership has declined, and the organisation has become less powerful/influential. Nevertheless, it has retained a voice at government and institutional level, and does provide a forum of exchange of information..
87. We recommend that REIAMA receive further support, but within the context of specific initiatives
- a. Be supported financially for a further period of 6 to 9 months. During this period BARREM PMU (and possibly other stakeholders) should actively interact with REIAMA to ensure that progress is made

⁵ Under BARREM, only one training course specifically for solar consultants has been run. There is a need for more training/capacity development of project implementation and management consultants for off-grid electrification.

⁶ It is of interest to note that the total PV market in Malawi is almost certainly less than 100 000 Wp/annum. If REIAMA costs 100 000\$ to maintain, and the main activities are solar PV, REIAMA is effectively costing 1\$/Wp installed. Given that there are also other parties engaged in training, co-ordination activities, this level of investment is on the 'high' side.

- b. The association should meet with key stakeholders to hammer out a clear way forward during the next three months. The outcome of the process should be a realistic assessment of needs and sustainability options. If the result of this is that an organisation employing staff with a professional 'secretariat' cannot be maintained, then suitable steps should be taken to change the organisation from being donor funded to one that is more in line with a voluntary membership based and member run organisation.
- c. In parallel with this, the organisation and BARREM should consider setting aside a 'pot' of money which can be used by REIAMA on an as needed basis for specific activities. In order to ensure that these funds are only used for 'high value' activities, disbursement could be on a cost share basis (50% from the pot, 50% from REIAMA members own funds).
- d. The association should *consider* broadening membership (and actively recruiting members) such that the association could include anyone with a specific interest in the promotion of renewable energy. The association should in particular try to add to its membership:
 - i. Government staff involved in promoting sustainable energy (DoE, BARREM etc. as well as representatives of key consumer departments (Education, Health, Gender, Water)), Malawi Bureau of Standards etc.
 - ii. Donor staff with an interest in sustainable energy
 - iii. Financial institutions or individuals from the finance sector
 - iv. Universities and University staff
 - v. Consultants or other individuals with a strong interest in renewable energy delivery and technologies
 - vi. One or two international 'interested parties' (invited).
 - vii. Any interested parties from within Malawi.
 - viii. This could bring significant additional leadership capacity, as well as improving general communication between different parties involved in development of the renewable energy sector.
 - ix. Within this broader network, the association could have 'chapters' or sub-groups that are primarily 'industry' members, and may have specific requirements for membership (of the sub group)..
 - x. The organisations overhead costs should be reduced to fit within budgets that are more likely to be raised and sustained. This may mean that a permanently staffed office with secretariat cannot be maintained. However, the increased membership base should allow for the organisation to draw on more 'in kind' support from members.
 - xi. The broader organisation would need to realign objectives to suite the broader membership base.

3.4 Immediate Objective 2: Create an enabling policy and regulatory environment

Development Objective(s): The long-term development objective is to ensure that the National Energy Policy (NEP) and its associated policy instruments serve as a reliable and up-to-date tool for all energy planning activities, including solar PV technologies.

Immediate Objective(s): The immediate objectives are:

- To provide a framework for constant review of NEP to suit the existing economic and policy conditions;
- To prepare sub-sector strategies to support policy implementation; and
- To prepare relevant legal frameworks and legislation for improved energy sector governance.

88. Significant achievements have taken place during the greater BARREM project period (project design/Danida Fast-track process/BARREM 'proper'). Specific areas are discussed below.

3.4.1 Output 2.1: Preparation of policies and legal frameworks supported

89. Malawi operated without an Energy Policy for a long time. Its development aspirations in all the sectors were included in Statement of Development Policies complimented by sectoral development plans. In 1997, the National Sustainable and Renewable Energy Programme (NSREP) was developed to provide a platform for synergy and harmonisation of renewable energy projects. In 1998, the Electricity Act was launched to strengthen the operations of the electricity sub-sector.

90. Despite the above efforts, the Government still felt the need for a more integrated energy policy to ensure efficiency, harmonisation and order in the energy sector in support of government goals of poverty reduction and economic transformation of the rural areas. In addition, sub sector strategies and acts have been developed to operationalise the NEP.

91. BARREM resources have contributed to the development of the NEP, Rural Electrification Reform Strategy (RERS), Other Renewable Energy Sources Reform Strategies and the Renewable Energy Strategy. They have also contributed to the strategy for liquid fuels and gas. Although development of this strategy is not specifically within the *renewable* energy mandate of BARREM, these fuels are very important from a rural energy and development perspective.

92. The NEP was published in 2003. The document has outlined the need to increase access to electricity from the current 4% access rate. RETs are taken as one of the appropriate technologies for off grid electrification. The government has an ambitious plan of increasing the level of contribution of RETs in the energy mix from 0.2% in 2000 to 5.5% in 2010.

93. The NEP makes specific mention of the following which are relevant to the BARREM project

- Malawi Rural Electrification Project (MAREP) and the accompanying strategy
- Other Renewable Supply and Service Industries (ORESSI) and the accompanying strategy Other Renewable Energy Sector Reform Strategy (ORESRS)
- Establishment of Malawi Energy Regulatory Authority (MERA)

3.4.1.1 Rural Electrification Reform Strategy (RERS)

94. The RERS aims specifically at increasing the access to electricity in the rural population which at present stands at only 1%. The strategy seems to have a very good synergy with the activities of BARREM project, and therefore adds to the sustenance of the activities beyond the project cycle. Some of the activities outlined in the strategy are:

- Establishment of MERA to regulate the energy sector;
 - Economic: vertical separation of the market
 - Technical
 - Legal enforcement: code of conduct & annual certification
- Government is expected to:
 - Develop licensing procedures;
 - Subsidise plant and equipment
 - Provide Policy guidelines and
 - Support public awareness activities
 - Encourage independent power suppliers/ off grid electricity
- Private sector is expected to:
 - Invest in power supply including solar PV;
 - Design systems (as energy consultants)

- Install and maintain systems (as certified contractors/ installers)
95. The establishment of MERA and its Board, and the legal instruments are expected to be in place by November / December 2005.
96. If the planned activities are implemented, they will contribute a great deal to the smooth transition and/or continuation of the BARREM activities after the project closure

3.4.1.2 Other Renewable Energy Sources Reform Strategy (ORESRS)

97. ORESRS was developed specifically to increase the contribution of renewable energy resources in the Malawi energy mix from 0.2% (in 2000) to 5.5%(by 2010). ORESRS makes specific mention of the barriers (technical, economic, institutional and socio-cultural) and outlines measures to remove them. There is thus a clear link between the BARREM activities and the activities proposed in the strategy. This is also another sustainability assurance for the BARREM activities.

98. Some of the proposed activities are:

- NSREP to be the implementing agency of ORESRS
- Certified companies to have physical presence in the district centres
 - Ensure efficient maintenance services
 - Easy to access spares
- Implement various delivery modes to suit the target groups
 - Commercial
 - Industry
 - Grant-aided
- Strengthen research institutions (to manufacture, fabricate or assemble RETS)
- Capacity building through TCRET
 - Train engineers and planners
 - Develop user manuals
 - Develop business management training for certified companies
- Establish a link between MERA and MBS in the implementation and enforcement of codes of practice and standards.
- Price regulation: currently users are not getting the benefits of duty waiver
- Supply and warehousing
 - Encourage the establishment of warehousing
 - Certified suppliers to host a bonded warehouse for RETS
- Source funds for the establishment of ESCOS

99. All the ORESRS activities have direct linkage with BARREM activities. The completion and publication of the ORESRS (and RERS) will be an important milestone in ensuring that the BARREM programmes have a home and a future.

3.4.2 Output 2.2: Codes and Standards for PV developed

Development Objective(s): The development objective is to prepare for an upcoming solar PV market that may otherwise be flooded with equipment and services of poor quality.

Intermediate Objective(s): The intermediate objectives are:

- To develop a set of standards and codes of practice for solar PV systems for individual households, agro-industrial, commercial and institutional delivery modalities; and
- To increase consumer confidence in use of solar PV technologies through reduction of maintenance problems that come with poor quality installations.

100. The Malawi Bureau of Standards (MBS) was contracted to co-ordinate and facilitate the development of a number of key standards in the area of PV technology. They have also made progress with domestic solar water heating standards. The process was started during the DANIDA FastTrack era, and continued through the BARREM funding phase.

101. The following standards have been published, and were briefly reviewed by the team:
- MS 695:2004: Battery-based solar photovoltaic (PV) systems – Specification
 - MS 696:2004: Battery-based solar photovoltaic (PV) systems – Code of Practice
102. The following standards have been approved by the board, but are not yet published. These were not reviewed by the evaluation team.
- MS 709 Fluorescent lights
 - MS 717 Batteries (deep cycle)
 - MS 711 Crystalline modules
103. MBS is in the process of developing the following domestic solar water heating standards.
- MS 758 Domestic Solar Water heaters
 - MS 759 Solar Water heaters code of practice
 - MS 760 Domestic Solar Water heater mechanical qualification tests
 - MS 761.1 Domestic Solar Water Heater thermal performance tests (outdoor)
 - MS 761.1 Domestic Solar Water Heater thermal performance tests (in door)
104. Observations from the evaluation team:
- The two published standards are very useful documents (MS 695, MS 696), and in our opinion represent a very significant contribution to development of the PV market in Malawi. Most people with whom we met supported use of the standards, and there seems to be a good sense of ownership in the industry. They are relatively brief, and simple to apply.
105. In some areas we feel that they are not sufficiently prescriptive to ensure quality, although this will in part be addressed by the components specs about to be published. Examples include
- Lights – inadequate guidance is given regarding the quality/switching cycles/lifetime required of fluorescent lights (presumably addressed in MS 709)
 - For integral compact fluorescent lights, no guidance is given on whether these should be bayonet (B22D0 or screw in fittings (ES27 or ES16). The bayonet fitting does not have polarity distinction, which can lead to confusion when lights are replaced. The ES27 or ES16 fitting can only be inserted one way. Furthermore, if a specific standard is selected, it may be possible to improve pricing through volume purchasing.
 - Basic system documentation fixed to wall: The standards require user documentation, which is good (although we did not find any during site visits!). In Uganda a further requirement is that a simple sheet indicating supplier name and contact details, basic equipment installed, key operational issues, is stuck on the wall next to the charge controller. This idea may be worth adding to Malawi requirements.
 - The standards specifically allow AC plugs to be used for DC applications. (Uganda allows this as well). In some of the Malawi installations visited there were signs that consumers had been unsure which is which. We strongly recommend that a distinct DC plugs/sockets be required. In South Africa low cost automotive 'cigarette lighter' sockets have been found to work well (available as either inline or panel mounted). Furthermore some DC appliances are equipped with male plugs compatible with a cigarette lighter socket.
 - MS 695, section 4.5 does not highlight the importance of using efficient refrigerators, which could lead to disappointment if conventional or absorption cycle refrigerators are used (depends on system sizing).

- The standard does not give sufficient guidance regarding physical integrity of module mounting (given observations from the field visit). Several installations used a system of installing a pole through the roof, attached to roof beams. At times the positioning of mounting brackets on the roof trusses did not in our opinion provide sufficient resistance to bending moment that might be caused by high winds.
106. In other areas we feel the standards are overly prescriptive, and contributing to high costs in Malawi:
- The blanket exclusion of amorphous technology is overly restrictive. There are some good amorphous products on the market, which can be identified through proper IEC or equivalent certification, and have good brand reputation as well as long-term warranties. Uganda, South Africa and many other countries allow amorphous technology (under controlled conditions).
 - The requirement for all internal wiring to be in conduit that is chased into walls⁷ adds cost in terms of both materials, and more importantly time of installation. It can at times also lead to damage of walls/less attractive installations. South Africa and Uganda allow surface wiring, especially for DC wiring.
107. There has been significant regional standards work over the last few years, in particular NRS 052 (a detailed SHS standard from South Africa), and the recent publication of several well reviewed standards in Uganda. Some of the Uganda standards have recently been adopted by the East African Standards body, and are also being considered for IEC adoption. We would encourage MBS or others involved in further standards development or review of the Malawi standards to engage in dialogue with counterparts in South Africa and Malawi to explore options for sharing of ideas and possibly to allow for further harmonization of standards across the region. Use of regionally accepted standards might facilitate more regional growth in industry
108. The proposed standards (and more particularly the proposed certification of installers, see section 3.4.3) do not, in my opinion address one of the key strategic recommendations made in the finance report of Mutisasira et al (2004). Mutisasira et al advised that efforts should be made to reach the low end market - in particular through solar lanterns, and encouraging modular purchasing of smaller systems, as well as development of a range of different distribution methods. The standards in their current form are primarily orientated towards larger systems.
109. The primary purpose of standards is to have systems in the field that have a less faults/failures. The CSR report indicates that only about 11% of systems visited were not in good working condition. This is a relatively low fault rate and indicates that targets have been achieved. It should however also be noted that the CSR report did not differentiate between system working fully and system partially working (e.g. systems with one or more broken bulbs or switches, or with weak batteries would presumably have been reported as working, even though performance is not optimum). The evaluation team's non statistical sample found some sort of problem (often minor) at most systems visited.
110. We recommend that the BARREM team institute some sort of data gathering exercise to monitor faults rates. One method would be to have a simple data card that is completed for each installation visited by BARREM staff. Fault reporting should at least indicate whether the systems are operational, *partially operational* or out of order.
111. One option that may help with maintenance reporting/management/data gathering is to require (as part of the standard) that:
- Pre-printed post cards be developed to allow customers to easily fill in a complaint/report a problem. These can then either be handed to local repair centers, or posted to a central 'free-post' address (from where they could be forwarded to the respective installer/maintenance person.

⁷ Note: we did not interpret section 3.2.14 of MS 696:2004 as requiring conduit. However almost all installations visited had conduit, and we understand that it is an implied, if not explicit requirement.

3.4.3 Output 2.3: Certification procedures for PV companies consolidated

Development Objective(s): The long-term objective is to consolidate existing solar PV Industry Certification Procedures so as to facilitate the development of a robust commercial RETs market.

Immediate Objective(s): The immediate objective is to establish a well functioning certification scheme for solar PV industry.

112. As per the inception report, 3 companies had been certified by the start of the GEF funded BARREM phase (they were certified under the ISU), and a further 6 were in process. At that time it was noted that certification processes were slow. By the 2005 APR report, the certification time had been reduced to 2 months (in line with targets), and at present there are 26 certified companies. There are still some uncertified companies operating.
113. There have been reports that the certification process is not as rigorous as it used to be. On the other hand, it is critical that the industry be supported, and not held back by overly restrictive/slow certification requirements.
114. At present there is one certification process for all categories of industry members (importers/suppliers/installers/maintenance organisations). Furthermore, proposed regulations being tabled for enforcement by the Malawi Energy Regulatory Authority require that all companies that are involved in the business of Renewable Energy Technology supply, retail or installation be certified.
115. It is recommended that certification processes and requirements for certification should be tailored for specific market segments. There could be different types of 'certificates' issued for different categories and/or scale of business. Some businesses may be so small, or operate in particular segments of the market such that certification is not required. For example, a one or two person village based maintenance company should have very different certification requirements to a larger company involved in importation and distribution of PV components. Furthermore, if retail outlets such as market traders, furniture stores or even supermarkets wish to stock solar components, this should be allowed and even encouraged provided that the products selected comply with the appropriate standards and are not mis-represented. It would however be unrealistic and restrictive to attempt to certify all these retail outlets.
116. The need for regulation of the industry/product quality improvement needs to be carefully weighed against the need to stimulate market growth and encourage investment/entrepreneurship at a range of different levels.
117. Certification of all companies/businesses operating in the sector should be strongly encouraged, but should not be *compulsory*. Certification can be a requirement for access to government or certain donor funds. It could also be a requirement for joining the industry chapter of REIAMA. However, if individuals or private sector clients (not making use of government funds/subsidies) wish to make use of non-certified companies, this should be allowed. Note that:
 - o All compulsory equipment standards would still apply
 - o PV equipment (especially as used in rural households) does not normally carry a significant safety risk. Some authors argue that it can be marketed as a consumer product through normal and informal retail channels. A rural general dealer or small market trader selling solar lanterns or even inverters should not have to be registered as a certified PV company. Some equipment can be owner installed. This more informal market should not be rendered

illegal, as it can be an important (and low cost) component of market development.

118. Note- the above comments are not intended to weaken the certification process, or imply that certification is not required as an integral part of improving standards and quality of RET business in Malawi, it is primarily a caution against swinging the pendulum too far, and over regulating the entire emerging industry. One of the primary purposes of BARREM is to create an *enabling* policy and regulatory environment.

3.5 Immediate Objective 3: Develop and test financing mechanisms

Development Objective(s): The long-term objective is to develop viable and sustainable financing mechanisms for RETs for private individuals, public institutions and agro-industry, with emphasis on using commercial delivery models.

Immediate Objective(s): The immediate objective is to consolidate the existing financing mechanisms namely Credit Guarantee Fund (CGF) for Solar Home Systems (SHS), and Health Clinics RET Fund. Further, the activity aims at encouraging commercial financial lending institutions to get more involved in solar PV systems promotion by providing the necessary financial resources.

3.5.1 Output 3.1: New and innovative financing mechanisms identified, tested and accessed and effectiveness of existing funds (CGF, HCRF) evaluated.⁸

119. The Credit Guarantee Fund was established through the DANIDA Fast-Track project, and was effectively left as a legacy to BARREM. This provides a 100% guarantee to participating banks, who then on lend to customers. The loans require a 30% deposit, and interest rates are not significantly subsidized.

- o The installer identifies and appraises the household (buyer) based on the checklist developed by the Fund Manager;
- o The installer passes on the applicant information to Fund Manager who authorises the loan and installation
- o The buyer completes the loan application form from a bank through the supplier
- o The buyer pays 30% deposit
- o The suppliers submits the application forms plus 30% deposit to the Fund Manager (FM)
- o The FM approves and authorises the bank to pay the supplier
- o The supplier sources equipment, installs and maintains the system for one year under contract;
- o The buyer signs loan and lease agreement with the commercial bank through the supplier;

120. If the buyer defaults beyond the stipulated period,

- a) the Fund Manager authorises the installer to repossess the equipment;
- b) Loan and lease agreement with buyer is terminated and residual loan balance calculated. Based on this the Financier is authorised to recover the balance from the Credit Guarantee Fund;

⁸ Note- this output description (taken from a revised project performance matrix) is different to the immediate objective given in the inception report, and is different again to the APR. This type of change can be very significant, and reflects in part a lack of clarity of objective that runs through several elements of the project.

c) The supplier pays the Fund Manager buy back value of the SHS.

121. In early 2004, Mutesasira et al reviewed the fund operations, and made several recommendations, both for the CGF, and for establishment of a revolving fund (See section 3.5.4). The report made extensive and detailed recommendations. At that time, only 7 loans had been processed.
122. As of April 2005, the fund reported 20 loans granted, two customers on their books but listed as paying cash, one loan was apparently rejected, and a further 7 loans in process. By August the number had increased to just over 30 households. This increase is promising, but is nowhere near the scale required for significant market penetration, or to achieve significant efficiency improvements in delivery.
123. During the last few years some changes have been made to the way in which loans are guaranteed.
- Initially the participating banks required that the full guarantee funds be lodged with them prior agreeing to on-lend to customers. More recently, they have allowed a proportion of the funds to be withdrawn by the fund manager (MEET) – and they can now be invested in high yielding instruments such as treasury bills. However MEET and the participating Banks still regard the ratio between CGF funds available and total loan portfolio as being limited to a 1:1 ration.
 - The suppliers are now expected to carry 50% of the default risk. (If a customer defaults, the supplier may repossess the solar equipment, and must pay 50% of the outstanding loan value to the financial institution).
124. The existing CGF fund has been observed by BARREM (with reporting primarily done by MEET). However, it is apparent that MEET and the PMU have not engaged as active partners in the process - in part because the funds lodged with MEET are from the DANIDA funded project, and their contract is with DOE – so the BARREM PMU is not seen as the key stakeholder. The BARREM team do not seem to have formally evaluated MEET, or engaged directly with it. (Note that the March 2004 report specifically encouraged greater interaction).
125. The CGF is not particularly attractive to installers as:
- It requires significant marketing/approval/processing overheads
 - It passes significant risk to the installer
 - Interest rates are fairly high, and loan period fairly short, so the impact on customer affordability is limited
 - The CGF administration process/marketing process is not leading to 'batched' installations of household systems. Thus one of the key opportunities for cost reduction is not being achieved⁹.
126. From the participating bank perspective
- There do not seem to be any incentives to the participating banks to market the loans (except that they can lend funds well secured)
 - They carry no risk, and thus are not particularly well motivated to ensure a low default rate
127. The rate of loan disbursements from the fund is far too low to justify the capital amount tied up, or the contracted management fee (1500\$/month). The fund is not significantly helping to reduce market barriers, or increase volumes of equipment supplied.

⁹ For many of the early phase Village Bank funded installations in Uganda under the UPPPRE project, the Village Bank acted as a consolidator of demand, issuing a request for pricing to installers for batches of 20 or more systems. The selected supplier could then transport and install a cluster of 20 systems, all in the same region. Batching of demand/supply/training/ sensitisation helps considerably to reduce costs.

128. Some interviewees argue that the low uptake rate is related to lack of active participation from suppliers and banks. It should also be noted that the fund manager (MEET) does not seem to have a direct incentive to place a higher number of loans. On the contrary, they seem to be limiting the number of loans made, so as to minimise risk. Furthermore, there have been some concerns regarding the limited size of the capital guarantee.
129. However:
- BARREM has actively marketed PV. If there was real client pull for the products, and if the loan system was attractive to suppliers and consumers then there would have been far higher demand.
 - Average loan size is approximately 100 000 MK, one would thus expect that the CGF could secure at least 60 loans on a 1:1 ratio. Furthermore, if the CGF had been fully exploited there would have been good case for requesting additional funds.
 - The ratio of guarantee funds to loan funds does not need to be 1 to 1 as the risk of ALL loans defaulting is very low. With strong negotiation, it should be possible to have a 1 to 3 or even higher, thus allowing a far greater amount to be actually lent to customers. This point was well articulated in the March 2004 report.
130. It therefore seems to the evaluation team that the primary reasons for low uptake are related to consumer demand for the product:
- That the loan product/process is not well suited to the market (loan period too short, loan interest rate too high, deposit required too high)
 - The levels of affordability/demand for the SHS product are simply not high enough in the target market
131. It is our opinion that these consumer demand related issues, coupled with the complicated management structures/lack of appropriate incentives to the fund manager/participating banks have led to poor roll out rate.
132. The CGF has also been used to make loans to suppliers. In the 'DANIDA' era three loans of 10 000\$ each were made. One of these defaulted badly, and the other two were recovered, but only through withholding funds on subsequent installation contracts paid for by DoE. As far as we could establish, the above loans were made without proper enterprise support mechanisms or proper business plan assessments being done. More recently, MEET have made short term working capital loans to suppliers to cover equipment purchase costs for installations related to normal CGF loan customers. However in this case there have also been problems, as the loans to customers were (at the time of the mid-term review meeting) temporarily on hold. It thus seems that experience with supplier loans has not been good. This however does not mean that vendor/supplier finance is inappropriate in Malawi. There are extensive examples of this type of specialised finance, and specialist organisations that have done this successfully (E+Co, Triodos Bank, Grofin, Centenary Rural Development Bank (Uganda), etc.).
133. As the CGF fund is not directly under BARREM control, the evaluation team have not made a specific recommendation regarding termination or otherwise of the CGF. However, we do feel that key stakeholders (MEET, DOE, participating banks, BARREM, REIAMA) should actively seek to derive maximum benefit for market development from the remaining funds. *If* the fund is to be maintained, then we strongly encourage the role players to re-read the March 2004 report, to internalise the recommendations made there in, and to implement them without delay. Although key recommendations from the March 2004 review are listed in the paragraph quoted below (from the executive summary), we strongly urge role players to review the detail of the March 2004 report:

“BARREM¹⁰ should draft and issue new terms of reference, eliminating contradictory clauses, to the current fund manager. The new terms should have performance-based remuneration. The terms of reference should exclude credit risk assessment and loan approval because this is the specialty of lending organizations and not the fund manager. After one year, BARREM should review the CGF and if banks are still not leveraging the funds, all the CGF money should be transferred into a revolving loan fund.”

3.5.2 Health Centre Rehabilitation Fund (part of output 3.1) (HCRF)

134. The inception report describes the Health Centre Rehabilitation Fund as:

“This Fund required CHAM¹¹ clinics identified under the Project to contribute 10% towards solar PV systems investment costs. These clinics are also expected to deposit with CHAM specified amounts into the Maintenance Fund used to replace the components after expiry of the warranty period. In addition, under this Fund, the clinic owners and solar PV system suppliers enter into a one year Service Contract to ensure that the systems are serviced after the warranty period.”

135. The BARREM PMU does not formally report on funds held by the HCRF, and no statistics were provided on the efficacy of this fund. This is concerning as it illustrates that another fund (like the CGF) that was set up under the DANIDA process, and formally incorporated in the BARREM project, has not been effectively monitored and followed up by the BARREM team. It is however ever reassuring to note that CHAM have developed a comprehensive strategy for Planned Preventative Maintenance – see CHAM (2005) and discussion in section 3.6.1.6.

136. CHAM Physical Assets Management Unit indicated key issues related to maintenance

- 38 of their staff have received maintenance training through BARREM activities
- The Physical Assets Management Unit within CHAM is not yet responsible for maintenance of all CHAM PV systems
- CHAM has signed one year maintenance contracts for PV systems with some suppliers
- CHAM is aiming to build up internal capacity for maintenance, but does acknowledge that some maintenance will need to be done by suppliers.

137. The Inception report suggests that BARREM should endeavour to set up similar funding process for school maintenance as well as possibly for other government departments. This has not happened on an extensive basis. There are still significant problems regarding:

- Financial provision for maintenance at schools and clinics (funding resource allocations at either local level or within department structures)
- Establishment of clear procedures for people to follow so that they know who to contact when for maintenance support. All too often we either heard that no formal reporting had been done, or that the district office had been informed of some fault several weeks/months ago...

138. Although there has been interaction with MoH regarding training (See section 3.3.2.2), it was our impression at the Meeting with MoH that there was insufficient

¹⁰ The March 2004 report seems to have assumed that BARREM could play a greater role in restructuring the CGF. It seems from the mid term review that the BARREM PMU either do not have the authority to engage effectively with the CGF process, or have not been willing to significantly take up that responsibility.

¹¹ CHAM (Christian Health Association of Malawi) runs about 40% of this health facilities in Malawi.

interaction between BARREM and the MoH regarding direct engagement on MoH off-grid procurement planning, or more importantly regarding maintenance. We recommend that the PMU engage directly with MoH and Ministry of Education to

- o Provide information on the costs, logistical and management issues related to maintenance of PV systems
- o Work out practical, strategies for maintenance provision and ensure that these are implemented.
- o Note- in this regard, there need to be a clear understanding that maintenance is a long-term issue, not just for the first year after installation.

3.5.3 New fund opportunities identified (primarily through consultancy assignment)

139. There does not seem to have been sufficient work done on identification of new and innovative financing mechanisms. A consultant team was appointed, who spent three weeks (March 2004) undertaking work and preparing a report, which has several detailed recommendations. However, it is not apparent to the evaluation team that this work has been fully internalised by the PMU and carried forward to the greatest extent possible. A meeting was held with National Bank of Malawi and the Malawi Savings Bank to explore options for mainstreaming of loans using own bank resources. Although results for this seemed positive (with agreements regarding need for training of bank staff) the action does not seem to have been followed through.

140. There has not been significant progression or development of finance models since then.

141. The evaluation team was only able to meet with the National Bank of Malawi (and given that this is now more than a year later met with a different official). At first it seemed that the options for mainstreaming of loans with the bank seemed limited. However, following extensive discussions related to:

- Target market (employed people in towns who have relatives or homes in rural areas seem better candidates for loans as they have higher income, and are closer to bank infrastructure)
- Marketing potential (e.g. NedBank's green cheque accounts)
- Options for employer guaranteed loans
- Options for leveraging of credit guarantee funds on a risk sharing basis

the official indicated that there is definite room for further consideration of the idea.

142. The evaluation TOR requested the consultants to provide a "quick-and-dirty" assessment of the possibility of involving commercial banks extend credit to solar PV end-users using their own resources using their existing loan schemes;

143. Based on the above discussions, and also informed by experiences in Uganda, we are of the opinion that commercial banks can use their own resources to extend credit to PV end-users. In Uganda FINCA, Centenary Rural Development Bank and DFCU are all developing or have applied solar loans. Furthermore, in the Malawi context employer guaranteed loans, personal loans and Mortgage schemes could be used to finance any product that the client may choose, including SHS (NBM indicated that their existing Mortgage scheme could be used). Malawi Savings Bank indicated that they would still need a guarantee fund of some kind.

144. However, it is also our opinion that the probability of developing a significant volume of sales using this method in Malawi is relatively low:

- o Applications will be done on an individual basis- and thus costs of equipment supply and installation are not significantly reduced (no batching of supply)

- Those people who have access to employer guaranteed loans mostly live in towns, where solar electrification is not a priority. Although they may have family in rural areas who they may wish to support, it does not seem all that likely that they would take out a loan to purchase SHS for family living far away.
145. We therefore feel that the model should be developed as another avenue, but that sales are likely to be of the order of 10's to 100's of systems per year, rather than 1000's of systems per year.

3.5.4 Output 3.2: Microfinance Fund capitalised and used

146. The inception report indicated that an amount of 100 000 \$ should be used to capitalize a microfinance institution revolving fund.
147. The project has made use of external consultants to review the finance activities of the project, and to explore opportunities for micro-finance to be established. Following this process, the PMU have met with micro-finance institutions to explore options. Preliminary results indicate that the micro-finance institutions have sufficient own funds (provided that they can charge their standard interest rates), but would need project type support for loan administration systems and to establish the new solar loan product. It is unfortunate that the BARREM project has not yet been able to explore options in far more detail with a range of micro-finance institutions, as it is our opinion that more dialogue and negotiation around modalities may have lead to a implementable outcome.
148. The UNDP/GEF sponsored UPPPRE project has been evaluated (mid-term, and terminal evaluations), and at present an ex-post evaluation is being done. The PMU should request copies of these reports from UNDP, as they have significant lessons learned regarding micro-finance. The terminal evaluation in particular raises key risks associated with selection and support/interaction with micro-finance operations. Also important to note is that the UPPPRE project benefited from a parallel UNDP funded programme to build capacity in micro-finance institutions. This provided key support in identification of strong 'village banks' and during negotiations to define interest rates and loan terms that would suit the market. If the BARREM project is to continue building relationships with micro-finance organization, they may need similar support from a micro-finance support organization.
149. The Uganda 'Village Bank' experience also indicates that interest rates for solar loans, and loan terms need to be more favourable than for normal 'productive use' or 'commercial' micro-finance loans if customers are to take up the loans. This is primarily because the solar installations do not generate income for the consumers. The solar loans were for 2 years, at an 18% interest rate, while normal micro-finance loans are for far shorter periods, and at interest rates of around 48%. The Uganda institutions also seem to have a shortage of capital for loan funds. There are however indications (2005) that some larger institutions may be able to offer solar loans in Uganda that are not 'bought down', but still just low enough to attract a wealthier class of customers (in some ways similar to the potential identified in Malawi for employer guaranteed funds).
150. The remaining project period – to February 2007 is probably too short to establish and support a new lending mechanism through micro-finance organizations, that is based directly on the Uganda experience- as this relied in the early years on considerable support and monitoring from the UPPPRE project. Any arrangement set up under BARREM will either need to be relatively autonomous, or DoE or some other institution will need to commit to monitoring and supporting the micro-finance operation that BARREM develops for at least a two to three year period (more than one loan cycle). The Uganda experience indicates that it is critical to build up good relationships, and to monitor the application of loan funds set aside for micro-finance.

3.6 Immediate Objective 4: Promote Renewable Energy Services

This component of the project is the primary avenue through which hardware is delivered to rural households and institutions, and demonstrated to work effectively. The methodologies used are intended to support development of a sustainable, commercial market. For this reason considerable attention has been placed on trialling not only the actual technology, but also the funding and delivery mechanisms. Each of the main delivery models is discussed briefly below.

3.6.1 Output 4.1: Delivery models for households, institutions and SMEs developed and tested

3.6.1.1 Solar PV for Lighting in Households

151. This applies to purchase of SHS by households (HH) on credit or cash basis. System ownership is by HH if paid for cash. If on credit, ownership remains with the financier until the credit is fully serviced. The credit model is described and evaluated more fully in section 3.5.1.
152. Sales of solar systems through the CGF have been very low, with less than 40 systems sold to date during the BARREM period..
153. BARREM and installers were not able to provide clear data on the number of systems sold using cash. However, none of the installers visited indicated doing more than 3 or 4 systems a month. If we assume 8 active companies, doing an average of 3 systems per month each, total sales over a 12 month period would 288, which is also very low. At the inception phase, it was estimated that 500 systems had already been installed by 9 companies over an 18 month period. Without access to more reliable data, we cannot confirm whether the household market has grown significantly during the BARREM era or not. Based on discussions held, it does seem to have grown. For the purposes of this evaluation we have assumed that 900 household systems have been installed as a result of BARREM sensitisation activities over a three year period. If the 500 systems mentioned in the inception phase are added, this gives a total of 1400.
154. Apart from the household system finance modalities to be developed through the project (see section 3.5.1, 3.5.3 and 3.5.4), the inception report (pg 46) makes specific reference to :
 - o BARREM and DoE developing operation, maintenance and service manuals
 - o Establishment of reliable maintenance methodologies (e.g. maintenance and service contracts) and maintenance capacity

Although draft customer manuals have been prepared, the review team was disappointed that this had not happened earlier, and noted that consumers did not seem to have documentation on their systems available. It is recommended that user manuals be prepared and distributed as soon as possible. Furthermore, the UPPPRE project (Uganda) have instituted a useful requirement for a document to be pasted to the wall next to the charge controller with provides basic information on the solar installation, as well as system specific information (such as name and contact details of supplier, size of battery, module Wp, serial numbers).

155. The household delivery models trialled so far in Malawi do not seemed to have achieved significant 'batching' of installations. Costs for product delivery to rural areas, installation, training and even marketing can be significantly reduced if groups of 10 to 50 households can have their systems installed at one time. The BARREM team needs to work with suppliers and communities to see if batched approaches can be achieved.
156. In the proposed ORESRS, the government is also planning an employee RETs delivery model that would benefit civil servants and those working for quasi-government institutions to access loans for RETs. This is likely going to have a big impact as the government is the largest employer and civil servants normally have difficulties to qualify for commercial loans. The government needs to put in place mechanisms to ensure

equal access, transparency and accountability in the management of such loans. This could best be managed by a third party MFI or Fund Manager.

3.6.1.2 Delivery model for Grant Aided Institutions and Government Institutions

157. This model involves the provision of solar facilities to public institutions such as schools, clinics, police or immigration posts. Four principle categories of client institution have been identified and delivery models trialled:

- Government supported health centres
- CHAM (or other donor supported) health centres
- Schools
- Others

158. For health centres, the delivery model was to be linked to the Health Centre Rehabilitation Fund (see section 3.5.2). The government makes a contribution of 90% to clinics under CHAM or any other religious organisation, while the clinic owners contribute the remaining 10%. The coordinating organisation such as CHAM acts as the Fund Manager. About 10% of contribution is reserved for maintenance purposes.

159. The DANIDA supported Fasttrack programme saw 12 health centre demonstrations being carried out, and JICA funded a further 8. It is not clear that BARREM directly supported implementation of further systems.

160. UNICEF have further supported health centre electrification, with the UNICEF contribution of more than 90 vaccine refrigeration units (procured in 2003) in particular being highly significant. During the interview with UNICEF it became clear that they were considering implementing a further 90 installations, but that there had been problems with procurement modalities. BARREM or DoE should engage directly with UNICEF to see if investment decisions can be facilitated.

161. BARREM did not play a highly significant role in the UNICEF roll-out. It is also not clear that BARREM were able to get long-term maintenance systems in place for the UNICEF and other role out programmes.

162. Several completed inspection check sheets were provided to the evaluation team by BARREM. These indicate that there is significant quality assurance checking being carried out by BARREM (in collaboration with DOE staff). The check lists are quite detailed, and comments made indicate that the system is picking up quite a few faults. This is a very valuable function, especially during the early phase of market development. BARREM should aim to institutionalise this function. Furthermore, BARREM could make the check lists (and guidelines on how to use them) more readily available to other implementing parties in Malawi.

163. During the evaluation team visits to Alinafe Health Centre (DANIDA funded) and the Choma Health Centre, it was observed that:

- Maintenance is being carried out from time to time (Alinafe had replaced batteries and had work done on the solar pump), but that problems are not yet being fully resolved (Alinafe pump). Furthermore, at Choma it was clear that minor component maintenance could be difficult to organise/fund (broken bulbs had not been replaced).
- The systems were highly valued – particularly for their impact on:
 - Communication (radio at Choma)
 - Support of Vaccine programmes (WHO EPI at Choma),
 - Water supply (Choma again)

- Blood bank (Alinafe)
- Maternity and other area lighting (both)
- Administration support (notebook computers powered by solar at Alinafe)
- Staff living conditions improvement (both institutions)

164. In discussions with the MoH, it became clear that they would appreciate further input on modalities and experience related to health centre electrification using solar. The representative concerned indicated that the Ministry is keen to have all health centres electrified (and in many cases renewable energy technologies are the most appropriate electrification option). Furthermore, he indicated that there is increasing understanding of the need to maintain energy systems at government health centres. This presents an opportunity for the BARREM team to share their health centre electrification experience, and provide important facilitatory and possibly even project management services. Currently a Zimbabwean consultant is providing technical support to the Ministry. It is encouraging that the MoH seems to at least be seriously considering further solar electrification, even if they are not drawing extensively on BARREM methodologies.

165. For educational institutions, the Government contributes 50%, and district assemblies or communities contribute the remaining 50%. The school community is supposed to set up a maintenance fund from the contributions by the community or income generating activities from the solar installations such as video shows.

166. BARREM extended the offer to all districts to co-finance electrification of one Community Day Secondary Schools per district. Although responses have not been received from all districts, there are 23 schools which have received solar electrification. Given the funding modality, this is a reasonably good response rate, and indicates that the schools/District assemblies value the solar service.

167. In discussion with staff members at educational institutions it was determined that there are some resources available for maintenance (levy from scholars, and contribution from staff for the systems at their homes). However, these systems need to be institutionalised, and implemented. There was little clear evidence that the budgeted funds for maintenance had actually been put aside. The uneven nature of solar system maintenance (with no funds be required for extended periods, and then rather sudden requirement for funds for example to repair an inverter or replace batteries) means that schools systems are vulnerable. It would certainly be preferable if some way could be found to keep monthly maintenance contributions off-site and in a secure fund dedicated to energy system maintenance.

168. The extent to which these school lighting systems will be utilized remains to be seen, as detailed evaluation has not yet been done. However, it seems that the main use of lighting will be for students who need to study in the evenings for examinations (about two months in the year). At present the schools do not usually have audiovisual or other equipment (notebook computers) that can make use of inverter power during the day. In order to maximize benefits from solar electrification in schools, it will be necessary to integrate the solar supply options with associated educational equipment and materials provision. This will almost certainly require that larger systems be utilized - at higher cost, but with longer battery life.

3.6.1.3 Solar PV for Beverage Coolers

169. This model involves active participation of an industrial partner. Following successful demonstration, the project planned to fund the incremental costs of using solar technology to provide beverage cooling at remote retail outlets. This modality could be readily justified in terms of the Global Environmental Facility 'incremental cost' approach

170. Currently this model is being tested in collaboration with Southern Bottlers Limited (SOBO) where six solar fridges are being tested at the sites that were collaboratively selected by the DoE/ BARREM and SOBO. Once the trials have been successfully done, it is expected that SOBO would replace most of its paraffin fridges with solar fridges. It is expected that SOBO would use certified suppliers to source, install, commission and maintain the systems. The agreement between SOBO and retailers would probably not change.
171. This is an important BARREM activity. It was supposed to have contributed a great deal both in terms of the budget and impact of reducing CO₂ emissions. During the project-planning phase, 2000 solar fridges were expected to be sourced. This figure was later significantly reduced to 350. To date SOBO has not come forward with funding for the fridges, and have not confirmed whether they regard the pilot project as successful or not.
172. During the site visits, the team visited two sites where the solar bottle coolers/ fridges were installed at Mwansambo in Nkhota-Kota and Kafukule in Mzimba. Both coolers were working well. In addition to cooling, the system was providing lights, allowing the retailers extended hours of operation. It is fair to say that the demonstrations have been successful but the industrial partner needs to be encouraged to move forward.
173. Although the evaluation team made several attempts to meet with the SOBO decisions makers, this was not possible, due to schedule conflicts. However, we did infer through discussions with BARREM staff that:
- BARREM was not keeping sufficiently close contact with SOBO decision makers to closely follow decision making processes
 - BARREM did not have readily available evaluation information on the demonstration sites, or business case information on the proposed roll out. In our opinion BARREM could play a far more active role in facilitating a decision by:¹²
 - Engaging in more active discussion with SOBO and vendors
 - Providing detailed cost and technical information on current refrigeration options for the bottle cooling options
 - Providing business plan information on the bottle cooling option (effectively a detailed case study which shows in financial and in qualitative terms what the bottle cooling/lighting adds to the business value of a rural SOBO retail outlet, and compares this with the capital and operational costs of the PV system/refrigerator.)

3.6.1.4 Solar PV Systems for Tobacco Fans

174. The model has been designed to serve the tobacco industry in particular. It is a variant of the commercial model. ARET is the coordinating organisation responsible for fund management and research on RETs with specific applications to the tobacco industry. Further details are provided in section 5.4.5 of the inception report.
175. With the support from BARREM, ARET is involved in the testing of solar powered fans used in the tobacco curing furnaces to test the potential savings on fuels (coal and firewood). ARET has tested the fans for two seasons at Mwimba and one season at Kabwafu.

¹² See section 5.4.4 of the inception report

176. The results did not show statistically significant difference (applied T-test at 5%). However, from the recorded results of the amount of fuel used there is an indication that the technology is yielding positive results:

- Saving on wood fuels: 21 to 26%.
- Savings in coal: 12%
- Saving in curing duration: 1 day (i.e. from 7 days down to 6 days).

177. Note that the above savings are similar to those reported in the inception report.

178. The ARET Board of Directors has approved the project/research as ready for dissemination. However, the researcher involved has not yet completed his research report, or prepared an analysis of the costs and benefits of using the technology for the farmer.

179. ARET has not yet been used as a Fund Manager as per the model.

180. As in the SOBO situation, it is the impression of the evaluation team that:

- BARREM is not maintaining sufficiently close communication with ARET to provide the necessary evaluation and technical support, or to remain fully informed of developments (we were told of the above decision to close the research phase during our interview with ARET).
- BARREM has not addressed key business case issues related to this delivery model with ARET during the experimental phase.
- Given that this analysis has not been done, it seems impossible to give a clear recommendation on whether promotion of the tobacco fans would be a good idea or not.

181. There are other options for improved tobacco curing efficiency that researchers may wish to explore. The remaining project time does not allow proper work on these, but in case of future interest¹³:

- Pre heating of combustion air using solar thermal heat exchangers (some work has been done on solar assisted drying in Zimbabwe, in collaboration with a Netherlands company)
- Pre heating of air entering the barn (not the flue air) using solar thermal heat exchangers.
- Improving the sealing of the interior flue pipes within the barn, so that the natural convection resulting from density differences between hot air (in the flues) and colder air (outside) will provide more natural airflow through the grate.

182. Note- regarding climate change impacts:

183. In the design phase it is estimated that 190 farmers, each curing 26 500 kg tobacco would save 2 kg wood per kg tobacco, yielding a net saving of 90 MT CO₂/farmer/year.

$$\begin{aligned} \text{kg C/farmer} &= 2 \text{ kg wood/kg tobacco} * 1.7 \text{ kg CO}_2/\text{kg wood} * 12 \text{ kg C/ 44 kg CO}_2 * 26,500 \text{ kg tobacco/farmer} \\ \text{kg C/farmer} &= 24 573 \text{ kg C/farmer/yr} \approx 90 026 \text{ kg CO}_2/\text{famer/yr} = \mathbf{90 \text{ MT CO}_2/\text{famer/yr}} \end{aligned}$$

The targets was thus set at $190 * 90 = \mathbf{17 100 \text{ MT/year}}$

184. However, in the inception report, the target is set at 190 **tobacco fans**. One tobacco fan is only enough to drive one barn (*not one farm*). If we assume that each barn cures 6 batches of 300 kg each, then the total per barn/fan is only 1 800 kg.¹⁴

¹³ The evaluation team is not expert in tobacco curing technology and has not had time to research options. More detailed research work would be required before considering implementation of any of these ideas.

185. If the target of 190 fans is maintained, then the target CO₂ reduction for the entire project is only

$$\begin{aligned} \text{kg CO}_2/\text{fan} &= 2 \text{ kg wood/kg tobacco} * 1.7 \text{ kg CO}_2/\text{kg wood} * 1800 \text{ kg tobacco/fan/year} \\ \text{kg CO}_2/\text{fan} &= \mathbf{6.12 \text{ MT CO}_2/\text{fan/yr}} \end{aligned}$$

The project target would thus be $190 * 6.12 = \mathbf{1160 \text{ MT/year}}$

186. The above is of course predicated on the assumption that wood is NOT sustainably harvested¹⁵.

187. In the case of coal combustion, the CO₂ saving resulting from an 11% improvement in efficiency is more clear. However,

- o if farmers shift from using wood to coal, there is an overall increase in CO₂ emissions, even if the fans allow a greater efficiency.
- o In discussions it seemed that use of coal was only possible if forced convection was used.

3.6.1.5 Other initiatives

188. The BARREM project is also involved in the piloting of a Solar Demonstration Village Model. The first experience with solar demonstration village in Malawi was way back in 1997/98 when UNESCO funded the Makanjira Solar Demonstration Village where some government institutions such health centre, CDSS, community hall and police post in order to demonstrate the efficacy and promote solar pV technology, while delivering tangible benefits to the community.

189. During the field visit, the team visited Eswazini solar demonstration village. The project supported the electrification of CDSS, primary school, agricultural EPA office, ADMARC office/hall and health centre (not visited). Note also the UNDP SSEEPP projects that BARREM have provided with some technical support (section 3.6.2).

190. The benefits to the communities observed/discussed during the visit were:

- Students were able to study in the night
- Communities charging their cell phones at ADMARC/ Agric. EPA office
- The ADMARC official indicated that he sometimes needed to work late at the ADMARC centre- but this appeared to be very seldom.

191. Challenges observed

- Maintenance not up to date. Faults reported to district offices, but feedback on the requested spares not there;
- Follow up by installers and BARREM not all that frequent/effective

192. In the ORESSI, the government is also planning to work with telecommunication companies to use RETs in their rural telecommunication facilities based on radiotelephony technology. This would be an interesting activity to be followed since it would increase the number of potential users of PV technologies for the benefit of the rural poor who have no access to modern telecommunication facilities. It may also be an avenue to promote commercial use of solar PV since it is possible to encourage private entrepreneurs to invest and operate such facilities. PV is well utilised in telecommunications infrastructure internationally.

¹⁴ Note: This estimate of the quantity of tobacco cured per **barn** per year has not been confirmed. ARET staff should please be asked to verify the estimate, and the calculations can then be adjusted accordingly.

¹⁵ If all wood used for tobacco curing is sustainably harvested, then changes in consumption efficiency will have no net effect on CO₂ emissions.

3.6.1.6 Maintenance

193. A key part of delivery strategies is to ensure that proper maintenance plans are in place. The primary strategies used by the project have been:

- a) to require certified companies to maintain systems for one year after installation
- b) to encourage clients to sign up maintenance contracts with suppliers or set up alternative arrangements (note- this practice was not identified strongly within BARREM – but we did note that some of the key institutional clients were working on this, and one or two of the solar suppliers).

194. It should be noted that option (a) above, while attractive in principle, does place a heavy burden on small/cash strapped suppliers, as it will be difficult for them to put aside the proportion of fees for maintenance that are paid on delivery of solar equipment, to ensure that they can do maintenance in a year's time. It would be better for clients to retain a portion of the fees payable, and only pay these over to the suppliers once the maintenance has been done. This would force both clients and suppliers to cost maintenance as a stand alone item (rather than trying to merge it with capital costs). This should help both parties to identify inefficiencies in the system and find more cost effective ways of doing maintenance.

195. We suggest that BARREM should pay more attention to identifying maintenance modalities, and encouraging establishment of *long-term* maintenance arrangements. This will require careful lobby work with relevant ministries, and detailed analytical work to

- o Demonstrate the economic benefits of proper solar system maintenance
- o Develop practical business models (with companies) for sustainable maintenance delivery
- o Develop methods to report maintenance problems
 - (e.g. consider requiring installers to leave pre-printed post cards at all installations, which can then be used to record a problem and post it to the relevant party that can assist with maintenance (preferably using a 'free-post' address))

196. Note that the Physical Assets Management Unit of CHAM have developed a comprehensive planned preventative maintenance (PPM) services document for the DANIDA and JICA funded health centres (Christian Health Association of Malawi (2005)). This provides a useful framework that could be used as an input to other maintenance strategies.

197. Several of the more common maintenance issues can be dealt with by beneficiaries directly (e.g. topping up battery with distilled water, replacing light bulbs). This relates in part to user training, and empowerment, but it is also important to ensure that small quantities of basic spares such as DC light bulbs are left on site.

3.6.1.7 Database of installations

198. Review of progress to date on the BARREM demonstration activities was made difficult by the lack of clearly presented data on the installations carried out or supported by the project. The summary sheets "Barrem Project Beneficiaries", headed Annex 3 and provided to the evaluation team does not provide sufficient information¹⁶. It is strongly recommended that the BARREM project (perhaps in partnership with REIAMA) develop and update a database of installations that clearly provides information on:

- o User and owner information (including contact details – preferably including cell numbers so that SMS can be used to keep up to date)

¹⁶ E.g. note 2 on page 5 which is not informative: "Systems include solar for either lighting or vaccine refrigeration or water pumping or radio communication or different combinations of any of the above"

- o Location – preferably with GPS co-ordinates
- o Supplier information
- o System technical details (Wp, battery size, loads)
- o Unique identifiers for the system (to avoid double counting) – suggest use module serial numbers and make
- o Installation dates
- o Funding mechanisms used (UNDP/GoM/DANIDA/JICA/DFID/UNICEF) – preferably with the actual or proportionate contribution by each party clearly stipulated
- o System status information (when last visited, status on visit)

199. The project should maintain (drawn from the above database) summary data by year on the number of key categories of Solar installations, preferably with some sort of size indication. A possible suggestion of categories is listed below.

No. Solar Lanterns

No. SHS between 10 Wp and 25 Wp

Amorphous

No. SHS between 10 Wp and 25 Wp

Crystalline

No. SHS between 25 Wp and 40 Wp

No. SHS between 40 Wp and 60 Wp

No. SHS between 60 Wp and 80 WP

No. SHS > 80 Wp

Total No SHS installed

No. School systems (DC)

No. School Systems (AC)

Total no school systems installed

No. Health Centre lighting installations

No. Health Centre Vaccine refrigeration

No. Health Centre radio communications

Total no. health sector systems installed

No. water pumping installations

No. telecommunications installations

No. other public sector installations

No. other private sector installations

Total Wp installed

200. Databases such this need to be maintained on a regular basis. It is far more difficult to get data in a short period of time (as expected from the CSR Survey conducted in 2005).

3.6.2 Output 4.2: Technical specifications for different PV applications developed

201. As noted in section 3.4.2 general standards and specifications for PV systems have been developed for Malawi. These, if properly implemented can have an important impact on Malawi system designs as well as quality of components installed, and general

installation practice. However, for specific applications (such as those discussed in section 3.6.1) system sizing is necessary, and in order for proper tender adjudication to take place, tender documents which list technical and information requirements for tender submissions are required. Significant resources (60,500 \$) were set aside for the development of specifications and tender processes in the inception report.

202. BARREM have been involved in the development of several sets of tender documentation. The following were briefly reviewed. *Note:* it is not always clear what the extent of BARREM involvement in each of the tenders has been. BARREM participated in evaluation of all three listed below, and it is understood that development of the tender documentation was a collaborative effort between BARREM and the DoE.

- 10 Community Day Secondary Schools (CDSS) – bid launched 20th December 2004
- Installation and Commissioning of the Solar V Systems for Renewable Energy Demonstration Centre (REDC)
- Several Sustainable Socio-Economic Empowerment Programme initiative tenders:
 - Chisala Health Centre
 - Folopense Solar Village
 - Kazyozyo Solar Village
 - Usisya Solar Village

203. We have the following general comments related to Usisya, Folopensi and Kazyozyo Solar Villages:

- The documents all refer to the MBS documents developed. This greatly simplifies the tender documents and illustrates the value of having basic standards and Code of practice documents in place.
- In most cases the issued tender documents specify the bill of materials required in some detail. This greatly simplifies the suppliers role, as supplier is thus not responsible for design/sizing decisions. This approach is preferred for repetitive installations, and facilitates both bidding and evaluation processes. It does of course assume that the engineers developing the tender have assessed loads properly, and done the system sizing appropriately¹⁷.
- However the document does not request information on the brand and model of equipment to be supplied. We recommend that more detailed information on the specific products offered should be obtained, this making it easier for the evaluation team to verify that products offered do indeed comply with the MBS standards. Proof of appropriate certification can be requested for key components (e.g. Modules). This will also allow the evaluation team to make some quality based assessments of specific products offered. This will avoid subsequent negotiations regarding changes in components during the contract signing process.

204. Regarding the tender documents for CDSS

- The schedules did not make provision for sundries, installation, travelling and maintenance.
- No information on specific products to be supplied was requested.
- Although the bill of quantities effectively specified system design, it was noted that some suppliers undertook and presented a basic system design/sizing calculation. It is recommended that tenders documents/specifications explicitly request that system sizing be checked by suppliers, as this maintains supplier

¹⁷ We trust the specification of a small 200 Ah battery for the 900 W PV plus 5550 Wh Hybrid system at Usisya was a typographical error which has been corrected!

responsibility for this critical area. This of course implies that detailed load information must be provided in the tender documents (either from a total energy required perspective, or broken down by load type/average daily hours of use).

205. Regarding the tender documents for the Renewable Energy Demonstration Centre
- Some of the systems required are very large, and in our opinion require a more detailed and professional tender approach. The basic MBS documents do not in our opinion provide sufficient information for suppliers to select and offer batteries, inverters and controllers of the capacity required.
 - The documents do not require suppliers to provide information on the specific products they are offering.
 - In their evaluation report the evaluation team acknowledge that 'the original tender documents were not explicit'. They recommended that future documents should be more "explicit and unambiguous". They also noted that technical meetings will be/were required with respective successful bidders to make adjustments. In discussion with BARREM staff it has become clear that discussions are still ongoing regarding the exact products to be installed on some of the systems. This will obviously have an impact on price and scheduling.
 - In our opinion the combination of a large AC system and three DC lighting systems specified for the Renewable Energy Demonstration Centre is not an example of good renewable energy system design and will result in an expensive installation that does not add all that much to practical experience in Malawi. The AC system seems to have been designed to meet standard office loads without taking due cognisance of
 - Potential significant savings that could result from the use of energy efficient computers, lighting and related office equipment
 - The potential to grid-interconnect the system
 - The potential for learning/demonstration through addition of innovative energy transfer displays and data logging equipment.
 - System integration efficiencies that could be achieved through using the AC system for energy efficient lighting (instead of having a further three separate DC lighting systems for the office block, Shelter and workshop)
 - Although the use of several distinct DC and AC systems has some advantages (including opportunities for training), a key disadvantage is that any surplus energy available in one system cannot be easily transferred to another. Integration of the different load/systems would allow for more efficient overall use of resources. If separate systems are required for training purposes, then we suggest installing one or two small 3 to 4 light 'SHS' systems as these are more typical of rural applications.
 - Note the evaluation team were not able to review the energy needs for the renewable energy demonstration centre in significant detail. Furthermore, we have not carried out a proper review of the design. The comments above should be treated as 'first impressions'. If the process is not too far advanced to be reviewed, we would however recommend that a system design review be undertaken.
 - If there is scope to re-design the package for the Renewable Energy Demonstration Centre then we would recommend that an installation more in line with a large school/IT centre or health facility be developed (for example similar to those installed in Madagascar or at South African health Centres). This would enable implementation staff to gain experience of larger systems (1 to 2 kW inverters, tubular batteries of between 500 and 900 Ah capacity), but still maintain the system within reasonable cost parameters. If system redesign is contemplated, then it should of course include a careful load and needs analysis.
206. None of the tender documents specifically required information on:

- Back up service, certification, linkage to suppliers, record of installations, time required to install systems. However, in some of the evaluation documents it was noted that these were criteria. It is strongly recommended that tender documentation be amended to at least mention these criteria, and where possible to include some data gathering to help evaluators to adjudicate these important issues in a transparent manner. This is particularly important for maintenance/back up services, as these are critical to the success of PV installations.
207. There is significant international and regional experience available regarding PV system tender documentation and process. This is an area where Malawi could benefit through obtaining such documents and incorporating elements into standard documents.
208. The BARREM project should ensure that standard tender documentation developed is in such a form that it can be easily adapted to new projects. It should also be made readily available to implementing agencies in Malawi, as this is often a barrier, especially for small projects. However, when made available, this needs to carry a warning that it is still very necessary to have professional review of the applicability of specific documents to particular projects, and to have professional oversight of the tender/project management process. It is very dangerous to encourage a 'cookie cutter' approach to the management of PV system procurement.
209. It was obvious from the discussions we had with the BARREM staff that the criteria set by the tender committee were not always observed. The tender committee could award the tender to a certified company merely to give the less experienced new entrants an opportunity noting the BARREM is not bound to accept any tender.
210. While such an approach may have good intentions, it is prone to abuse. An individual may easily influence others to select a company for other reasons on pretext of promoting newer companies. At the same time, the more experienced installers may feel disappointed if they are left out for reasons other than technical and financial competitiveness. Tenders ought to follow strict criteria, be transparent and accountable

3.6.3 Output 4.3: Solar fridges demonstrated

This output already discussed in section 3.6.1.3. Its place holder maintained here for ease of cross referencing to 2005 APR and performance matrixes.

3.7 Immediate Objective 5: Increase public awareness of the efficacy of PV technologies and services

3.7.1 Output 5.1: RET information secretariat established and functioning

211. The Inception report (section 5.5.1) proposed (and budgeted for) the establishment of an information secretariat for renewable energy. This was to have the following expected results
- International journals and newsletters available in the Secretariat
 - Computerised data management on RETs
 - Secretariat connected to the internet
 - Trained manpower to manage information system
 - Newsletters produced and circulated
212. It was proposed to house the secretariat within the DoE, but with satellites at REIAMA and TCRET. The inception report also specifically mentioned that "Support will also be given to establish a Renewable Energy Information Network linking GoM, NGOs and

private sector dealing in renewable energy both at regional and international levels with a purpose of exchanging experience.”

213. This secretariat has not yet been established, although there is a measure of co-ordination of energy information taking place through the DoE, BARREM project office, REIAMA, TCRET, MBS etc. BARREM staff indicated that plans are under-way to have it housed within the offices of Department of Energy. They propose to contract a company design and install the web page and other requirements of the secretariat (computer installations, net working, etc). The secretariat should be established by February, 2006.
214. Provided that DoE and BARREM staff prioritize the establishment of this secretariat, we consider that it can still be achieved prior to project completion. However the opportunity for this activity to contribute significantly over the past two years has been lost. Further delays will mean that it runs for a relatively limited period with full GEF funded project support- and we thus recommend that activities be started as soon as possible. We also note that this activity could contribute to the establishment of an association or society that has a broader membership base than REIAMA (see section 3.3.5 and 3.12.2). Given the fact that this activity will be hosted within DoE, and once operational requires relatively little resources, it has good prospects for sustainability. Any activities conducted should be carried out using a 'lean' approach, with an emphasis on ready available access to existing information. We advise that any web site established should be structured in such a way that it is easy to maintain – and preferably so that the online community in Malawi and even international participants can easily contribute directly to content/*supply* documents for uploading.

3.7.2 Output 5.2: Publicity and Promotional Campaigns conducted

215. BARREM have conducted a range of sensitization and promotional activities. These have for the most part been well documented. In summary:
- Radio adverts (jingles –broad cast several times per day on two radio stations)
 - Radio discussion programmes (interviews or panel discussions) (once per week)
 - Tobacco farmers sensitization (meetings in rural areas)
 - Other target group sensitization meetings and road shows (e.g. District Assemblies/educators regarding CDSS electrification, microfinance institutions and customers)
 - Attendance at trade fairs (usually with industry participation)
 - Production of brochures (not yet actively distributed on large scale)
 - Press releases
 - Video partly prepared (pending comments from DoE and finalization)
 - TV not yet utilized as a medium, (although the team are keen to pursue this and have subcontracted a media company to prepare materials).
216. Several parties indicated that the BARREM sensitization and promotion activities have been an important contribution to development of the market. The awareness activities certainly seem to have improved general awareness in the country of solar technology. Furthermore, the implementation activities supported by BARREM have lead to a far greater number of people and institutions having a direct/personal experience of the capability of solar technology.
217. However, it also must be acknowledged that the awareness activities have has not lead to a huge flood of enquiries. For example, the radio Jingles refer to the BARREM telephone number- and a detailed list of callers is maintained by BARREM (Summarized in Table 4 below). Of course some people call either DoE or REIAMA. Also, we trust that some call companies direct. However, given that the number listed on the Jingles is BARREM, the number of calls received is somewhat disappointing.
218. Public awareness through the radio jingles and panel discussions was judged by most parties interviewed to have been a success. It seems that many people have heard about solar PV on the radio. However, detailed internalization of RET knowledge cannot take place at this level. Various parties felt that more interactive or detailed (community level) sensitization would be necessary. This needs to be integrated with delivery modalities, so that potential consumers can engage directly with the product information/purchase decision.

Table 4 Number of enquiries received by BARREM

| Trimester | 3/3 2003 | 1/3 2004 | 2/3 2004 | 3/3 2004 | 1/3 2005 | 2/3 2005 |
|--------------------------------|----------|----------|----------|----------|----------|----------|
| Average number calls per month | 25 | 9 | 26 | 18 | 7 | 13 |

219. In discussions with CHAM, DFID and UNICEF, and the MoH it was clear that these parties are reasonably well informed about the capabilities of solar technology, and either already do, or are considering incorporation of solar PV into their ongoing programmes. This is encouraging.

220. The evaluation team were not able to directly assess the extent to which local level political decision makers and District Assembly personnel have taken on board solar technology as a result of BARREM. However, the decision by 23 schools (with a variety of different financial support mechanisms) to finance 50% of the CDSS roll out is a positive indication.

221. Given the move towards the Sector Wide Approach (SWAP) to development, it is probable that local level decision makers will become a more important component of renewable energy technology delivery planning. It is thus important for BARREM and the industry to continue to find ways to interact with these decision makers, and keep them informed about solar options. A key challenge will be to find ways of doing this at reasonable cost. Printed brochures/articles on actual implementation experience/results/modalities might be a cost effective information delivery tool.

222. BARREM has conducted extensive 'general' sensitisation and promotional activities. It is our opinion that further significant expenditure in this area is unlikely to yield significant further expansion in the market unless:

- It is closely tied to specific delivery models, with delivery channels that are active in the target communities (e.g. sensitisation of members of a micro-finance institution that has an established solar loan product)
- Is taken to the level where it presents sufficient information to allow consumers/planners to make concrete decisions on whether to invest or not.
- We therefore recommend that BARREM carefully evaluate the cost/benefit of the different dissemination activities currently being employed
- Use should be made of less frequent, but more in depth information dissemination modalities.
 - In this regard the video on SHS activities needs to be finalised
 - The project should try to motivate editorial teams to cover renewable energy technology as part of their news/actuality content, rather than always requiring BARREM to fund dissemination
 - Brochures should be finalised and disseminated – these should be sufficiently targeted to be readily applicable to implementation decisions.
- Local level sensitisation activities be focussed around specific delivery interventions (as in the past when sensitisation was conducted before the CDSS role out).
- We also recommend that BARREM pay more attention to opportunities for promotional activities at an institutional/donor level (seeking to get renewable energy technology firmly entrenched within delivery objectives of health, education, social service and business development practitioners).

3.7.3 Output 5.3: Investors Guide prepared (for Energy Supply Company Model)

Development Objective(s): The long-term objective of this activity is to develop a framework that will demonstrate how the provision of renewable energy services in rural areas can be organized in an institutionally, financially and technically sustainable manner.

Immediate Objective(s): The immediate objectives are: (i) to develop and test a framework for providing rural communities with solar PV electricity services using the concept of Energy Supply Companies (ESCOs); (ii) to design a general model specifying the necessary financial, institutional and managerial criteria needed for an ESCO operating in rural communities in Malawi, using solar PV systems as a source of electricity supply; (iii) to establish guidelines to be used in application of this model in specific potential locations, including financing, credit, and technical support; and (iv) to prepare and publish a guide for investors in solar PV-based ESCOs.

223. The 2005 APR indicates a target of enticing three companies to set up ESCO's (APR 2005 target). The Inception report provided far more detailed targets including development of a guide document, identification of possible project areas and establishment of 10 ESCO's.

224. The government is also planning to work on the ESCOs model, using a fee-for-service approach. This is also highlighted in the NEP. The government sees it as an attractive model since it eliminates the need for upfront capital to purchase SHS. Instead household will be paying for the service.

225. Under the BARREM, a study tour to visit ESCOs in Zambian border town of Chipata was conducted. The government is also planning to source funds for the establishment of ESCOs.

226. The BARREM team is not making significant progress with the development of the ESCO model. It is disappointing that extensive work has not yet been carried out regarding the development of possible models, and carrying out the necessary design and analysis work implement the recommendations of the inception report – amongst others including:

- “A general model specifying financial, institutional and managerial criteria needed for solar PV-based ESCO operating in rural communities will be designed in order to prove its viability”.

227. Failure to carry out this work would have been more understandable if the other household delivery mechanisms being explored in this project had been more successful (CGF, use of micro-finance). It seems that the PMU have not had time or the necessary capacity to adequately address household solar service issues.

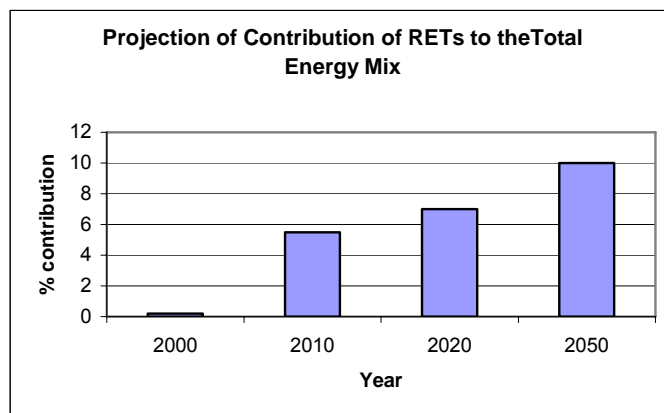
228. It is recommended that the project utilize the remaining 14 month project period to actively explore the applicability of the ESCO model for Malawi. It is very unlikely that an ESCO could be established during the remaining term. However, it should be possible to

- Undertake a proper review of the applicability of the ESCO model. The model can be implemented in many different ways, and it will be critical to tailor ESCO type delivery to the Malawian situation,
- Gather data on willingness to pay and affordability issues related to energy utilisation and to electrification in particular (socio-economic surveys). Any investment business plan will need to have data on the ability of consumers to pay for the services. Indications at present are that affordability in Malawi is very low in the current economic climate.
- Spend time with stake holders setting up the necessary institutional framework so that ESCO's could be implemented in the near future (it can take several years to get the institutional framework in place for ESCO roll out)

- Identifying clearly what the potential for government or other support for an ESCO model is (rural electrification, whether grid or off-grid will almost certainly have to be subsidised if there is to be significant household roll-out).
 - Work with other emerging strategies in Malawi to develop a robust framework.
229. There is significant South African experience of ESCO models. Furthermore we are aware that Uganda is looking seriously at the model as well. There should thus be good potential for collaboration. We recommend that the project make use of regional or international consultants to participate in, and guide this work.
230. If the ESCO model is to be pursued further, we would strongly recommend that it be looked at in an integrated fashion, not only looking at the range of different PV energy service needs in rural communities, but also considering thermal energy service needs. There is also some interest in the concept of integrating grid and off-grid service provision to rural areas.¹⁸

3.8 Project relevance

231. The BARREM project overall objective of reducing greenhouse gas emissions is in line with the global commitment under United Nations Framework Convention on Climate Change (UNFCCC). Malawi signed the UNFCCC in April 1994.
- As discussed in section 3.1 the contribution to CO₂ emission reduction from PV under the project is likely to remain relatively small. However, given the development impact of PV system application in health, education, water supply and at a household level, we feel that the investment/return ratio is satisfactory.
 - An important area of planned savings in is the use of PV to improve the efficiency of flue cured tobacco processing. There remains significant uncertainty regarding the financial viability of this.
 - In the area of SWH larger savings are being achieved, and more are probable if the market continues to grow (with more than 1600 SWH already installed in Malawi, although not installed through the project).
 - If the market for PV and SWH does continue to grow, cumulative savings will become more significant over time.
232. At local level, both the National Energy Policy (NEP) and Environmental Policy advocate for sustainable energy. The government has clearly spelt out its intentions to promote the use of RETs. An example is the projection presented in Figure 1, drawn from the National Energy Policy.



¹⁸ See UNDP/GEF 2004, pg 61

Figure 1 Source: Data extracted from National Energy Policy, DoE (2003)

233. The project also meets the wider developmental objectives. Although energy does not feature as a basic human need, nor does it feature prominently in global and national development agenda (Millennium Development Goals: MDGs, Malawi Poverty Reduction Strategy Programme: MPRSP, Vision 2020, Malawi Economic Growth Strategy : MECS)¹⁹, it has been recognised that energy is a critical element in achieving most of the developmental goals. Only between 4% and 6% of Malawians have access to electricity grid, and Grid extension to dispersed rural communities is very expensive. PV is a lower cost alternative and can be deployed in a far more dispersed area. Even though PV electrification meets a more limited range of needs than grid electricity, the provision of solar PV to a community will improve the quality of lives of the rural poor through the improvement of quality of education, health, water supply, agriculture and environment. Other renewable energy technologies such as biogas and solar water heating (partially supported by BARREM) also have significant development impact. The improvement in the access of sustainable energy sources is critical in the achievement of the MDGs as described in the World Summit on Sustainable Development (WSSD) Water, Energy, Health, Agriculture and Biodiversity (WEHAB) Model.
234. The focus of the project on PV technology has been questioned. From a development perspective, the institutional systems present a high return, as they directly impact on key sectors as listed below:
- Health sector
 - Health- maternal and infant mortality
 - Lighting in maternity and other wards
 - Refrigeration for storage of medicines, vaccination programmes
 - Radio communication for reporting emergency cases
 - Staff retention (staff housing electrification)
 - Education- literacy level
 - Extended hours of studying (students) & preparation (teachers)- 15 CDSS have benefited from 50% funding
 - Staff retention (staff housing electrification)
 - Water supply- access to safe drinking water
 - Solar water pumps
235. At a household level, it should be noted that a more basic energy need is for cooking fuels (particularly given deforestation concerns in some areas, and risks due to high levels of indoor air pollution from wood and charcoal combustion). However, solar electrification does have more indirect long-term potential (improved conditions for study at home, access to news and information through electronic media, cell phone charging, longer working or leisure hours at night). There is also potential for PV to contribute to more productive uses of energy (business centres, telecommunications power supply, internet and computer access, other productive uses).
236. Significant preparatory work was done on biogas during the Danida project (although slower than anticipated). The opportunity to build on this work has now been lost.
237. There seems to have been a tension in the project, with at times a pull towards a broader RET focus (indicators at inception report phase specifically targeted wind, biogas and solar thermal), while other parts of the project documents focus almost exclusively on PV. If a broader range of technology interventions had been maintained, relevance would have been higher, and CO₂ mitigation may also have been higher. However, this carries significant risk related to loss of focus/dissipation of effort, and would have meant that less depth in a particular area could have been achieved. Given the already broad nature of the project objectives, the evaluation team considers that the focus of the project management unit on PV technology was reasonable.

¹⁹ MDGs looks at reduction by half of most of the indicators of poverty. PRS

3.9 Efficiency

3.9.1 Use of Financial resources

238. Table 5 and Table 6 show the annual GEF resource allocation so far, and the total resource allocations respectively. It will be noted that project budget spend started off quite slowly. This reflects the relatively slow start to the project, as well as the delays in procurement of certain items. Resource allocation has speeded up significantly. However, in our opinion there will be sufficient funds left over to have a no cost extension until February 2007.

Table 5 Budget allocation by year (GEF) (in US\$ '000)

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005/date | Balance | Total |
|--|------|-------|-------|-------|-----------|---------|---------------------|
| Actual UNDP GEF disbursements (USD millions) | 52.3 | 233.9 | 584.3 | 605.3 | 748.3 | 1.089 | 3 353 (+0.065 PDFB) |
| % of Budget Utilized | 2% | 7% | 17% | 18% | 22% | 34% | |

Table 6 Planned and actual allocations – all sources except beneficiaries (in US\$ '000)

| Source | | GRANT | Equity | In-kind | Comment |
|----------------------------------|---|-------|--------|---------|---|
| GEF | P | 3 353 | | | In |
| | A | 3 353 | | | Not yet all allocated |
| UNDP (TRAC) | P | 1 199 | | | Was intended to contribute directly to BARREM activities |
| | A | 1 040 | | | See below for details of how this has been allocated. The figure could still increase. |
| GoM | P | 1 855 | | | Was intended for PV demonstration projects |
| | A | | 200 | 1 655 | Equity has contributed to demonstration. In kind has primarily been for DoE staff time and use of BARREM premises |
| Bilateral Donors (DANIDA) | P | 2 250 | | | Was intended to support a range of BARREM activities |
| | A | 2 250 | | | Was implemented before BARREM, but set up several initiatives that BARREM has built on |
| Private Sector (SOBO) | P | | 2 000 | | |
| | A | | 0 | | May increase to 350 |
| Total | P | 8 657 | 2 000 | 0 | |
| | A | 6 643 | 200 | 1 655 | |
| | | | | | 10 657 |
| | | | | | 8 498 |

239. Note: the contribution of consumers and institutions to the above budget is not indicated as this is not known.

240. Note that the actual UNDP (TRAC) contributions to date are as listed below. Although some of these activities have been done partially in collaboration with BARREM (SSEEP) the extent of direct linkages is not as close as originally envisaged in the BARREM project design phase. As noted in the inception report (p5), the reduction in funding available from UNDP to directly support project activities has limited the ability of the project to install "the required number of visible, tangible and affirming demonstrations as envisaged in the original PRODOC". This has compromised the impact of the project – particularly as related to objective 4.

| Project | Amount (USD\$ '000) |
|---|---------------------|
| Renewable Energy Project | 353 |
| ENAREM (Environment and Natural Resources Management project) – solar village project | 150 |
| ENAREM : training and tree planting | 80 |
| Sustainable Social Economic Empowerment Programme (SSEEP) – ongoing | 430 |
| SSEEP – natural resource related | 17 |
| Other UNDP projects –estimate | 10 |
| Total | 1 040 |

241. The original project design had good potential for efficiency, as the GEF and UNDP resources were to be combined with private sector, government and other donor funds to comprise a 10 million USD project.

242. However, this reliance on co-financing, and the attendant complexity and dispersion of decision making authority has led to significant delays, and in some cases to resources not becoming available (e.g. from SOBO, UNDP and to some extent GoM). The various parties have not collaborated sufficiently to leverage the maximum benefit possible from such a multi stakeholder/multi party financed initiative.

243. Initially it was planned that the DANIDA project would run in parallel, and that the UNDP/GEF PMU would be co-funded by DANIDA. As a result of the delays in BARREM project initiation, the DANIDA project started before the BARREM project, and as a result of DANIDA country level decisions, the DANIDA project stopped rapidly, a few months before BARREM came on line. This had some negative impacts. It has however meant that it has been possible to sustain a level of activity in the sector for a longer period (positive). There was some staff continuity between the two projects, which was very positive. Furthermore project achieved several key milestones including:

- conducting of training courses for planning engineers
- certification procedures established and 9 companies certified
- loan scheme established, with three banks participating in the Credit Guarantee Fund Scheme
- six hundred potential SHS client identified
- 60 SHS installed with support of the programme

244. These provided a good foundation on which the BARREM project was able to build, and contributed significantly to BARREM success factors.

3.9.2 Project management and co-ordination

245. The PMU has the necessary project management, public relation and technical skills (as illustrated through reasonable implementation of demonstration projects, training support, awareness raising).

246. Interaction between the PMU (as the principle party responsible for outcomes of the project) and key sub-contractors/partners has not been sufficiently efficient. This is reflected partly in time delays, but also in an observation that subcontractors are left too much on their own - the PMU did not effectively develop a 'team' approach with subcontractors and stakeholders. Examples include:

- Long period of time required to jointly arrive a decision regarding roll-out of tobacco flue curing PV fan intervention.

- Long period of time required to establish clear strategy and implement replication with SOBO (or make a decision that it cannot work and move on)
- Failure to implement the recommendations of the BARREM commissioned report related to the Credit Guarantee Fund
- Delays in setting up micro-finance or other delivery models.
- Reported delays from some suppliers regarding the inspection process related to certification of installations.
- Delay in finalising key CSR report on SHS installations (and insufficient time spent by the PMU to work with subcontractor to ensure that results are of good standard)
- PSC meetings were not held with sufficient frequency
- In the opinion of the evaluation team there was insufficient regular interaction (emails, regular meetings) between the PMU and key sub-contractors (TCRET, MBS, REIAMA). This is partly because sub-contractor contracts were with the Ministry, and not the PMU – so these other parties did not necessarily see themselves as reporting through the PMU, and PMU did not feel sufficiently responsible for their outputs..

247. The evaluation team was able to spend time with all key project management unit staff. It seems that there is reasonable link between individuals and outputs, and that the PMU as a whole is carrying out tasks diligently. However – we observed that the PMU has run up against various barriers/hurdles from time to time, which they have not been able to unblock themselves quickly, or with sufficient innovation. The project has in some ways ended up being ‘stuck’ and could have benefited from a more active problem solving approach on the part of the PMU²⁰. Some examples of such delays include:

- Procurement of equipment for TCRET
- Action related to micro-finance establishment
- Decision facilitation/getting feedback from SOBO and ARET
- Adjustment of the specifications for the Renewable Energy Demonstration Centre and closure of negotiations related to procurement for this.

248. An apparently trivial issue is that the project management unit does not seem to have effective use of email- with only one shared address available to the entire PMU. Even during the evaluation process, it became apparent that email communication to the project manager was not particularly effective. Given his role, it seems to the evaluation team critical that efficient email communication be established between key project participants.

249. It is also the opinion of the evaluators that the PMU would have benefited through more engagement with regional or international role players in the field. At the inception phase a decision was made not to employ a Chief Technical Advisor (CTA). This released significant resources that could have been used for consultancy assistance. A financial consultant was employed for a short assignment, and technical assistance was obtained for standards development. However, more should have been done.²¹To this end we would recommend greater use of carefully selected short and even medium term consultants during the remaining part of the project. Some longer-term interaction (say one week a month) might complement more intense two to three week assignments.

²⁰ In many cases these delays were due in part to project partners or stakeholders, but it is the Project Managers and the PMU’s responsibility to manage processes and communication effectively to resolve blockages quickly

²¹ Note STAP technical review, Dr Mark Trexler: “Depending on who is managing the 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”

3.9.3 Financial Management

250. The financial management of the overall project has been carried out reasonably well. The financial audits have raised several issues for attention from time to time, some of which have been repeated for more than one audit period:

- Payment of PAYEE to government
- Small number of payments not adequately supported by third party documentation
- Continued under expenditure on almost all budget lines, this may account in part for the slower than anticipated delivery

251. The year ended December 2004 financial audit was conducted by a different audit company, and lists several important issues (the summarized findings cover 6 pages). Only selected ones are listed here:

- Budget is being significantly underutilized
 - Management responded for the period indicating that certain planned activities did not take place (procurement of equipment and books for test and training laboratories at TCRET, purchase of solar equipment for Renewable Energy Demonstration Centre, Consultancy services for solar PV baseline survey and the planned mid-term evaluation)
- There is a difference of US\$ 153 721 between the UNDP Combined Delivery Report and the financial reports prepared by BARREM
- Some transactions were wrongly posted to the miscellaneous budget line
- Project operating bank accounts not reconciled properly.
- Concerns expressed about substance allowances (higher than approved rates) and staff salary payments for Mzuzu University/TCRET (contract stipulates that Mzuzu University shall provide appropriate staff for the training of students)
- Supporting documents and training report for certain training funded at Mzuzu University were not available.
- Concerns regarding changes in contract prices for certain suppliers
- Personal files (staff) not up to date at BARREM PMU (although these are presumably at the formal employer- the Ministry of Mines, Natural Resource and Environment.

252. Several of the monthly and quarterly financial reports prepared by the project accountant were reviewed. These provide significant detail on particular transactions related to the project. However they could be made significantly more useful as a management tool if:

- A table giving the detailed description of each budget account code was provided with the report
- A summary of expenditure from 'inception' to date could be provided and compared with budget
- A sheet could be provided which has expenditure to date, and for the period under review cross tabulated in the same manner as in the project design budgets (see for example the activity specific budgets provided in the inception report). This would enable PMU to more easily monitor level of effort and expenditure on *specific output related* aspects of the project. The evaluation team was not able to clearly allocate resources to tasks in the time available. This significantly compromised our ability to judge the financial efficiency of the project.

3.10 Effectiveness

253. The project has been effective in achieving outputs in a number of key areas:
- Awareness (radio jingles, panel discussions, sensitization activities), demonstration of institutional models, training, standards, supporting policy development, capacity development at DoE, certification of industry role players, building the number of PV suppliers/installers.
254. The project has been less effective regarding:
- Establishment of sustainable household finance mechanisms
 - Establishment of sustainable REIAMA model
 - SOBO evaluation/decision making/roll out
 - ARET testing/evaluation /decision making/rollout
255. The implementation of activities is a function of a number of parameters that include the quality of work-plan (targets, budget), capacity, and the drive of the lead institutions. Work plans are approved on quarterly basis. This gives adequate time for the PMU to schedule monthly/ weekly activities in order to meet plans for the quarter.
256. It was observed that formal meeting between PMU, DoE and UNDP were few and far apart. More informal contact was reported to be much more frequent. The lack of formal meetings with minutes/verification of objectives and progress does seem to have compromised the project.
257. Most of the implementing agencies indicated a reduced level of contact during this phase compared to the DANIDA-FTP phase. This led to lost opportunities and lower enthusiasm.
258. Several public organizations were involved in the project. Judging from the range of stakeholders interviewed – all of who knew of BARREM, the project has had very significant public sector involvement. However, on an implementation level, communication between BARREM and the implementing agencies (MEET, NBM, MSB, TCRET, MBS, ARET, REIAMA) was more limited, and hence led to lost opportunities and enthusiasm. Perhaps there were simply too many stakeholders for the BARREM team to be able to effectively deal with all?
259. Although the close linkages of the project to the DoE have many positive benefits, particularly related to ongoing sustainability, the evaluation team does have the impression that the PMU and other stakeholders in the programme effectively regarded the DoE as the primary decision maker and project reference. A stronger, more independent PMU might have been able to make more progress – provided of course that it had been able to keep the DoE fully ‘on board’.
260. Several of the project activities above clearly illustrate the way in which the UNDP/GEF project has supported implementing agencies and national institutions. However, from a project management and implementation perspective the contribution of the UNDP office has not been all that clear. In particular we feel that UNDP could have played a larger role in:
- Identifying through regular meetings/received reports aspects of the project that were not achieving decisions/progress as fast as required and working more actively with the team to unblock these
 - Identifying earlier where additional expertise may have helped the process along, and using their linkages to similar regional activities to improve sharing
 - Note: UNDP have invited project management staff to attend at least two international workshops relevant to the objectives of BARREM (African PV workshop, and international workshop on productive use). However, neither BARREM PMU or the UNDP office have managed to leverage significant synergies from this.

261. At times it seems that the respective parties (GoM, PMU and UNDP) were not always sufficiently informed of each others administrative and process requirements (e.g. regarding requirements for recruitment of PMU staff, procurement processes and requirements for contracting of national consultants).
262. The significant delays in procurement processes (even in part related to this mid-term review) also have an impact on the project. It would be very helpful if UNDP could improve/speed up the administrative processes related to running projects of this nature. We should also note that procurement delays in multiparty procurement projects are almost inevitable. It is a key project manager (PMU) responsibility to ensure that there is regular follow up of administrative processes to ensure that procurement takes place as fast as possible.
263. The inception report included a very detailed table of performance monitoring indicators/targets (Appendix X). A subsequent meeting with the GEF co-ordinator resulted in identification of a slightly different project planning matrix and streamlined indicators. The APR's use a further slightly different set of indicators. The relationship between different indicators is sometimes confusing. In particular, the APR indicators do not provide the necessary distinction between outputs from the project, and ripple effect indicators (particularly as relates to installations completed). Although we agree that consolidated numbers (project funded plus ripple effect) are the primary indication of RET market growth in the country, the fact that project specific outputs have been blurred means that it is very difficult for the PMU and other stakeholders to assess their direct contributions, of for evaluators/UNDP to assess the project specific contribution. This may have contributed to a loss of focus on the part of the PMU/PSC. We have therefore reverted to the inception report indicators as our primary comparator for more detailed analysis (see Appendix B). The revised matrix as agreed with the GEF co-ordinator is used as a more narrative tool in part I of the same appendix. For analysis of the project going forward, a further *revised* LFA matrix is needed. We recommend that this should be drawn up following final agreement on priorities for the next year.. However, it must have sufficient detail to differentiate between achievements of this project, and those funded or supported through other related interventions.
264. Where activities were more fully under control of the PMU, and where indicators were easier to measure (such as training, certain public awareness activities), the LFA matrix assisted in monitoring achievements, and verifying that goals were being met. However where matters were less easily controlled by the PMU – and more difficult to measure (renewable energy system installations and price of renewable energy systems) it is not clear that the PMU/PSC were readily able to react to adverse data coming in, which showed that targets were not being reached.
- The project team were not able to readily provide clear, thought through information on certain key indicators such as system pricing and the number of solar installations. This is primarily because these numbers are difficult to obtain, as the information is in part proprietary. However, we feel that more effort should be made to gather and record the necessary data during the remainder of the project.

3.10.1 Solar Inventory Survey

265. The BARREM project commissioned the Centre for Social Research of the University of Malawi to conduct a baseline survey and assessment of the developmental impact for solar PV and solar thermal (Solar Water Heating) systems in Malawi. The scope of work was extremely ambitious, in that the team attempted to visit and interview users of all solar systems in Malawi. Few other countries have ever attempted to do a complete country wide inventory of solar systems. However the report has a wealth of information on the products distributed. Furthermore, the observations and recommendations made yield important lessons regarding the user perspectives, problems that they have encountered. Distribution of the report within Malawi, and reactions to the report have been somewhat clouded by concerns regarding key outputs (disagreement regarding the number of systems in Malawi, and concerns regarding the technical accuracy of some of

the data)²². However, we wish to encourage the community in Malawi to utilize the report in a positive light, as it contains a wealth of information.

3.11 Impact of the Project

266. Impact of the project has been discussed in some detail in sections 3.3 to 3.7 of this report. A project performance matrix is presented in appendix B.

267. The project has so far had mixed results in the delivery of impacts to intended beneficiaries.

- Key areas of success have been in the growth in active PV companies, certification of companies, capacity building (various levels), and in the policy environment.
- The impacts through health centres, water supply and education facilities electrified is satisfactory.
- The number of rural households directly reached through the project is lower than anticipated.
- The SOBO initiative and the tobacco curing initiative have not yet achieved desired results. There is some potential for both these initiatives in the next 14 months.

268. Overall, we feel that the project has contributed significantly to the development of the renewable energy technology market (and particularly the PV market) in Malawi. However, the environment has not yet evolved to a stage where a vibrant commercially driven PV market exists (and it should be noted that this has not really occurred in any country to date, without significant government subsidy).

269. Contributions to global environmental objectives are discussed in section 3.1

270. Unfortunately, inadequate data is available to clearly determine whether the ongoing training activities for engineers, planners and technicians has led to direct improvements in the quality of PV systems in Malawi. However our clear impression is that this is the case. This observation is supported through:

- Observations that the installation quality of most sites visited is reasonable
- The technical standards developed by the MBS are suitable
- Inspection reports indicated that quality assurance measures are in place.
- Various parties such as CHAM are putting in place clear maintenance strategies.
- Suppliers frequently mention the importance of maintenance, and in some cases are trying to construct business models that directly support this.

3.11.1 Impact of the project on the PV supply industry in Malawi

271. Section 3.3.5 discussed the establishment and support of REIAMA. It is however important to briefly review the impact of BARREM on the overall PV supply industry in Malawi. Key observations:

- a) BARREM does not seem to have focussed specific attention on company support (the DANIDA ISU seems to have had a higher company support focus)
- b) Number of companies active in PV has increased significantly
- c) Some of these companies are off-shoots of pre-existing groups
- d) Some of the companies are very small

272. PV system pricing was expected to reduce significantly through:

- a) Increased market size (larger volumes being imported)

²² The first draft of the report was not accepted for distribution. An updated version was released during the mid-term review mission.

- b) Reduction in surtaxes/import duty on PV technologies
- c) Higher volumes being delivered through retailers.

273. The reduction in import duties was achieved.

274. The nature of the importation/supply industry in Malawi has changed during BARREM, such that there are now at least one importer who holds some stock, and can then on sell to installers. Although this has introduced an extra link in the supply chain, there is potential for price reduction, as this supplier can order larger volumes. Other companies still do import from time to time- there is thus still a measure of supply competition. Availability of local supply has also made it far easier for smaller companies to manage cash flow, and to source products.

275. Some companies have been encouraged to set up agencies/outlets in outlying towns. This has also been a positive impact of activities of BARREM and the ISU. However, these outlets do seem to be struggling a bit, as the volume of local sales is very small.

276. The project does not yet seem to have achieved significant batching of installations. This is a critical element to reduce costs of marketing, product delivery to rural areas, installation technician time and to reduce the logistical, travel costs for installers.

277. At a more local level it should be noted that battery recycling is a common concern for PV system dissemination. Establishment of a battery recycling initiative was not formally listed as a project output. To date no formal battery recycling takes place in Malawi, and we have been informed that batteries are usually left on site following maintenance. The MBS standard for SHS requires that batteries be returned to suppliers for recycling

3.12 Sustainability

278. In this section we address sustainability questions related to the different key initiatives of the project, as well as to the overall objectives of the programme.

279. Key risks identified in the inception report were that:

- ...private entrepreneurs will seize the opportunity of a transformed market and take over the investment process for replication and sustainability of solar PV technologies.
- ... implementation of this project will improve the commercial attractiveness of the technologies. Assuming this does not happen, the sustainability of the Project activities will be greatly undermined

280. At the institutional level, the project (and related activities) have achieved significant demonstration of delivery models and of equipment performance. Other role players in the health and education sector (donor, government and at a district level) have participated reasonably actively, and are planning or considering further PV interventions. There is thus good potential for sustainability of institutional roll out (although there are still areas for improvement/problem areas, see section 3.6.2 and recommendations, section 6.2)

281. In the household market (which ultimately represents the biggest potential market in terms of numbers of systems), there has been less achievement of large scale sustainability. The CGF has not achieved sufficient delivery scale to justify its costs. Alternative finance schemes have not yet been established.

282. On the other hand a small scale cash market has continued to develop- and does seem to be slowly growing. The rate of renewable energy systems being delivered is higher than at project start – and some economies of scale (on the supply side) have been achieved. However, the delivery of solar systems to rural communities still remains relatively expensive. In order to get significantly larger scale delivery happening, delivery efficiency will have to be improved and affordability barriers still need to be addressed.

3.12.1 BARREM PMU Activities

283. The DoE has been involved in the entire project preparation to launch and continues to play advisory role in the project. It is evident that the DoE takes BARREM and its activities as the extension of DoE ongoing programmes. As regards capacity, the DoE has benefited a lot in terms of support for staff training on long-term courses. Five members of staff have attained master level qualification abroad and four are attending a BSc in RET at Mzuzu University (TCRET). These people would have the necessary technical and managerial skills to absorb most of the activities which are currently undertaken by BARREM. In particular it seems that DoE could continue to play a co-ordination role, while of course maintaining their important policy and strategic level functions.
284. DoE is regrettably unlikely to have sufficient resources to continue with large scale public awareness and sensitisation activities. Although it would be preferable to pass these on to REIAMA, the institution does not currently have the resources to do this. Experience from Uganda UPPPRE indicates that this is an area which has suffered following project closure, and the project needs to develop a sustainable strategy.
285. BARREM offices belong to DoE, hence there will be very little disruption in terms of shifting of facilities and assets. It is however difficult, at this stage, to make any comments on the DoE's ability to sustain the funding of BARREM activities from government subvention.
286. BARREM and DoE are currently playing a joint role regarding certification of companies, and inspection of installed systems. Although in the ideal world it would be preferable for the industry to self regulate (through REIAMA), it seems that this is unlikely to be effective given concerns regarding conflict of interest. MBS are also unlikely to have sufficient resources for an ongoing role in this regard. It therefore seems that DoE and or the Malawi Energy Regulatory Authority (MERA) will need to absorb these functions. BARREM and DoE will need to ensure that they are streamlined as much as possible (to reduce costs) and that DoE/MERA budgets necessary resources before project termination.

3.12.2 Renewable Energy Industries association of Malawi (REIAMA)

287. As discussed in section 3.3.5, the support to REIAMA has not yet achieved a sustainable, independent organisation. There only 35 paid up members. The current fee structure is too little to sustain REIAMA secretariat. Members do not feel they are getting value for money and are generally sceptical of its ability to sustain itself. It is encouraging to note that REIAMA are revising their strategy documents- but as yet this does not provide sufficient confidence. In Uganda, a similar association was also set up, and two years after the UPPPRE project closure, UREA strength and capability has also been observed to grow weaker. At the current status, REIAMA cannot sustain itself if support is withdrawn. See section 3.3.5 for more suggestions regarding a way forward.

3.12.3 Test and Training Centre for Renewable Energy Technologies (TCRET)

288. TCRET has a high chance to sustain its operations as a Centre within Mzuzu University. Apparently, two new staff recruited to support the BSc in RET programme have their salaries paid for by the University. The critical issue affecting the Centre is the major delay in procurement of equipment and books for the Centre. TCRET may not have reached its optimal operational level by the time all the equipment and books arrive, and the project closes. In particular extensive further work is required to ensure that TCRET (and MBS) staff have developed clear objectives for testing, developed test procedures and the necessary skills to utilise the test equipment with maximum effect.
289. The TCRET is already charging the BSc Renewable Energy Technology course and its short courses on commercial rates. This is very positive, although the ratio of staff to students is quite high, we thus anticipate that TCRET will need to secure additional resources to maintain the planned level of staff/activity. Alternatively, the staff ratio will have to be reduced (more students or less staff).

3.12.4 Malawi Bureau of Standards (MBS)

290. The development of standards for Solar PV was a special request which required external support to ensure timely development of standards and code of practice. Under normal circumstances, MBS is able to develop standards for the country using own budget provided there is demand for such a standard from the industry. With appropriate linkage among the various stakeholders in the industry led by the DoE, MBS should be able to continue updating the developed standards from time to time, and to finish the standards that have been started. Development of additional standards is unlikely to occur unless further support is provided or there is substantial growth in the market demand.

291. MBS may also be involved in testing and certification of RETs in liaison with TCRET, and have and indicated that they should be the standards certification authority.

3.12.5 Consumer Finance modalities for PV

292. Particular attention will need to be given to developing a sustainable finance model for SHS delivery to rural customers. The current CGF is not sustainable, as management costs are far too high in relation to the number of loans being given.

293. There are some indications that alternative finance models could become operational (using institutional own funds). These need to be explored further (see section 3.5).

4 Lessons Learned

294. The project design and funding mechanism was based on the assumption that several different parties would commit funding and other resources to a fairly complex co-funded arrangement. To date, several of these synergies have been achieved. However, there have also been differences in timing, and in some cases resources have not been released at the initial rate expected. This is an inherent risk of complex multi-stakeholder projects, and needs a patient and trusting project supporter. This could partly be alleviated through requiring more firm and binding commitments during the project initiation phase, and finding mechanisms to ensure that all parties share a similar vision and motivation.

295. Facilitating large scale take up of solar electrification in a developing country context (and in particular one that is facing severe economic hardship) is a very difficult challenge. Although the BARREM project has so far been able to address several of the perceived barriers, the products remain expensive for rural consumers and institutions to purchase. It seems that significant market penetration will take some time to evolve. Internationally, even with a far more sophisticated retail and delivery infrastructure, subsidies of one form or another are required for large scale take up (Germany, United Kingdom, California). A small scale (and growing) market is likely to be stimulated by projects such as BARREM, but if targets of several thousand systems of good quality are to be obtained, it seems that significant financial support will be required.

296. The rate of PV system procurement and delivery into Malawi has not been high enough to really allow prices to reduce to those of large scale high volume tenders. This remains a problem area, and in our opinion is unlikely to be resolved unless a sustained programme with regular delivery can be introduced.

297. Marketing alone does not necessarily lead to significant growth – PV products have been widely marketed in the project, but market growth will only occur if they meet a clear need at an affordable price. Furthermore, purchasing decisions need to be made a specific context, generalized marketing alone is not adequate

298. It was observed that even in a country such as Malawi, where there is a low level of grid electrification, there is still a moderate risk of grid electrification arriving at off-grid sites (the evaluation team observed grid poles at two of the sites visited, and at a third site the health centre had grid power and a solar wind hybrid system).

299. In summary, BARREM (and parallel activities) in Malawi have been able to address many of the barriers and have demonstrated several positive applications and results of renewable energy implementation. Market growth has been significant. However, the market has not yet developed to such a point that we can say with reasonable confidence that commercial drivers will see large scale household electrification or even substantial educational and other institutional delivery (apart from the health sector which seems to have good application potential). As with grid electrification, large scale PV electrification is likely to require significant financial support for some years to come.

5 Conclusions

300. In conclusion, we have the following overall ratings of the project to date. More specific performance ratings are given in annex B. Obviously are more detailed comments are presented in the main report and recommendations sections.

Ratings as per the GEF guidelines:²³

| Item | Rate |
|---|-------------------------|
| Sustainability | Satisfactory |
| Outcome/achievement of objectives (the extent to which the projects environmental and development objectives were achieved) | Marginally Satisfactory |
| Implementation Approach | Marginally Satisfactory |
| Stakeholder Participation/Public Involvement | Satisfactory |
| Monitoring & Evaluation | Marginally Satisfactory |

301. We regarding the remaining project period (to February 2007) as being necessary for the team to achieve the objectives of the project. It will be a challenge to do so, but with careful planning and active use of the range of resources available, it should be possible.

6 Recommendations

Following is list of the key recommendations. Further recommendations are provided in the context specific sections of the report and in section 3.12 (sustainability).

302. The evaluation team concurs with the PSC recommendation that the project be extended until February 2007.

303. The PMU should with immediate effect draw up a detailed work plan for the entire period (including budget).²⁴ The notes below are simply intended to give some indication of perceived priorities. Preparation of a more detailed work plan with timelines is a critical task and should be carried out urgently. If the project is to achieve the remaining key tasks in the time indicated the PMU will need to be highly focussed and effective. In preparing this detailed work plan, the PMU will need to allocate budgets and resources to continuation of project activities according to the overall project objectives, as well as to the more specific recommendations listed below.

6.1 Recommendations related to specific activities

304. Output 1.1: TCRET –

- ensure that laboratory equipment procurement is finalised as soon as possible

²³ Note: these ratings are specified in GEF: guidelines for Implementing Agencies to conduct Terminal Evaluations (dated 4 March 2005) – although they are being used here in a mid-term evaluation.

²⁴ Although the Project Manager was requested to provide a proposed budget to the evaluation team, he preferred to wait for the results of the evaluation to do this. Regrettably the evaluation team do not have enough resources allocated to the evaluation to allow us to develop a detailed/costed work plan.

- TCRET (and MBS) staff need to develop clear objectives for testing of renewable energy technologies, develop test procedures and the necessary skills to utilise the test equipment with maximum effect.
305. Output 1.2: Training activities
- No major changes recommended here. See section 3.3.1, 3.3.2 and 3.3.3 for areas of concern/comment
306. Output 1.5 REIAMA
- See section 3.3.5 and 3.12.2 for specific recommendations regarding options to strengthen REIAMA and improve potential for sustainability
307. Output 2.1 Preparation of policies and legal frameworks supported
- This has been an area of significant contribution already by BARREM. Project should spend a bit less in this area during final 12 months. Key areas still requiring support from a policy perspective are:
 - Regulatory environment – ground rules for MERA, an in particular certification of companies (see comments in section 3.4.3 on this)
 - Policy issues related to possible establishment of ESCO's (See section 3.7.3)
308. Output 2.2 Codes and Standards for PV developed
- The PV standards developed by the project are an important contribution. We recommend that MBS consider making a first revision of these about 6 months before project closure. In doing this they should specifically look at the latest Uganda and East African Community standards (available from Uganda Bureau of Standards), as there has been extensive UNDP/GEF funded work on standards in Uganda, and several of the applications issues are similar. Note: it should be possible to further harmonize standards in the region. A brief review of these standards should indicate that a low cost harmonization exercise can be conducted.
 - The ability of the BARREM project to support development of other standards (e.g. SWH, Biogas, micro-hydro) will depend on overall resource availability. However, given other BARREM priorities, it may be that MBS/the industry need to look elsewhere for support in these important areas.
 - Given current activity on SWH standards, we specifically encourage MBS to enter into dialogue with South African and Ugandan parties involved in the development of SWH standards and test procedures.
309. Output 2.3 Certification procedures for PV companies consolidated
- The key systems are in place for this under BARREM/DOE. BARREM should now focus on getting longer-term systems properly in place within MERA for continued management of this process. Please see notes in section 3.4.3 regarding the dangers of over regulation. We would recommend that the REIAMA be encouraged/facilitated to play a bigger role in discussions about probable future regulation of the industry.
310. Output 3.1 New and innovative financing mechanisms identified, tested and accessed and effectiveness of existing funds (CGF, HCRF) evaluated
- The recommendations of the March 2004 Finance report should be internalised and implemented. Further observations and suggestions that will help in decision making are highlighted in section 3.5 of this report. The CGF is not achieving significant scale effects, and urgent action is required if further concrete delivery is to be achieved before February 2007.

- The Health Centre Rehabilitation fund had specific maintenance objectives. Maintenance in general, and for institutions in particular needs concerted attention from BARREM during the final year. Please see sections 3.5.2 and 3.6.1.6
311. New fund opportunities to be identified
- See microfinance (below). The only other significant opportunity identified so far is to use existing loan instruments within the banking sector for renewable energy delivery. Further development should be encouraged in this regard. In particular the necessary information and documentation should be provided to Banks. This should not require significant project resources, but can leverage a sustainable funding opportunity (although it is likely to remain at a relatively low level).
312. Output 3.2: Microfinance Fund capitalised and used
- The remaining project period – to February 2007 is probably too short to establish and support a new national level lending mechanism through micro-finance organizations, as this will require ongoing support and monitoring.
 - If something is to be attempted it will either need to be relatively autonomous from the start, or DoE or some other institution will need to commit to monitoring and supporting the micro-finance operation that BARREM develops for at least a two to three year period (more than one loan cycle). The Uganda experience indicates that it is critical to build up good relationships, and to monitor the application of loan funds set aside for micro-finance.
 - However, it is important for Malawi to start gaining experience in this sector as soon as possible. We therefore recommend that:
 - BARREM find out through literature and direct linkages with implementers as much as possible about related regional *operational* experience in this field (particularly from the UNDP/GEF funded UPPPRE project).
 - BARREM should then work with selected micro-finance institutions to develop a complete set of operational procedures/methodology/supporting documents (effectively a business plan) to roll out a micro-finance SHS delivery programme. During this process interest rates and loan periods should be negotiated, on the assumption that the micro-finance institutions would be able to access a dedicated renewable energy technology revolving fund.
 - The business plan can then be used to inform a final decision as to whether a pilot batch of between 10 and 30 SHS could be implemented per institution. Provision should be made to finance these systems from BARREM resources (and possibly the CGF)
313. Output 4.1: Delivery models for households, institutions and SMEs developed and tested
- Significant progress has been made in trialling delivery models for institutions. BARREM should
 - Pay particular attention to maintenance provision for those systems already installed (see 3.6.1.6)
 - Engage with MoH, Ministry of Gender and other stakeholders (including Donors) to ensure that experiences are shared, lessons carried forward, and to ensure that renewable energy technologies are seriously considered for future interventions in the institutional sector.
 - Household delivery rate has been lower than hoped for- see recommendations on finance and ESCO models

- The SME sector (solar beverage coolers and tobacco flue fans) interventions have not yet resulted in significant replication. BARREM needs to ensure that the experiences gained so far are properly documented, and that key business case analysis is carried out. BARREM should engage actively with partner organisations to ensure that decisions on roll out are taken urgently. If partners do decide to roll out on a larger scale, then BARREM must provide active support to the implementation, as these would be key outputs of the project.
 - See section 3.6.1 for further detail on all the above.
314. Output 4.2: Technical specifications for different PV applications developed
- As discussed in section 3.6.2, the standard specifications documents developed by the project should
 - Be further developed to ensure that information required for evaluation on specific product, quality, business, ability to deliver, etc. be obtained
 - Examples of international tender documentation should be reviewed to identify missing elements/areas for improvement
 - Standard tender/specifications documents should be made more available in Malawi – subject to the cautions listed in paragraph 208.
 - If the process to install the Renewable Energy Demonstration Centre is not yet fully committed, we recommend that the system design be reviewed and possibly adjusted to reduce the expenditure but still achieve a solid demonstration/training impact.
315. Output 5.1: RET information secretariat established and functioning
- This area has not been well developed yet. Although time is short we recommend that
 - A database on renewable energy delivery in Malawi be established (section 3.6.1.7)
 - A website with document storage/retrieval functionality be set up (section 3.7.1)
 - Other information activities (to be prioritised) be undertaken (section 3.7.1)
316. Output 5.2: Publicity and Promotional Campaigns conducted
- BARREM has conducted extensive 'general' sensitisation and promotional activities. It is our opinion that further significant expenditure in this area is unlikely to yield significant further expansion in the market unless:
- It is closely tied to specific delivery models, with delivery channels that are active in the target communities (e.g. sensitisation of members of a micro-finance institution that has an established solar loan product)
 - Is taken to the level where it presents sufficient information to allow consumers/planners to make concrete decisions on whether to invest or not.
- We therefore recommend that BARREM carefully evaluate the cost/benefit of the different dissemination activities currently being employed
 - Use should be made of less frequent, but more in depth information dissemination modalities.
 - In this regard the video on SHS activities needs to be finalised
 - The project should try to motivate editorial teams to cover renewable energy technology as part of their news/actuality content, rather than always requiring BARREM to fund dissemination

- Brochures should be finalised and disseminated – these should be sufficiently targeted to be readily applicable to implementation decisions.
- Local level sensitisation activities be focussed around specific delivery interventions (as in the past when sensitisation was conducted before the CDSS role out).

We also recommend that BARREM pay more attention to opportunities for promotional activities at an institutional/donor level (seeking to get renewable energy technology firmly entrenched within delivery objectives of health, education, social service and business development practitioners). Related initiatives that could be worthwhile exploring linkages with are:

- DFID Safe Motherhood Project (with about 100 teacher houses to be equipped)
- DFID and MoE: teacher Development Centres
- UNICEF – planning a further 90 vaccination refrigeration systems
- MOH PAM – who are planning radio communication/lighting and refrigeration interventions
- MOH PAM – who would like District Engineers to be trained

317. Output 5.3: Investors Guide prepared (for Energy Supply Company Model)

This seems to be an area where BARREM have become a little 'stuck'. It is an important initiative, that if implemented properly could still catalyse significant further 'post BARREM' activity. Specific recommendations on taking this forward are made in section 3.7.3.

6.2 Other recommendations

318. Several recommendations regarding project management and have been made in section 3.9.2.

319. BARREM needs to start putting in place mechanisms for sustainability of BARREM operations during the next year. Recommendations for the key institutional parties (BARREM, REIAMA, TCRET and MBS are discussed in section 3.12.

320. Overall we feel that the project management unit and its key stakeholders are currently in a bit of a 'slump' regarding the BARREM project. As noted in this report, several areas have not progressed as far as may have been hoped, and there are blockages in the system. On the other hand several positive activities have been undertaken. We do however feel that an injection of new life is needed into the overall project. This may be partly provided through this evaluation process, and the closer/more regular interaction with stakeholders suggested. It can also be facilitated through contact with other projects/programmes (in particular the Uganda UPPPRE project, but possible also the Namibia NAMREP project). However, in addition we recommend that the project make more use of international or regional expertise to bring in 'fresh thinking' and help make clear progress. This could be on an intermittent basis, but should preferably be one person with a wide background in the relevant areas.

321. Some activities in the project have been well documented (e.g. training reports, reports on particular meeting). However, there is a need during the final 14 months of the project life to ensure that good documentation is done of activity areas – in a format that will be useful to future implementers of renewable energy activity in Malawi.

Appendix A Terms of reference



UNITED NATIONS DEVELOPMENT PROGRAMME

TERMS OF REFERENCE FOR THE MID TERM EVALUATION OF THE

BARRIER REMOVAL TO RENEWABLE ENERGY PROGRAMME

MWI/00013617 (MLW/99/G31)

August 2005

Terms of Reference

Final Evaluation: Renewable Energy Project: Project Number MLW
Mid-Term Evaluation: Barrier Removal to Renewable Energy in Malawi:
Project Number MLW99/G31/99

I. Context

Malawi has a largely rural and agricultural population with over 80 % of the inhabitants living in the rural areas. The majority of the population practice subsistence agriculture. This, coupled with an ever growing population which is dependant on fuel wood for its energy needs has resulted in large areas of land being cleared of vegetation and subsequently this has resulted in soil erosion and land degradation. The economy is agro- based. This has further exacerbated land degradation and water pollution through agro-chemical run off

II. Background

Electric power, a key ingredient to the industrial and commercial sectors in the Malawi economy, is supplied to only 4% of the population primarily in the urban centres through the grid. Lack of access to electricity for small commercial energy services hinders the ability of rural Malawians to advance in their economic development. It is a fact however that access to electricity can be increased in those rural areas away from the electricity grid through promotion of renewable energy technologies (RETs) such as low cost stand-alone solar photovoltaic (PV) systems.

Realizing this, the Department of Energy Affairs conducted a study to understand problems that inhibit the uptake of RETs in Malawi. A number of barriers were identified. Several barriers to the expansion of renewable energy technologies (RETs) included: (i) limited number of companies and lack of skilled personnel working in the sub-sector; (ii) poor quality RETs systems; (iii) lack of information on the technology to make knowledgeable decisions; (iv) absence of regulatory frameworks, particularly standards and code of practice for the design, installation and maintenance of RETs; and absence of dedicated financing mechanisms and incentives for the purchase of RETs.

This led to the formulation and signing of the umbrella NSREP in April 1999. The Program aims at enhancing the efficient and sustainable utilization and marketing of renewable energy resources in rural, peri-urban and urban Malawi. Specifically, NSREP was designed in order to:

- a) increase the access to energy sources by the majority of the population in order to raise the level of productivity;
- b) raise the living standards of the poor segment of the population;
- c) empower women as key players in the society by recognizing their special relationship to energy, particularly at the household level;
- d) promote and develop sustainable and renewable energy technologies, thereby enhancing socio-economic development; and
- e) enhancing institutional and household capacity to access and manage renewable energy in a sustainable way.

BARREM evolved out of NSREP to focus on the promotion of solar PV. It was signed in February 2001 and officially launched in March 2002. However, the first disbursement of the funds under BARREM was made in October 2001. In June 2002, the Project Management Unit was put in place.

BARREM Project has in place co-financing and parallel arrangement with the Government of Malawi (GoM), UNDP, and the Danish International Development Agency (DANIDA) and a private soft drink company Southern Bottlers (SOBO) Ltd. Due to the late start of BARREM, certain components of the Project were executed under DANIDA Fast Track Project (DANIDA-FTP) starting from March 2000 and prematurely came to an end in early 2002.

At global level, the objective of BARREM Project is to reduce atmospheric carbon dioxide emissions. At the national level, the Project aims at removing market barriers to increase solar PV energy service delivery. Specifically, the Project focuses on:

- assisting local stakeholders in building local capacity to promote, install and service solar PV systems;
- helping develop favorable regulatory frameworks for solar PV technologies;
- facilitating development of viable financing mechanisms for solar PV technologies; and
- helping demonstrate the viability of investments in solar PV technologies and promotion of widespread replication.

Following the above focus areas, the Project came up with five components namely:

- a) capacity building and institutional strengthening;
- b) creation of an enabling environment;
- c) development of financing mechanisms;
- d) promotion of renewable energy services; and
- e) creating public awareness.

III. Implementation Arrangements:

The Department has experimented with different implementation arrangements. For example, execution of NSREP was done in-house by the Department of Energy Affairs. This, however, was deemed to be inappropriate considering the numerous mainstream energy-related responsibilities the Department had to perform. The DANIDA-FTP was direct implementation by the Danish Government through assigning of technical assistance. This model was also deemed inappropriate because it did not allow for the Department's great involvement in the activities of the Project. Under BARREM, the execution is contracted out to the Management Unit which is responsible for the day-to-day coordination of the activities.

A lot has happened since the inception of the Project. Until now, NSREP has had no final evaluation. BARREM Project is now mid-way its implementation. Hence the need for both a final evaluation of NSREP and mid-term evaluation of BARREM.

IV. TERMS OF REFERENCE OR Expected Tasks

The overall objective of this Mid-Term Review is to review progress towards the projects objectives and outputs, identify strengths and weaknesses in implementation, assess the likelihood of the project achieving its objectives and delivering its intended outputs, and provide recommendations on modifications to increase the likelihood of success (if necessary).

The policy context in which the project operates has seen significant evolution in recent years. This includes the development of the MPRS, Water, Energy, Health, Agriculture and Biodiversity Framework (WEHAB) following the 2002 Johannesburg World Summit on Sustainable Development; and articulation of the New Plan for African Development (NEPAD).

A particular emphasis of the Evaluation will be on providing recommendations for modifications required to ensure that project activities are aligned with these commitments. More specifically, the Mid-Term Evaluation will undertake the following tasks:

- Assess progress towards attaining the projects environmental objectives and outcomes. The effectiveness of these actions given the available funding will be considered.
- Clarify the project objectives and activities both in light of the evolving thinking on global and local thinking and action, and how these relate to the UNFCCC priority work programme. Validate the developing project approach to incorporating those priorities.
- Review the clarity of roles and responsibilities of the various agencies and institutions and the level of coordination between relevant players. In particular, the capacity and performance of the project secretariat will be reviewed.
- Review the balance between 'technical product' and 'mainstreaming process' in the project; and given the nature of that balance, assess the optimum institutional placing of the project with regard to mainstreaming products. Optimal here includes both cost effectiveness and technical effectiveness.
- Assess the level of public involvement in the project and comment as to whether public involvement has been appropriate to the goals of the project.
- Describe and assess efforts of UNDP in support of the implementing agencies and national institutions.
- Review and evaluate the extent to which project impacts have reached the intended beneficiaries.
- Assess the likelihood of continuation of project outcomes/benefits after completion of GEF funding; and describe the key factors that will require attention in order to improve prospects for sustainability of project outcomes.
- Assess the level to which the Logical Framework Approach (LFA) and performance indicators as developed at the inception phase have been used as project management tools; and review the implementation of the projects monitoring and evaluation plans. Assess the strength of the log-frame process as a whole.
- Make recommendations as to how to improve project performance in terms of effectiveness and efficiency in achieving impact on both capacity and the targeted Institutions.
- Describe the main lessons that have emerged in terms of: efforts to secure sustainability; knowledge transfer; and the role of M&E in project implementation. In describing all lessons learned, an explicit distinction needs to be made between those lessons applicable only to this project, and lessons that may be of value more broadly.

- i) assess the extent to which on-going training activities of engineers, planners and technicians in solar PV design, installation and maintenance has led to improved quality of system installations;
- ii) assess the extent to which the different solar PV sensitization activities have led to government ministries/departments, donor community, and non-governmental organizations (NGOs) incorporate solar PV in their development plans;
- iii) assess the extent to which the different solar PV sensitization activities has impacted on the decision making of political and/or traditional leaders and other stakeholders at District Assembly levels;
- iv) assess the impact of the support given to the Department of Energy Affairs and other institutions is assisting in creating an enabling environment (policies, standards and coders of practice) for participation of solar PV players in the sub-sector;
- v) assess the extent to which solar PV end-users have accessed the existing Credit Guarantee Fund (CGF) and make recommendations on improving the operationalization of the Fund;

- vi) provide a “quick-and-dirty” assessment of the possibility of involving commercial banks extend credit to solar PV end-users using their own resources using their existing loan schemes;
- vii) assess the impact of demonstration solar PV installations (solar for lighting in schools, solar powered beverage coolers, solar powered tobacco fans, solar powered water pumping, solar powered radio communication) to increased adoption of the technology;
- viii) assess the extent to which campaign messages have increased the knowledge of, and exposure to solar PV technologies amongst policy makers, planners and the public;
- ix) assess the extent to which sensitization/campaign messages to political/traditional leaders have been used as a two-way information between local communities at District Assembly level and NGOs/donors working in the surrounding area;
- x) assess the appropriateness of the existing institutional linkages and recommend ways of improving these linkages as means of promoting solar PV activities; and
- xi) assess the future sustainability of the different project activities in relation to the roles and responsibilities of the different collaborating institutions; with particular emphasis on the Renewable Energy Industries Association of Malawi (REIAMA)

V. Evaluation Team

The international consultant would serve as both the team leader and the technical expert while the national consultant(preferably a Malawian) would serve as an institutional and organizational expert.

The evaluation team shall be composed two individuals. These are: the Team Leader who will the technical expert and a national consultant (preferably a Malawian) who would serve as an institutional and organizational expert.

- a) *Team Leader.* The Team Leader should have a post-graduate qualification in electrical or mechanical engineering with some management knowledge. He/she shall have at least 10 years practical experience in implementing (promotion and replicating) and managing RETs-related programs, particularly in Southern Africa. Experience in RETs programs/projects in Africa, particularly Southern Africa is strongly preferred. He will also be knowledgeable in the installation and maintenance of the systems as it relates to quality assurance and consumer satisfaction. He will also review the training Manuals currently being used by the Project to ascertain appropriateness. He will also review the responsiveness of the different technologies to the needs of the market they are serving and should be knowledgeable in the various RETs systems designs, installation and maintenance.
- b) *Institutional and Organizational Expert:* The Expert will review the existing institutional linkages of BARREM and their effectiveness to promote RETs service delivery. He/she will also review relationships, roles and responsibilities of the various stakeholders in implementing RETs activities; analyze commitment of stakeholders to project implementation; appropriateness of monitoring and evaluation systems to provide performance data for decision making; and recommend any modifications needed to make BARREM work better;

The expert should have an advanced degree in institutional structures and linkages and an understanding of RETs markets in the less developing countries.

VI. Deliverables:

The Contractor shall provide the Department of Energy Affairs and BARREM a complete draft of the Report for review and comment. Following the submission of the draft Report, a joint review meeting between the Department, BARREM, UNDP and other stakeholders will be held to discuss the draft Report. The Report shall follow the format as follows:

1. Executive Summary
2. Introduction
 - a. Purpose of the Evaluation
 - b. Background
 - c. Evaluation Methodology
3. Evaluation Findings
 - a. Project Relevance
 - b. Efficiency
 - c. Effectiveness
 - d. Impact of the Project
 - e. Sustainability
4. Lessons Learnt
 - a. Operational
 - b. Developmental Lessons
5. Conclusions
6. Recommendations
7. Annexes
 - a. Terms of Reference
 - b. Project Performance Matrices
 - c. Itinerary for the Evaluation Team
 - d. List of Persons Consulted
 - e. Literature and Recommendation

By the end of the exercise, the Consultants shall submit five hard copies and an electronic copy on CD-ROM Microsoft Word of the Report to BARREM Project.

VII. Performance Period

The exercise shall be carried out over a period three weeks. The Consultants will be authorized to a six-day workweek. Local holidays are not authorized.

VIII. Logistics

The Project will be responsible for arranging and scheduling meetings, hotel bookings, work/office space, in-country travel arrangements, and Xeroxing of report.

Appendix B Project Performance Matrices

B.1 Project performance matrix – GEF co-ordinator version with performance rating by evaluation team²⁵

| Summary | Objectively Verifiable Indicators | Means of Verification | Performance |
|--|--|--|--|
| Global Objective: Reduce carbon dioxide emissions | 1,209.4 Mt CO ₂ avoided per year due to PV installations starting in year 3 after project start 0.19 MW installed over the lifetime of the project (Project design has 28 475 Mt CO ₂ /yr) | National GHG inventories and M&E reports REIAMA files and project files (DoE and PMU) | Total no. installations in Malawi 4582 of which 1400 attributed to BARREM 1 536 MT CO ₂ per year avoided at present Approx 0.1 MW installed so far during project period Rating – satisfactory according to above targets, but un satisfactory regarding key CO ₂ initiative (ARET, SOBO). Also data confidence is poor [MS] |
| Development Objective: Remove market barriers to increase PV energy service delivery | Cost of PV systems reduced by 17,5% (\$3.35/wWh) by the end of the project compared to baseline year 2003 Number of PV systems installed and operating increased by 400% by project completion compared to baseline year 2003 (target: 4000 HH, 200 health clinics, 400 schools, 300 solar fridges, 190 tobacco fans) | REIAMA files, market survey REIAMA files, market survey DoE and PMU files | APR 2005 indicates costs for 5 light std system: 2002: 5.31 \$/Wh 2004: 4.49 \$/Wh 2005: 5.3 \$/Wh Prices in MK have increased by about 50% Factors: MK devaluation Modules increase in price (shortage) Charge controllers, batteries seem to have remained fairly constant Lights- small component, no clear information Malawi retail prices still significantly higher – primarily as result of: <ul style="list-style-type: none"> supplier/installer chain |

²⁵ Ratings: HS: Highly satisfactory/ S: Satisfactory / MS: marginally satisfactory / U: Unsatisfactory.

| Summary | Objectively Verifiable Indicators | Means of Verification | Performance |
|---|--|---------------------------------------|---|
| | | | <ul style="list-style-type: none"> • freight • small volumes • indirect purchase <p>Volumes – targets not met, Households: 1400 (approx) Health centres 150 (approx) Schools: 23 Solar beverage coolers: 6 Tobacco fans: 8 (experimental)</p> <p>Several other positive achievements (see below) [MS]</p> |
| <p>Immediate Objective 1: Strengthen public, private and civil society institutions</p> | <p>Number of businesses dealing in PV increased by 300% by project completion compared to baseline year 2002</p> | <p>REIAMA files Market survey</p> | <p>Achieved – 26 certified records – but note that number of active companies seems to be far lower.</p> <p>Public sector</p> <ul style="list-style-type: none"> Standards promulgated Energy Regulatory Authority act passed? Plans well advanced to regulate renewable energy industry Draft Other Energy Policy in place Draft rural electrification policy in place that specifically discusses renewable energy technologies <p>Civil Society: REIAMA established Membership grown to 35</p> <p>[S]</p> |

| Summary | Objectively Verifiable Indicators | Means of Verification | Performance |
|--|--|-----------------------|---|
| Output 1.1: Test and Training Centre at Mzuzu University established and functioning | At least 20 visitors per year after 1 year of establishment of the centre | Visitors logbook | Training centre has been established (TCRET) Test centre not yet established – waiting for equipment delivery, and test procedure development/training Visitor record erratic, but seems to be well more than 20 [S] |
| Output 1.2: PV engineers, technicians and trainers trained | At least 25 technicians, 10 engineers, and 10 trainers trained per year from 2003 onwards | | 37 engineers/planners trained 171 technicians trained Targets well on way to being achieved [HS] |
| Output 1.3: Government district planners, advisors and DoE staff trained | At least 20 district planners and advisors trained per year from 2003 onwards | | 843 District energy advisors sensitized /trained. 4 Engineers from DOE sent to for post graduate studies [HS] |
| Output 1.4: NGO/CBO practitioners sensitised and trained | Number of NGOs/CBOs involved in PV increased by 400% by the end of the project compared to baseline year 2003 | | Significant involvement from CHAM, other involvement not clearly articulated [MS] |
| Output 1.5: Industry association (REIAMA) strengthened | REIAMA membership increased from 15 to 40 by the end of the project All professional REIAMA staff trained by the end of the project | | REIAMA membership currently 41, of which 35 paid up 26 certified companies Director in place Significant concerns re sustainability [MS] |
| Immediate Objective 2: Create an enabling policy and regulatory environment | Energy policy, favourable to RETs, finalized by 2004 | | Policies are in place and are favourable, although do not allocate significant resources yet. [S] |

| Summary | Objectively Verifiable Indicators | Means of Verification | Performance |
|--|---|----------------------------------|--|
| Output 2.1: Preparation of policies and legal frameworks supported | Energy sub-sector strategies legislated by 2004 | | Legislation well under way. Several enacted: Energy Regulatory Act, Electricity Act, Rural Electrification Act, Liquid Fuels and Gas Act Sector strategies in place: Power Sector Strategy. Drafts: Other Renewable Energy, Liquid Fuels, rural Electrification. [HS] |
| Output 2.2: Codes and Standards for PV developed | Rate of faulty PV systems reduced to 20% by 2006 from baseline of 50% | Survey amongst field technicians | CSR report indicates significant improvement (11% of systems not working). However data does not report systems that are only partially working. Data should be gathered on <ul style="list-style-type: none"> • systems 100% in order • systems partially working • systems no working at all Site visits by evaluation team still found significant faults rate [S] |
| Output 2.3: Certification procedures for PV companies consolidated | Non-certified PV companies driven out of the market by the end of the project Certification period reduced from 5 months to 3 months | | Non-certified companies are still operating. Certification period has been reduced, but some have raised concerns as to quality of certification process. [HS] |
| Immediate Objective 3: Develop and test financing mechanisms | Number of end-users and companies accessing financing mechanisms to purchase PV systems increased to 1000 by the end of the project | | Finance mechanism has been developed and tested- however found not to be very successful Target not likely to be achieved [S] |

| Summary | Objectively Verifiable Indicators | Means of Verification | Performance |
|--|---|-----------------------|---|
| Output 3.1: New and innovative financing mechanisms identified, tested and accessed and effectiveness of existing funds (CGF, HCRF) evaluated. | Number of end-users and companies accessing new financing mechanisms to purchase PV systems increased from 0 to 1000 by the end of the project | | New methods partially identified, but not developed CGF fund tested fairly well – but found not to be particularly successful [US] HCRF fund not actively monitored although encouraging outputs from CHAM Note that delivery model to schools tested and working [S] |
| Output 3.2: Microfinance Fund capitalised and used | Number of end-users accessing capital from the Fund increased from 0 to 1000 by the end of the project | | Note done yet Will be difficult to achieve before Feb 2007 [U] |
| Immediate Objective 4: Promote Renewable Energy Services | | | Broadly has been done in variety of ways – see below for details [S] |
| Output 4.1: Delivery models for households, institutions and SMEs developed and tested | Number of PV systems installed through tested delivery mechanism increased by 40% by the end of the project: APR has: Mid Term <ul style="list-style-type: none"> • 2653 (commercial) • 422 (institutional) End of Project <ul style="list-style-type: none"> • 4390 (commercial) • 600 (institutional) | Not stated in | Two main Delivery model for household developed and tested Cash sales – (existing model) Credit sales with organised loan scheme Have also been some examples of part payment/dealer financing [MS] Institutional delivery models (schools and clinics) have been developed and implemented, although volumes lower than target [S] SME model <ul style="list-style-type: none"> ■ SOBO delivery tested- although this was fully funded – no large scale roll out yet– still concerns re maintenance, business case |

| Summary | Objectively Verifiable Indicators | Means of Verification | Performance |
|--|--|-----------------------|--|
| | | | <ul style="list-style-type: none"> ■ Tobacco farm method – not taken beyond test stage yet. [U] |
| Output 4.2: Technical specifications for different PV applications developed | Technical specs used for all new installations | | MBS standards being used. Actual tender documents need further work to gather required information from suppliers for proper adjudication [HS] |
| Output 4.3: Solar fridges demonstrated | 300 solar fridges installed by the end of the project | | (4) demonstrated Original target was very high, but performance so far disappointing [U] |
| Immediate Objective 5: Increase public awareness of the efficacy of PV technologies and services | Number of enquiries to the PMU averages 60 per month by the end of the project | | 2005 average of 10 per month [MS] |
| Output 5.1: RET information secretariat established and functioning | Number of enquiries to the secretariat averages 30 per month after 1 year of operation | | Secretariat not established, although DOE, REIAMA and BARREM fulfil some of the functions. Could still be established before project termination [U] |
| Output 5.2: Publicity and Promotional Campaigns conducted | Number of radio jingles averages 60 per month | | Jingles are being aired at high rate Good radio coverage and fair local coverage. Need to link sensitisation to concrete decision making opportunities. Video partly prepared [S] |
| Output 5.3: Investors Guide prepared | Guide in place | | Not yet done [U] |

B.2 Project Performance Indicators

Project performance indicators as per inception report, with current status as determined/assumed by the evaluation team

Note for Draft Report: The PMU is specifically requested to update the table below.

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment |
|---|----------------|---------------|------------------------------|----------------------------|-----------------------------|----------------------------------|-------------------------------|
| Component 1: Capacity Building and Institutional Strengthening | | | | | | | |
| Sub-Component 1.1: Support to Private Sector | | | | | | | |
| Indicator 1.1.1: PMU established and operational | PMU | | Done | | | | |
| Indicator 1.1.2: TCRET established and operational | PMU/TCRET/DoE | 0 | <i>Done</i> | Done | | | Lab equipment not yet sourced |
| Indicator 1.1.3: Technicians trained | PMU/TCRET/DoE | 48 | 36 107 | 36 0 | 23 29 | 143 136 | |
| Indicator 1.1.4: Engineers/planners trained | PMU/TCRET/DoE | 14 | 24 | 20 | 10 | 68 | |
| Technicians Trained- Tailor made Training | | 0 | 43 15 43 | 0 15 ? | ? 15 28 | ? 45 ? | |
| Indicator 1.1.5: Technical trainers trained | PMU/TCRET/DoE | 3 | 15 - | 15 - | | 33 ? | |
| 7 Sub-Component 1.2: Support to Government Institutions | | | | | | | |
| Indicator 1.2.1: Policy makers trained | PMU/DoE | 0 | 100 | 50 | | 150 ? | No data in APR |
| Indicator 1.2.2: RETs Demonstration Centre established | | 0 | | 1 0 | | 1 0 | |
| Indicator 1.2.3: AED Staff trained at | PMU/DoE | 1 | 3 ? | ? | ? | 4 4 | PMU please update |
| (a) post-graduate level | | | | | | | |
| (b) short courses | | 2 | 2 | ? | 2 ? | 2 ? | |
| (c) training of Inspectors (In- Country) | | 1 | 9 | ? | ? | 10 ? | |

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment |
|--|-----------------|---------------|----------------------------|--------------------|--------------------|----------------------------------|---|
| 8 Sub-Component 1.3: Support to NGOs/CBOs | | | | | | | |
| Indicator 1.3.1: Increase in number of NGOs involved in solar PV application | PMU/DoE/NGOs | 5 | 25 19 | 15 5 | 10 11 | 55 35 | APR report combines NGO/CBO |
| Indicator 1.3.2: Increase in number of CBOs involved in solar PV application | PMU/DoE/CBOs | 5 | 15 ? | 15 ? | 10 ? | 45 ? | See above |
| Indicator 1.3.3: 700 Energy advisors trained | PMU/DoE/CBOs | 60 | 320 843 | 320 0 | | 700 843 | |
| Indicator 1.3.4: An efficient and sustainable REIAMA in place | | | | | | | |
| (a) Increased Membership(Cumulative) | PMU/DoE/REIAM A | 15 | 25 15 | 33 22 | 40 35 | 40 35 | |
| (b) Increased Member Subscription (Annual) | | 1.1 | 6.3 | 8.3 | 10.0 25 | 10.0 25 | |
| Indicator 1.3.5: REIAMA Members/Staff trained | | | | | | | |
| (a) Staff | PMU/DoE/REIAM A | 1 | 0 | 0 | 0 | 1 | Was current or previous staff member trained |
| (b) Members(International) | | ? | ? | ? | ? | 1 | |
| | | 1 | 2 | 2 | 2 | 7 | |
| | | | ? | ? | ? | ? | |
| 8.1 Component 2: Creation of Enabling Environment | | | | | | | |
| 9 Sub-Component 2.1: Support to NEP, Strategies and Legislation | | | | | | | |
| Indicator 2.1.1: National Energy Policy Finalised | DoE | | <i>Done</i> Done | | | | |
| Indicator 2.1.2: Energy Sub-sector strategies developed/legislated | DoE | | <i>Done</i> | Done | | | ERA, Elec Act, Rur elec Act, Liquid Fuels and Gas Act |

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment |
|---|----------------|---------------|--------------------|--------------------|--------------------|----------------------------------|---|
| 10 Sub-Component 2.2: Support to Standards and Codes of Practice | | | | | | | |
| Indicator 2.2.1: Technical standards and codes of practices developed | PMU/MBS/DoE | | Done | Done | | | |
| Indicator 2.2.2: Increase in consumer confidence | Survey | | | Done | ? | | CSR Survey – does not specifically identify consumer confidence |
| 11 Sub-Component 2.3: Support to Consolidation of Certification Procedures | | | | | | | |
| Indicator 2.3.1: Period for certification reduced (in months) | PMU/MBS/DoE | 5 | 4 4 | 3 4 | 3 2 | 3 | |
| Indicator 2.3.2: Increased number of companies certified | PMU/MBS/DoE | 10 | 5 ? | 5 ? | 5 ? | 25 26 | |
| 11.1 Component 3: Financing Mechanisms | | | | | | | |
| 12 Sub-Component 3.1: Support to consolidation of RETs financing mechanisms | | | | | | | |
| Indicator 3.1.1: Increased number of beneficiaries accessing loan facility | PMU/MEET/MFIs | 0 | 100 4 | 300 6 | 600 ? | 1000 37? | |

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment | |
|---|----------------|---------------|--------------------|--------------------|--------------------|----------------------------------|---|---|
| 13 Sub-Component 3.2: Support to extend financing mechanism to other RETs | | | | | | | | |
| Indicator 3.2.1: Delivery modes for other RETs in place | PMU/MEET/MFIs | 0 | 4 | 4 | 2 | 10 | Biogas/SWH/Wind not well articulated in other documents | |
| (a) Biogas | | | 0 | 0 | 0 | 0 | | |
| (b) solar thermal | | | 0 | 2 | 2 | 1 | | 5 |
| (c) wind | | | 0 | 2 | 2 | 1 | | 5 |
| Indicator 3.2.2: Lessons learnt | Survey | | | | CSR survey | | CSR report has good section on lessons learnt/recommendations | |
| 14 Sub-Component 3.3: New financing mechanisms developed | | | | | | | | |
| Indicator 3.3.1: Increased number of new financing mechanisms | PMU/MFIs | 1 | | | | 3 0 | Only CGF set up by Fast-Track project functioning (see 3.5.1) | |
| Indicator 3.3.2: Number of customers adopting new financing mechanisms | PMU/MFIs | 0 | 100 0 | 300 0 | 600 0 | 1000 0 | | |
| Component 4: Promotion of renewable Energy Services | | | | | | | | |
| Sub-Component 4.1: Support for PV for lighting in households | | | | | | | | |

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment |
|---|-------------------------|---------------|--------------------|--------------------|--------------------|----------------------------------|---|
| Indicator 4.1.1: 4,000 SHS installed | PMU/PV Industry | 1000 | 400 | 800 | 1800 | 4000 | (From APR) |
| (a) CGF | | 0 | 50 | 100 | 200 | 350 | |
| (b) MFIs | | 0 | 150 | 500 | 1000 | 1650 | |
| (c) Cash | | 1000 | 200 | 200 | 600 | 2000 | |
| | | | | | | ? | No reliable data |
| 15 Sub-Component 4.2: Support to solar PV lighting in grant-aided clinics | | | | | | | |
| Indicator 4.2.1: PV Systems installed in grant-aided health clinics | PMU/PV Industry/Clinics | 19 | 22 | 107 | ? | 200 | APR does not distinguish between demo and ripple. PMU to provide data |
| (a) Project demons | | 14 | 7 | 5 | 3 | 29 | |
| (b) Replication effect | | 14 | ? | ? | t.b.d | 171 | |
| | | | 5 | t.b.d | t.b.d | | |
| | | | 5 | | | | |
| 16 Sub-Component 4.3: Support to solar PV lighting in government institutions (excluding clinics) | | | | | | | |
| Indicator 4.3.1: 400 solar PV systems installed | PMU/PV Industry | | 95 | 128 | 63 | 328 | APR does not differentiate demo and ripple. Also APR numbers may include clinic- PMU please clarify |
| (a) Project demons | | t.b.d | 28 | 0 | 0 | 28 | |
| (c) Replication effect | | t.b.d | ? | ? | ? | ? | |
| | | | t.b.d | t.b.d | t.b.d | | |

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment |
|--|----------------------|---------------|--------------------|--------------------|--------------------|----------------------------------|--|
| 17 Sub-Component 4.4: Support to solar PV systems for beverage coolers | | | | | | | |
| Indicator 4.4.1: 300 solar PV coolers installed | PMU/SOBO/PV Industry | 0 | 56 | 120 | 124 | 300 | Earlier APR's indicate 11 beverage coolers, later ones only indicate 6 |
| (a) SOBO demonstration | | 0 | 6 | 0 | 0 | 6 | |
| (b) Replication effect by SOBO | | 0 | 6 | 0 | 0 | 6 | |
| (c) Replication by other players | | 0 | 50 | 100 | 94 | 244 | |
| | | 0 | 0 | 0 | 0 | 0 | |
| | | | ?? | ? | ? | ? | |
| 18 Sub-Component 4.5: Support to solar PV systems for tobacco fans | | | | | | | |
| Indicator 4.5.1: 190 solar powered fans installed | PMU/ARET/PV Industry | 0 | 30 | 70 | 90 | 190 | |
| (a) ARET demons | | 0 | 2 | 0 | 0 | 2 | |
| (b) Replication by tobacco farmers | | 0 | 8 | 0 | 0 | 8 | |
| | | | 28 | 70 | 90 | 188 | |
| | | | 0 | 0 | 0 | 0 | |
| New indicator?: solar vaccine refrigeration | | | | | | | |
| (a) Project demons | | | | | | | |
| (d) Replication effect | | | | | | | |
| New indicator?: water pumps | | | | | | | |
| (a) Project demons | | | | | | | |
| (e) Replication effect | | | | | | | |

| Component | Source of Data | Baseline 2002 | 2003 Target Actual | 2004 Target Actual | 2005 Target Actual | 2006 (Cum) Target Actual to date | Comment |
|---|-------------------|---------------|--------------------|--------------------|--------------------|----------------------------------|---|
| 18.1 Component 5: Creating Public Awareness | | | | | | | |
| 19 Sub-Component 5.1: Support to establishment of RET Information Secretariat | | | | | | | |
| Indicator 5.1.1: Information Secretariat established and operational | PMU/DoE | | Done | | | | |
| Sub-Component 5.2: Support to publicity and promotional campaigns | | | | | | | |
| Indicator 5.2.1: Increased awareness of solar PV systems | Survey by PMU/DoE | | Done | Done | | | Anecdotal evidence indicates good awareness through radio |
| Sub-Component 5.3: Support to investors guide on ESCOs | | | | | | | |
| Indicator 5.3.1: ESCOs investors guide published | PMU/PV Industry | | | Done | | Not done | |
| Indicator 5.3.2: Potential sites for ESCOs identified | Survey by PMU/DoE | | Done | | | Not done | |
| Indicator 5.3.3: Number of ESCOs introduced | PMU/PV Industry | 0 | | 5 | 5 | 10 0 | |

Note: t.b.d. means to be determined

B.3 Estimates of PV systems installed

The APR (205) report indicates that 1263 systems had been installed by 2004, and 2669 by July 2005.

Table 7 Data on number modules imported for 2005 (to September) and 2004 (as per requests for tariff exemption), with evaluation team calculations to estimate number systems installed per year.

| Data from import tariff exemption requests | | | |
|--|------|-------------|--------------|
| | Size | No. modules | Wp |
| 2004 | 50 | 177 | 8850 |
| | 60 | 20 | 1200 |
| | 75 | 400 | 30000 |
| | 10 | 114 | 1140 |
| | 20 | 164 | 3280 |
| Totals 2004 | | 875 | 44470 |

| Estimates of number SHS installed | | |
|-----------------------------------|------|------------------|
| No.+20% | % hh | No SHS installed |
| 212 | 50% | 106 |
| 24 | 50% | 12 |
| 480 | 30% | 144 |
| 137 | 100% | 137 |
| 197 | 100% | 197 |
| 1050 | | 596 |

| | | | |
|------------------------------|----|------------|--------------|
| 2005 | 80 | 236 | 18880 |
| | 55 | 30 | 1650 |
| | 50 | 77 | 3850 |
| Totals 2005 (to Sept) | | 343 | 24380 |

| | | |
|------------|-----|------------|
| 283 | 30% | 85 |
| 36 | 50% | 18 |
| 92 | 50% | 46 |
| 412 | | 149 |

322. The household market is particularly difficult to estimate based on data available. The LHS of Table 7 is from the records kept by BARREM/DOE on requests for tariff exemption on imports of solar modules for certified companies. On the RHS we have assumed:

- that an additional 20% of modules are imported with out going through the tariff exemption process.
- That the proportions as indicated of modules imported are used for SHS systems.

323. Given these assumptions, and given that the 2005 data is only up to September, it seems that about 500 SHS are being installed per year.

The CSR report has the following data (gathered from installers) for solar systems (including SWH) installed.

| Year of installation | Number systems installed |
|----------------------|--------------------------|
| 1999 | 43 |
| 2000 | 11 |
| 2001 | 34 |
| 2002 | 131 |
| 2003 | 156 |
| 2004 | 280 |
| 2005 | 82 |

324. The above table is for all solar systems (including large systems and solar water heaters). This implies that the number of SHS reported as being installed by companies is less than 100 per year!

325. On the other hand, the CSR information from installers shows that 28.5 percent (or 870 systems) of the installations were done after 2001 whereas the field survey results indicate that 71.4 percent or 3,858 systems were done after 2001. If 40% of these were SHS, this corresponds to about 385 systems per year.

326. Based on the above, a reasonable estimate for the number of SHS being installed in Malawi at present is about 500 systems per year, of which perhaps 200 are being installed by companies. If we assume that there are 8 active companies, this means (on average) that each would be doing about 2 installations per month. During interviews with companies, we certainly did not get the impression that the figure is any higher than this- indeed it may be lower.

Table 8 Estimates of the number of solar systems installed in Malawi

| System Type | Project Design Document (total) | | CSR report | | | APR 2005 | Used for this review | | |
|--|---------------------------------|--------------|----------------------|-------------|---------------------|-------------|----------------------|------------|---------------|
| | Base | Target | phase 1 (table 3A.3) | Table 3.2.3 | Final estimate | No systems | No systems | Average Wp | Total Wp |
| Households | 5000 | 6500 | 786 | 5005 | | 2669 | 4000 | 20 | 80000 |
| Institutions (not stated whether schools or health or other) | | 600 | | | | 328 | 178 | 75 | 13350 |
| Health Centres (lighting) | | - | | | | - | 150 | 75 | 11250 |
| Health Centres (vaccine) | | - | | 116 | | 129 | 130 | 140 | 18200 |
| Refrigeration (not necessarily vaccine) | | - | 185 | 86 | | - | 80 | 140 | 11200 |
| Tobacco Fans (not farms) | | 2470 | 4 | | | 8 | 8 | 50 | 400 |
| Beverage Coolers | | 2000 | | | | 6 | 11 | 375 | 4125 |
| Water pumps | | - | 221 | 113 | | - | 113 | 200 | 22600 |
| Radio communication | | - | | 419 | | - | 150 | 30 | 4500 |
| Solar Water Heaters | | - | 1692 | 591 | | - | 1700 | | |
| Other | | - | 3 | 84 | | | 100 | | |
| Total | 5000 | 11570 | 2891 | 6414 | 9000 to 1000 | 3140 | 6620 | | 165625 |

B.4 Climate Change indicators

Table 9 CO2 Emission estimates and proposed targets

| Installation type | Saving MT CO2/installation | Base Case | Project Doc (end project) | Mid term review estimate | Mid-term review-estimated attributed to BARREM | Suggested targets (BARREM plus other) |
|--------------------------------|----------------------------|------------|---------------------------|--------------------------|--|---------------------------------------|
| Households | 0.75 | 2500 | 6500 | 4000 | 1400 ²⁶ | 4500 |
| Schools (or other) | 1.5 | not stated | 600 | 178 | 89 | 208 |
| Health Centres (lighting) | 3 | not stated | not stated | 150 | 75 | 230 |
| Health Centres (vaccine) | 0.93 | not stated | not stated | 130 | 65 | 210 |
| Tobacco Farms | 90 | not stated | 190 | 0 | 0 | 10 |
| Beverage Coolers | 2.8 | not stated | 2000 | 11 | 6 | 350 |
| Water pumps | 5 | not stated | not stated | 113 | 10 | 113 |
| Total number PV systems | | | | 4582 | 1645 | 5621 |

MT CO2/yr

| | | | | | |
|---------------------------|--------------|---------------|--------------|--------------|--------------|
| Households | 1875 | 4875 | 3000 | 1200 | 3375 |
| Schools (or other) | | 900 | 267 | 133.5 | 312 |
| Health Centres (lighting) | | | 450 | 225 | 690 |
| Health Centres (vaccine) | | | 121.3333 | 60.66667 | 196 |
| Tobacco Farms | | 17100 | 0 | 0 | 900 |
| Beverage Coolers | | 5600 | 30.8 | 16.8 | 980 |
| Water pumps | | | 565 | 50 | 565 |
| Total MT CO2/yr | 1 875 | 28 475 | 4 434 | 1 536 | 7 018 |

Detailed Calculations for Evaluation Team estimations

The assumptions below are taken from the project document (page 51) with the following changes.

- Converted to savings per year instead of over 15 year estimate life of PV system
- Converted to savings in CO2, not C (inline with GEF indicators requirements)
- Modifications drawn from APR 2005 (pg 23) – for water pump
- Tobacco fan (not farmer) estimates added

The consultants have not had time to review the assumptions used in any detail.

B.4.1 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 * 1 year * 0.081 lt kero/hr * 3.18 kg CO2 /lt kero * 12 kg C/44 kg CO2
kg C/hh = 205 kg C/hh ≈ 752 kg CO2/hh/yr = **0.75 MT CO2/hh/yr**

²⁶ The review team were not able to find data quantifying the 'ripple effect' BARREM activities on household installations.

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*1 years *0.081 lt kero/hr *3.18kg CO2/lt kero*12 g C/44 g CO2
kg C/school = 410 kg C/ school ≈ 1504 kg CO2/school/yr = **1.5 MT CO2/school/yr**

kg C/Health Centre (lighting) = 820 kg C/yr ≈ 3008 kg CO2/h_centre/yr = **3 MT CO2/h_centre/yr**
(they use lights for twice as long as schools)

Kg CO2/Health Centre (vaccine refrigeration) = one third of CO2 reduction realized by beverage coolers
(see below)

Kg CO2/Health Centre (vaccine refrigeration) = **0.93 MT CO2/h_centre(vaccine)/yr**

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 * 1 yrs
kg C/farmer = 24 573 kg C/farmer/yr ≈ 90 026 kg CO2/famer/yr = **90 MT CO2/famer/year**

Note: Following discussions with ARET personnel, it was estimated that one tobacco fan system (fitted to two barns run in parallel) would be able to cure only 300 kg/tobacco per load, and do about 12 loads a year. This means that a single tobacco fan installation will only cure about 3 600 tons tobacco, or **12 MT CO2/installation/yr**

The standard farm unit used above, producing 24 573 kg year would therefore require 7 installations

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 * 1 yrs
kg C/retailer for refrigeration = 565.74 kg C/retailer/year

kg C/ retailer lighting = 205 kg C/hh

kg C/ retailer total = 770 kg C/retailer yr ≈ 2 826 kg/CO2/yr = **2.8 MT CO2/yr**

Water Pump: A diesel pump uses 10 litres to pump 5 0000 litres of water consumed within 2 days, ie. 1 825 litres fuel per year. 1 litre diesel produces 2.76 kg of CO2

Kg C/Water pump = 1 825 litres diesel/yr * 2.76 kg CO2/liter = 5 037 kg CO2/water pump
= **5 MT CO2/water pump**²⁷

²⁷ Note, the 2005 APR has a 5 MT saving in C, not CO2. This is an error

Appendix C Itinerary/List persons consulted for the Evaluation Team

| Date | Name of Person interviewed | Position/ designation | Organisation | Location |
|---------------------------|----------------------------|--------------------------------|---------------------|-------------|
| 19 th Sep2005 | Mr V. Nkosi | Project Manager | BARREM | Lilongwe |
| | Mr D Nyasulu | Engineer (Inspection) | BARREM | Lilongwe |
| | Mr W Kasakula | Engineer (Training) | BARREM | Lilongwe |
| 20 th Sep.2005 | Mr P Matundama | PRO | BARREM | Lilongwe |
| | Ms. E. Mmangisa | Project Analyst | UNDP | Lilongwe |
| | Dr C Kafumba | Director | DoE | Lilongwe |
| 21 st Sep.2005 | Dr I Phiri | Deputy Director | ARET | Lilongwe |
| | Mr J Kaipa | Research Engineer | ARET | Lilongwe |
| | Mr H Kamlaka | Director | REIAMA | Lilongwe |
| | Mr. A Nkoloma | Managing Director | Global Solar | Lilongwe |
| 22 nd Sep2005 | Ms. D Casey | Deputy Resident Representative | UNDP | Lilongwe |
| | Mr H. Tanna | Managing Director | Solair Corporation | Lilongwe |
| | Mr Kashiwagi | Technical Advisor- JICA | CHAM- PAM | Lilongwe |
| | Mr Gulule | Technician | CHAM-PAM | Lilongwe |
| | Mr D Msowoya | Programme Coordinator | Alinafe Clinic | Nkhota-Kota |
| | Mr M M Banda | Grocery Owner | Mwansambo | Nkhota-Kota |
| | Mr K Nkhoma | Head Teacher | Chamalire CDSS- | Nkhota-Kota |
| 23 rd Sep2005 | Mr J Dausi | Teacher | Chamalire CDSS- | Nkhota-Kota |
| | Mrs E Nyasulu | Senior Nurse | Choma Health Centre | Mzuzu |
| | Mr M Magawa | Health Surveillance Assistant | Choma Health Centre | Mzuzu |
| | Mr J Chimaliro | Health Surveillance Assistant | Choma Health Centre | Mzuzu |
| | Prof P Mwanza | Vice Chancellor | MzuzuUniversity | Mzuzu |
| | Prof Mphande | Dean of Education | MzuzuUniversity | Mzuzu |
| | Mr Uka | College Librarian | MzuzuUniversity | Mzuzu |
| | Mr Mshali | College Registrar | MzuzuUniversity | Mzuzu |
| | Mr Mataya | Dean, Environmental Studies | MzuzuUniversity | Mzuzu |
| | Mr K T Gondwe | Lecturer, Energy Studies | TCRET | Mzuzu |
| 24 th Sep2005 | Mr Chitaya | Head, Energy Studies | TCRET | Mzuzu |
| | Mr | Accountant | TCRET | Mzuzu |
| | Mr Manda | Grocery owner | Kafukule | Mzimba |
| | Mr Mkandawire | Household | Emoneni | Mzimba |
| | Mr M Munkondya | Depot Sales Officer | Eswazini ADMARC | Mzimba |
| | Mr V Sinkhamba | Programme Officer | Eswazini EPA | Mzimba |
| | Mr C Harawa | Extension assistant | Eswazini EPA | Mzimba |
| 25 th Sep2005 | Mr J Kaipa | Research Engineer- ARET | Mwimba Research | Kasungu |
| | Mr M J Chankhondo | Head Teacher | Malonda CDSS | Ntcheu |
| 26 th Sep2005 | Mr T Madovi | Managing Director | IPCS | Blantyre |
| | Mr T Chibwana | Chief Executive | MEET | Blantyre |
| 27 th Sep2005 | Mrs B Mahuka | Director of Finance | MEET | Blantyre |
| | Mr R Kacheche | Manager, RE | Bestobell | Blantyre |
| | Mr C Malata- | Director General | MBS | Blantyre |

| | | | | |
|--------------------------|------------------------|-----------------------------------|-------------|----------|
| | Chirwa | | | |
| | Mr L Mwakayoka | Standards manager | MBS | Blantyre |
| | Mr E Kaime | Account Relationship Manager | NBM | Blantyre |
| 28 th Sep2005 | Mr J Milner | Deputy Director | CSR | Zomba |
| | Mr H Mdebwe | Programme Officer | UNICEF | Lilongwe |
| | Mr A Maclean | Construction Advisor | DFID | Lilongwe |
| | Mr L Mhango | Chief Energy Officer- Planning | DoE | Lilongwe |
| | Mr Mbwana | Deputy Director-PAM | MoH | Lilongwe |
| 29 th Sep2005 | Mr F Nkhoma | Project Manager | ISP-EP&D/WB | Lilongwe |
| | Stakeholder meeting | See below | Various | Lilongwe |
| 30 th Sep2005 | E M'Mangisa | Project Analysis | UNDP | Lilongwe |
| | Barrem PMU | | BARREM | Lilongwe |

Note: E M'Mangisa and members of the PMU were consulted on more than one occasion. Only date of first meeting is indicated above.

**PARTICIPANTS OF THE STAKEHOLDERS PRESENTATION OF PRELIMINARY FINDINGS AT
DOE BOARDROOM ON 29TH SEPTEMBER, 2005.**

Presented by:

| | |
|------------|--|
| Dr D Banks | Team Leader-International Consultant -BARREM Mid-term Evaluation |
| K J Gondwe | Team Member-National Consultant- BARREM Mid-term Evaluation |

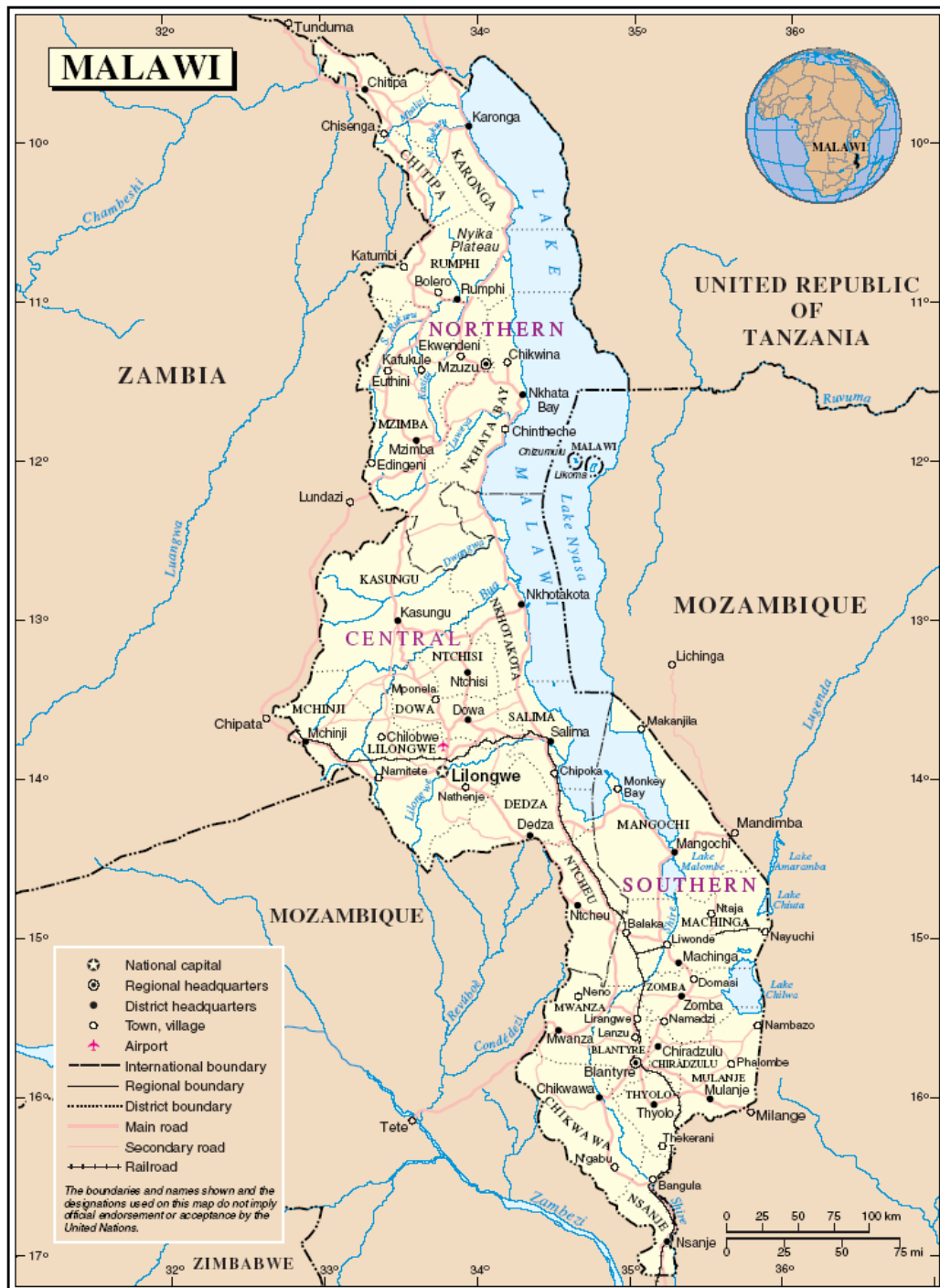
Present:

1. Ms. E Mmangitsa UNDP (Chair person)
2. Mr. LB Mhango DoE
3. Mr. K Lungu DoE
4. Mr. Maluwa DoE
5. Mr. V Nkosi BARREM
6. Mr. D Nyasulu BARREM
7. Mr. W Kasakula BARREM
8. Mr. J Mkwezalambaa BARREM
9. Mr P. Matundama BARREM
10. Mr H Kamalaka REIAMA
11. Mr Mataya Mzuzu University
12. Mr. C Malata-Chirwa MBS
13. Mr. L Mwakayoka MBS
14. Mr Kashiwagi CHAM-PAM

Appendix D Literature

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- BARREM Project Document
- BARREM Inception Report
- Annual Project Reportss (APR's) (2002, 2003, 2004,2005
- Project Steering Committee Minutes
- Various BARREM internal reports (trip reports, inspection reports, training reports, sensitization reports)
- Tender documentation and evaluation reports for selected BARREM tenders
- Financial reports and selected audit reports

Appendix E Map of Malawi



Map No. 3858 Rev. 3 UNITED NATIONS
January 2004

Department of Peacekeeping Operations
Cartographic Section