Piloting an Inventory of Renewable Energy Projects in Malawi

An assessment under the Malawi Renewable Energy Acceleration Programme (M-REAP), funded by the Government of Scotland

Technical Report on Inventory Process

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This inventory study was undertaken by Renew'N'Able Malawi (RENAMA) in partnership with WASHTED and with input from a variety of key stakeholders both in Scotland and Malawi.

The pilot inventory database as well as this report draw on the readiness of multiple stakeholders, including project implementers, private sector contractors and funding agencies, to provide data and evidence on their projects and activities; review and revise collected data, often within very short timeframes; explain project details to the authors in long meetings, sometimes even at odd hours; and facilitate visits to remote project sites in order to check the installations and interview beneficiaries and others involved.

The authors appreciate the contributions of all e-mail and phone counterparts and participants of interviews and project visits. Since data from previously contacted stakeholders was incorporated in the pilot database, their number is large and to mention them here individually by name would exceed the available space. However, they can be found in the contacts section in the database as well as in the attached stakeholder list in Appendix D.

Guidance on past efforts related to this undertaking in order to avoid duplication, as well as valuable opinions of the Director, Deputy Director and staff at the Department of Energy under the Ministry of Natural Resources, Energy and Environment were very helpful to ensure the practicability and adaptability of the pilot study.

Thanks go to scholars at the WASHTED Centre who contributed to the technical survey question development and shared their experience and additional stakeholder information.

Cordial thanks shall also be expressed towards the Gift of the Givers Foundation, Malawi for providing infrastructure and ongoing support to Renew'N'Able Malawi. This support, among other things, facilitated that several stakeholders and projects could be visited despite the non-availability of funds to cover for project-related expenses to the inventory team at RENAMA and WASHTED before the actual hand-over of the inventory report.

Contents

ACRONYMS

BL	Blantyre
DoE	Department of Energy
GoM	Government of Malawi
ISP	Institutional Support Programme
LL	Lilongwe
MNREE	Ministry of Natural Resources, Energy and Environment
M-REAP	Malawi Renewable Energy Acceleration Programme
RE	Renewable Energy/ies
RENAMA	Renew'N'Able Malawi
RET	Renewable Energy Technology
SG IDF	Scottish Government International Development Fund
WASHTED	Centre for Water, Sanitation and Appropriate Technology Development (at the University of Malawi, Polytechnic)

FOREWORD

The following inventory exercise is one of the first stepping stones for the activities under the Institutional Support Programme in the Scottish Government funded Malawi Renewable Energy Acceleration Programme (M-REAP). The objectives of the M-REAP programme are to

(i) address significant gaps in knowledge around off-grid energy management in the country,
(ii) reduce poverty and tackle climate change and to empower disadvantaged communities in remote rural areas and
(iii) develop and sustain a variety of appropriate, affordable and sustainable renewable energy projects at the community level.

The objectives were identified during a Scoping Study funded by the Scottish Government International Development Fund, which was undertaken in 2011 by Professor Graham Ault, Department of Electrical and Electronic Engineering, University of Strathclyde.

The inventory exercise has been managed by the Centre for Water, Sanitation, Health and Appropriate Technology Development (WASHTED) at the University of Malawi, Polytechnic. Advisory support has been provided by Renew'N'Able Malawi (RENAMA) who brought in their existing data and network to increase the scope of data collection for this exercise. We are much indebted to them for doing so. This support focused on developing a coherent framework for the inventory and facilitating data collection, compilation, and updating.

We at WASHTED are grateful to the Department of Electrical and Electronic Engineering, University of Strathclyde for the opportunity to manage the M-REAP programme in Malawi. We are excited at the prospect of collaborating with the finest researchers, academics and consultants involved in the off-grid energy management sector – both in Scotland and in Malawi. Our collective goal is to make renewable energy affordable and sustainable to the poorest and most vulnerable people who reside within local communities in our great nation.

Salule J. Masangwi (PhD)

Director of WASHTED

EXECUTIVE SUMMARY

The following report outlines the procedures, observations and recommendations derived from creating a pilot inventory of community-based renewable-energy interventions in Malawi.

This pilot study was undertaken as part of the Institutional Support Programme (ISP), a component under the Scottish Government funded Malawi Renewable Energy Acceleration Programme (M-REAP). The pilot inventory is to respond to the significant gaps in knowledge sharing and management around off-grid energy use and community energy projects in the country, which were identified by a number of stakeholders from the Malawian energy sector during a Scoping Study in August 2011[1].

The creation of a comprehensive national inventory of existing and planned off-grid community energy interventions in Malawian communities based on renewable energy sources is a crucial precondition for measuring the impacts of such interventions, as well as for the comparison of different approaches to community energy provision and their related limitations and best practices. It is also a prerequisite for regulatory oversight, efficient steering and policy development by the Government of Malawi and to avoid the risk of a fragmented, inefficient off-grid 'sector' in which money and resources are being wasted by implementers, funders and communities repeatedly due to lack of shared information and experience analysis.

This report gives an overview of the steps undertaken in the pilot inventory process and the limitations and challenges connected to it, and outlines the basic results from the pilot inventory database and lessons learnt regarding the inventory process.

Drawing on this experience, a potential structure and strategy is suggested for up-scaling efforts towards a comprehensive and professional inventory and its usability to support the Government of Malawi's coordinating role as well as other stakeholders. The necessary resources and prerequisites for the implementation of this strategy are elaborated on, and ideas for incorporation in existing networking efforts are presented.

[1] https://pure.strath.ac.uk/portal/en/projects/malawi-scoping-study(5309d7c8-3d62-41f4-9358-c664b2429285.html

1 INTRODUCTION

1.1 Background

The Scottish Government International Development Fund (SG IDF) commissioned a scoping study on Supporting Community Energy Development in Malawi in 2011[2]. The scoping study was led by Professor Graham Ault of the Department of Electrical and Electronic Engineering, University of Strathclyde. The outcome of the scoping study resulted in the award of a SG IDF grant (£1.7 million) to Strathclyde University[3] to instigate the Malawi Renewable Energy Acceleration Programme or M-REAP. This project builds upon on a previously successful Community Rural Electrification and Development (CRED) project[4] between Scotland and Malawi.

The objective of M-REAP is to reduce poverty and tackle climate change and to empower disadvantaged communities in remote rural areas of Malawi to develop and sustain a variety of appropriate, affordable and sustainable renewable energy projects at the village level. To achieve this objective, we will work in conjunction with the Government of Malawi and other key stakeholders to accelerate the growth of community and renewable energy development through multiple, targeted and coordinated activities.

M-REAP involves a number of Scottish and Malawian partners. In Scotland, these are: International Organisation Development Ltd. (IOD PARC)[5], Community Energy Scotland (CES)[6], and SqurrEnergy[7].
In Malawi, the management of M-REAP rests with the Centre of Water, Sanitation, Health and Appropriate Technology Development (WASHTED) at the University of Malawi - The Polytechnic[8]. Our partners here include the Mulanje Renewable Energy Agency (MuREA)[9], Concern Universal[10], Electricity Supply Commission of Malawi (ESCOM)[11], Department of Energy (Ministry of Natural Resources, Energy and Environment)[12] at the Government of Malawi, Opportunity International Bank of Malawi[13] and the University of Mzuzu (MZUNI)[14]

M-REAP has four key streams, based on the recommendations of the University of Strathclyde scoping study:

- Institutional Support Programme (ISP)
- Community Energy Development Programme (CEDP)
- Wind Energy Preparation Programme (WEPP)
- Renewable Energy Capacity Building Programme (RECBP).

[2] https://pure.strath.ac.uk/portal/en/projects/malawi-scoping-study(5309d7c8-3d62-41f4-9358-c664b2429285.html
[3] http://www.strath.ac.uk/eee/news/17millionawardedtomalawienergyprogramme/
[4] http://www.strath.ac.uk/malawi/projects/communityruralelectrificationanddevelopmentcred/
[5] http://www.iodparc.com/
[6] http://www.communityenergyscotland.org.uk/
[7] http://www.sgurrenergy.com/
[8] http://www.poly.ac.mw/centres/washted/
[9] http://www.hedon.info/docs/E-MINDSET-CarryingOutCommunityBasedEnergyPlanningInSouthern Africa.pdf
[10] http://www.concern-universal. org/our_partners_in_malawi
[11] http://en.wikipedia.org/wiki/Electricity_Supply_Commission_of_Malawi
[12] http://www.malawi.gov.mw/index.php?option=com_content&view=article&id=75&Itemid=20
[13] http://www.oibm.mw/
[14] http://www.university-directory.eu/js/jredirect.php?job=686316&typ=5&jtyp=0&university=Mzuzu+University&country=MW&sid=19508&title=Bachelor+of+Science +(Renewable+Energy+Technologies)&ref=http://www.university-directory.eu/Malawi/Mzuzu-University.html)

The Institutional Support Programme is aimed at addressing the gaps in knowledge associated with off-grid energy management systems currently operating in the country. Although there are a variety of small-scale renewable energy projects operating throughout the country (e.g. solar photovoltaic installations, hydropower, energy-efficient cook stoves etc.), there is no clear or shared understanding around the relative merits of each approach. At the present time, the 'off-grid' sector is fragmented, inefficient and un-coordinated which prevents a coordinated regulatory approach by the Government of Malawi. As such, the scoping study undertaken by University of Strathclyde recommended the need for a national 'inventory' of off-grid energy installations.

The objective of this study is to create a pilot inventory of community off-grid renewable energy projects across Malawi that will serve as a tool for the management of community and renewable energy development for the Government of Malawi and partner organizations. This will facilitate an assessment of the potential for renewable energy sources, requirements and possible constraints for up-scaling and sustainable usage of a comprehensive inventory which could be owned, managed and regularly updated by the Government of Malawi and/or its appointed partner organization(s).

1.2 WASHTED

WASHTED is a Training and Research Centre within the Faculties of Applied Science, Engineering and Built Environment at the University of Malawi (UNIMA) – The Polytechnic[15]. The Centre has a diverse range of expertise in Engineering, Environmental Health, Social Sciences, Management and Information fields blended together for professional service delivery in collaboration with national, regional and international sector institutions. UNIMA – The Polytechnic has a long standing relationship with the University of Strathclyde going back to the 1970's and with Scotland since the days of David Livingstone. The Director of the Centre is Dr. Salule Masangwi[16]who, together with Prof. Graham Ault from the University of Strathclyde, leads the M-REAP Programme Steering Group. The M-REAP project coordinator within WASHTED is Mr. Kelvin Tembo[17], who has been working with Professor Ault for over three years on the CRED project.

1.3 RENAMA

Renew'N'Able Malawi (RENAMA) is a non-governmental organization based in Malawi with a primary focus on renewable energy promotion in Malawi as well as enhancing coordination in the sector. Prior to the instigation of this project, RENAMA had already established an extensive data base of stakeholders in the renewable energy sector and a range of data on diverse renewable energy interventions and had visited several projects to independently evaluate their socio-economic impacts and lessons learnt.

[15] http://www.poly.ac.mw/centres/washted/
[16] smasangwi@poly.ac.mw
[17] ktembo@poly.ac.mw

This was done in preparation of their ongoing web-based national peer-to-peer knowledge sharing and information database and networking project for involved stakeholders[18]. For these reasons, RENAMA was contracted through IOD Parc and WASHTED to undertake this task in conjunction with the M-REAP project coordinator. The Director of RENAMA is Ms Martina Kunert[19].

1.4 M-REAP Programme Steering Group

The M-REAP Programme Steering Group is led by Prof. Graham Ault, University of Strathclyde and Dr. Salule Masangwi, Director of WASHTED, and consists of programme partner representatives, the GoM Department of Energy and other government authorities, and other vital stakeholders. The final make-up of the Programme Steering Group will be determined at the first meeting between all partners, scheduled for the 11th of May 2012.

The pilot inventory and sample case studies drawn from it (Appendixes B and C), in conjunction with this report, will be presented to the Programme Steering Group at this meeting.

1.5 Definitions

The inventory focuses on **off-grid** energy provision. **Off-grid** is herein defined as "any trial, project or programme that is not currently connected to the Malawian national grid, and has limited or no prospect of being connected to the Malawian national grid in the next 5-10 years". In different contexts 'off-grid' does not represent the same situation. For example, remoteness of location, density of population and access to market, can all differ.

The inventory further concentrates on energy provision based on **renewable energy** (RE) technologies. **Renewable energy** is herein defined as "energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished). New renewables are small hydro, modern biomass, wind, solar, geothermal, and biofuels".[20]

For piloting the inventory, a clear **scope** had to be identified to clarify which out of the abundance of existing micro-, mini-, small- and community-scale off-grid RE interventions in Malawi, and based on which technologies, should be considered and incorporated in the database. Since M-REAP, according to its background and goals, focuses mainly on community energy projects, only these are a considered in the pilot. However, a clear definition had to be found for the term "community energy" and consultations among WASHTED, IOD Parc and RENAMA resulted in the agreement that at the pilot stage, the RE inventory would focus on:

[18] www.renewnablemalawi.org/
[19] martina@renewnablemalawi.org
[20] http://en.wikipedia.org/wiki/Renewable_energy

1) interventions based on involvement and benefit of local communities, and
2) interventions which are institutional installations providing benefits to a target group

but would NOT include:
- private sector / commercial installations which are serving purely commercial aims (unless they were designed to provide apparent additional benefits to a wider community, which would make them part of 2), nor
- installations and micro-devices which are owned and used by individual households.
Nevertheless, the inventory database format has been set up in a way that it could later on comfortably cater for those kinds of projects as well.

RE installations are usefully categorized according to their **scale** in order to determine the scope and impact expectations. The definitions which form the base of the categorization used in the pilot inventory (mini-grids, single/multiple installations, Community Energy Resource Management) can be found in the ToRs between IOD Parc and WASHTED in Appendices G&H.

Regarding the **type of RETs**, it was agreed that the inventory should embrace all available technologies, including sustainable biomass energy use as it forms part of the renewable energies and looking at its relevance being the predominant heat energy source to over 90% of Malawians today[21], and the current up-scaling of improved cook-stoves within many energy-related programmes in Malawi, it would be negligent and not reflecting a realistic picture if the inventory would bypass this component.

It also is important to differentiate between "programme", "project" and "installation" levels. Please refer to section 5.5 for their recommended use in the inventory database.

2 Approach and Methodology

2.1 Preparatory Work

Two meetings were convened to draw the Terms of Reference for the Inventory process and to design instruments for the project (5th and 6th of March, 2012). The meetings were attended by representatives of the contractors IOD Parc, WASHTED and RENAMA.

The pilot inventory study was undertaken between 7th March and 12th April 2012 and involved consultations with diverse stakeholders throughout the country (see section 2.2.5). However, the pilot inventory is mainly built on insights and experience from the existing database which RENAMA had been compiling since 2010 and which already involves a large variety of stakeholders in the sector, as well as overview data on diverse interventions. The creation of the pilot inventory involved the development of tools, desktop research and field visits to projects to verify data for some sample case studies.

[21] Considering the energy sector as a whole, reducing biomass burning has clear potential to bring about the highest impact and the most pro-poor outcomes. While the poorest stand to gain the most, the direct linkages between biomass burning and the quality of major 'public goods' (such as air quality and forests), everyone in Malawi would gain from reduced burning. Although electrical generation is a government energy priority, a huge reduction in biomass burning is also central to the delivery of the MGDS. As such, it is recommended that any package of SG support to the energy sector should take into account biomass burning, and not just electricity generation.

2.2 Steps of the Inventory Process

1. *Development of an appropriate set of questions for the collection of inventory data.*

   Questions which would inform knowledge on used systems and approaches as well as their impacts and dis-/ advantages were categorized in sections as outlined in Appendix A. For the pilot inventory compilation, a limited set of questions was used as the collection of more detailed data was out of scope of this assignment due to time restrictions. The questions in bold in the attached table are the ones which have been used in the pilot inventory to give an initial overview of project data.
   The Department of Energy was also consulted on the question framework to ensure that data perceived as crucial by them would not be neglected.

2. *Selection of stakeholders approached for data collection*

   As mentioned above, many main players in renewable energy installations and related projects had already been identified through a) the already performed research of RENAMA since 2010 and b) the Scoping Study commissioned by SG IDF in autumn 2011.

   These main stakeholders can best be divided in categories after their functional role in the projects, as categorizing them simply by the type of organization would not allow conclusions on the different types of implementing partnerships. Evidence shows that one organization can have a different stake/influence in different projects:

   - **Main Project Implementers** (mostly NGOs, but also private initiatives as well as specific Government ministries or institutions like OPC, University Departments, but also local government on District level like Assembly, Commissioner or District Health Office)
   - **Project Initiators** (mostly NGOs or donor agencies, but partly also local government bodies, CBOs, community-based or private initiatives) – on the long run it can be measured from this e.g if projects are generally more successful if initiated by NGOs, CBOs, GoM, etc.
   - **Implementing partners** (same as implementers, but with restricted responsibilities in the project)
   - **Installers/Contractors** (mostly private companies, but also experienced individuals being contracted by overall project implementers to do the technical installation and maintenance of RE systems, or University/Research institutions)
   - **Funders** (mostly bilateral donors, foreign governments or development funds, church-related organizations, foundations & trusts, international organizations, but also private donors, revolving funds or communities themselves)

- **Research Institutions** (universities, colleges, policy think tanks etc. within and outside Malawi who are involved in designing, monitoring and/or advocating of project and/or technology development)

In the pilot inventory, a number of stakeholders from each of the categories have been included. The selection was focused on ensuring that a reasonably representative range of most common projects in Malawi can be covered by the pilot. A list of the stakeholders involved is to be found in Annex D.

3. *Creation of an inventory database file*

It was agreed that the pilot database should be in form of an Excel sheet to ensure its usability by all involved people independent from access to or knowledge of sophisticated software. Existing and new data was copied or inserted directly into this Excel form.

Recommendations on the preferable file format for a bigger inventory are given in section 5.5.

4. *Data gathering, comprising projects of at least the main implementers in different fields of RE technologies.*

The data gathering took place in form of phone or personal interviews with the person who was presented by the respective organization as knowing most about RE projects of the organization. Where first contacts were by phone, these were followed by e-mailing the database questions to the counterpart for their completion. Personal interviews were partly followed up by sending the captured data in the inventory format for review and gap filling through the counterpart, if necessary.

In cases where local contractors were involved, their data was partly complementary but partly also contradicting the information from the project implementers. In these cases, it was necessary to seek individual clarification by phone or through personal visit.

Within the given time and budget, only basic data could be collected and most data sets are yet incomplete in view to the suggested data to be collected for a detailed inventory – they still require completion and partly confirmation/quality checking. This would be part of further inventory work. The level of completeness and reliability of the data is rated in the database, so that the user can judge if the data can be confidently used (reliability high), not totally confident but of use (reliability medium), or would need to be seriously confirmed on the ground before further use (reliability low).

Table 1. Recommended data sources and data reliability rating based on source.

Data Type	Data Source	Indication of Reliability
Project Overview Data, Financial & Scope of Project	public press releases in trusted media, informal information from implementers	Medium
	official communication or contract documents, personal site visits and beneficiary interviews	High
Technology-specific Details	contract documents, installer/contracter protocols, personal site visits	High
Device Performance & Maintenance	project reports from implementers, information from installer/contractor	Medium
	independent technical evaluation reports, interviews with beneficiaries	High
Ownership model, Outlook	Publications from project implementers	High
Impacts, community participation and sustainability	Personal site visits, interviews with beneficiaries	High

5. *Data sampling/verification through stakeholder meetings and live visits at a number of selected sites and/or contacting of project beneficiaries.*

Purposive sampling was used in the selection of projects sites visited to verify data and these were based on the following criteria:

- Projects from at least 3 different Districts
- Covering a variety of RETs
- In existence for a period of time, preferably 3 years (this criterion was neglected in favor of the second criterion as otherwise, only solar PV could have been visited and many interesting projects have only recently been developed which will inspire learning on community energy management).

Based on this, the following sites were visited:

(Northern Region)

- Household Biogas Digesters for Cattle Farmers (Biogas, Single Installation), Mzimba District
- Waste To Profit Market Sanitation Project (Biogas/Solar-Thermal/Solar PV), Mzimba District
- Nchoma Health Centre (Solar PV, Multiple Installations), Mzimba District

(Southern Region)

- Community Renewable Energy Development Project (Solar PV, Multiple Installations), Chikwawa District

- Community Centre Mirale (Solar Micro PV), Chikwawa Distr.
- Bondo Micro-Hydro Generation Project (Hydro-Electricity, Mini-Grid), Mulanje Distr.
- Kondanani Orphanage Institutional Biogas Digester (Biogas, Institutional), Thyolo Distr.

Six sites in the Northern, Central and Southern Region which were originally planned in the visiting agenda could not be reached due to the acute fuel shortage and the highly inflated prices for fuel on the parallel market which lowered the available budget considerably. Instead, more organization representatives than originally planned were personally visited during the ground-truthing trip (which were available in Lilongwe, Blantyre, Mzuzu and as such "on the way"), to increase the chance of getting detailed and actual data within the given timeframe, which proved difficult purely using phone or email in many cases. The stakeholders consulted in meetings during the pilot inventory exercise are named in Appendix D. They included commercial contractors, implementing NGOs, funding agencies, academic and research institutions.

6. *Creation of a set of single-page Case Study Profile Sheets which visualize the basic features of projects and lessons learnt.*

   These are meant to accompany the inventory file and visualize data for some representative case studies. Case Study sheets can be used to keep a user-friendly and compact overview of the most important data of the projects.

   In the inventory, these are presented in MS Word format. Using a professional database system, these Case Study sheets could quickly and simply be created from the available data with a few clicks, and be accessible to the respective GoM Departments and other stakeholders at any time. The Case Study sheets can also be printed and filed offline where ICT-based data cannot easily be accessed or used.

   Initially it was planned to create a number of these sheets based on those projects that could be visited and/or data verified on the ground reliably, however in the process it turned out that less sites could be visited, hence only 3 Case Study Profile Sheets were created for the pilot study presentation.

7. *Drafting a scientific-technical report on the inventory process, needed prerequisites and resources, potential constraints, and recommendations to the Government of Malawi on how to scale-up and administer an inventory of this kind for Malawi.*

3 FINDINGS FROM THE PILOT INVENTORY

3.1 Kind & Usability of Information Derivable from the Inventory

From the inventory, especially once it is up-scaled nationally and coherent M&E procedures are in place and followed, data can be derived for a variety of purposes connected to the coordination, management, planning and long-term sustainability improvement of RE installations and project:

Table 2: Examples for type of information derived from the database and its potential use / users

Type of Information	Potential User /Use
Technical performance indicators & average success rates of different manufacturers and technologies	Contractors as evidence to clients/project implementers; decision makers in procurement positions in GoM, NGOs and funding agencies
Success rates / reliability of contractors engaged in RE installations in the past	
Geographic spread of RETs in Malawi	GoM for holistic development planning: e.g. OPC, Ministry of Rural Development, MNREE ; decision-makers in funding agencies
Areas of renewable energy use – most apparent needs for energy supply (e.g. health, education)	
Success rates and challenges of different ownership models	Project implementers: for design and as evidence to donors; decision-makers in funding agencies, project evaluators
Comparative cost advantages of different technologies	
Average cost of certain systems, installations and interventions per site, beneficiary etc. in Malawi	
Percentage of energy supply from off-grid energy in comparison to grid energy in Malawi	GoM for infrastructure / energy planning: MNREE, ESCOM
Carbon emission reductions from off-grid energy projects	GoM: MNREE, esp. Dept of Environmental Affairs for planning, policy adjustments and reporting to International Frameworks

The usefulness of the inventory for a variety of stakeholders is hence very obvious, which should be utilized for motivating and engaging them in actively feeding into the database.

3.2 Summary of Pilot Inventory Data

In the pilot inventory, more than 270 installation sites were incorporated which were implemented or planned under more than 20 development programs and/or projects.

The RET types include: Solar PV (single and multiple installations), Biogas (community, household and institutional scale), Improved Biomass Stoves, and Micro-Hydro.

3.2.1 Geographic Spread Sites and Technology, Purpose of Installations

RE installations are spread all over Malawi's 28 administrative Districts.

From current data, there seems to be a clustering of **biogas** projects in the Northern Region due to the historical bundling of experience on this technology in very few organizations, specifically the University of Mzuzu, and very limited scaling-up of installations since the first known Malawian biogas trials in the 1970ies.

With regard to **solar photovoltaic** sites, a big number of them seem to be sector-specific (esp. health, education, agriculture) and are found either in schools and health centres where they have mostly been deployed in connection to governmental initiatives for lighting and basic electrification e.g. of vaccine fridges, or in irrigation schemes. As such, solar installations are spread throughout the country.
Solar PV as well as solar-thermal energy (water gysers) are used to a considerable extent in commercial settings and private households in Malawi as well but those are not part of the focus on community energy of this pilot inventory exercise.

There are 6 known **solar-wind hybrid** sites spread over all three regions initiated by government as village electrification pilot projects.

A handful of small-scale community-based **wind** electricity generation projects are so far known in the Northern Region around Mzuzu and in the Southern Region around Blantyre.

The only **micro-hydro** site for a whole community is so far known to exist in Mulanje and some smaller private initiative for household electrification were found in the North.

Rather systematic and documented **improved cook-stove** projects are so far known in the central region in Balaka and Dedza, in the South in Mulanje, and in the North in Rumphi.

3.2.2 Operational Status and Impact of Installations

Some of the sites in the pilot inventory are still in their planning or first implementation stage hence no comprehensive evaluation can take place so far.

Regarding the energy installation sites with expected community benefits which have been installed some time back, though the sampling of sites to verify data through live visits during the pilot inventory phase was fairly small and the existing database had to build mainly on data collected from different stakeholders, the assumption from the observations made so far is that a majority of them actually are partly or completely non-operational to the intended extent at this point in time. This has a number of different reasons, however these reasons seem to always fall in the same categories as shown in the next section – an indication that information sharing and common learning could have a great effect on improving the sustainability of community RE installations.

3.2.3 Common Reasons Observed for Project Failure

Projects building on or partly engaging RETs clearly build on 3 components for their long term sustainability: quality hardware & installation; appropriate community engagement, ownership/management and finance systems incl. support from local leadership and government; access to professional maintenance services and supply of spare or replacement parts and supplies e.g. from private companies.

Summarizing the data which was obtained and site visits undertaken so far, the common reasons for failures in these projects are suggested:

A) On the technical sustainability level:
- Design of systems undertaken by inexperienced engineers or not at all based on professional and realistic needs analysis (often technical people have not even been at site before installation, but source materials and install based on a rough estimate of energy of project implementer who are not technically familiar and also often underestimate the dynamics in the community which evolve once the "feel" of electricity is there…so overloading of batteries is more the rule than the exception)
- In most cases, no locally comprehensible and visibly published agreement is made with the community regarding their responsibilities and restrictions on use of the system is made, nor are any sanctioned connected to the misuse of the systems (e.g. constant drainage or overloading of batteries through excess or personal usage, use of vaccination fridges for cold drinks or "room cooling", etc.)
- Monitoring mechanisms are mostly based on capacity and staffing of implementing organization which is often limited to undertake regular visits to remote sites
- Maintenance contracts are expensive and often not planned in the budget (or for too short periods), and prolongation of maintenance contracts not planned in sustainability financing models though repairs can be more expensive
- No clear communication chain – who reports to whom in case of system failure
- Partly no response and no follow-ups from contractors or implementing organizations, or huge delays in response for different reasons
- Contact details (especially phone numbers) are generally very often changed and new ones not communicated
- Smaller, new local contractors seem to have short life-spans in some cases so new and more expensive maintenance companies have to be found and funded first

B) In community ownership systems:
- Trainings are often short and based on theory; since the technology is very "new" to people, unguided real case intervention in case of faults is connected to uncertainty and fear of being blamed by community if repair is not successful
- If a whole group is trained, often no clear leadership responsibility who does small repairs and pays for locally available spare parts (similar experience to "borehole stand-still syndrome")
- Models to establish a working and well-managed maintenance fund based on regular contributions of beneficiaries are still being developed; in many cases,

contributions are initial “one-offs”, in other cases people simply don’t comply with regular payment agreements as there are no real sanctions, in other cases responsible committees misuse funds or the amounts are not yet sufficiently saved up as first failure occurs well the before calculated replacement period because of misuse of systems

- Precautions (e.g. caging of batteries) against theft are often only taken after the first incidence has appeared, however no “best practice” which reliably deters armed robbers seems to have been identified for now, so risk depends fully on location and site environment.

These finding underline the urgent need for improving the monitoring and overview on RE interventions, if the considerable waste of time and funding resources – and more particularly, bad impacts on trust of communities in RETs and project implementers – are to be transformed into more effective self-help and development projects with real impacts on sustainable energy provision, based on raised awareness of common problems, learning networks and knowledge sharing.

4 Limitations to the Pilot Inventory Process

The critical lessons learnt and technical challenges faced during the pilot inventory exercise could have direct relevance on the design and management of an eventual up-scaled inventory, hence they are described here.

4.1 Scope and Information Value of the Pilot Inventory

As the selection of installations and projects in this case was based on purposive sampling, they merely showcase how a starting point for a comprehensive inventory can look like and what kind of data are generally available.

No definite, quantifiable conclusions on the status, success and impacts of community renewable energy installations in Malawi can yet be made based on the pilot inventory due to its incomplete nature, nor was such an evaluation part of this task. As described in the methodology section, the sites for which data could be collected were not based on representative sampling and most of it could not yet be verified. The total number and kind of RE sites in Malawi at this point in time is not yet known and can only be established through a wider and more intense inventory process.

Notwithstanding, it can already be stated based on this process as well as on former experience of the team that a considerable percentage of these installations is either partly or completely dysfunctional for different reasons (e.g. misuse by beneficiaries, theft, maintenance issues, etc.). Another very clear observation from this process is that hardly any of the implementing organizations representatives are aware of what others are doing in the field hence there is hardly any learning taking place.

4.2 Data Sourcing and Availability

It is the experience of RENAMA that without personal contact on a one-to-one basis or at least phone-based interaction with stakeholders, it is difficult to get reliable and complete data for each installation. This again was reconfirmed during the pilot inventory process.

This is not essentially because of a lack of willingness to share information, but mainly due to the fact that many implementers do not have the requested detail data themselves. It appears that there is generally a huge gap in monitoring and evaluation (M&E) of renewable energy related projects across most organizations.

The main causes which have been identified in relation to non-availability were:

- renewable energy installations often only being components within wider interventions and not much emphasis is put on their detailed monitoring and evaluation as the benefit focus might be on other aspects (RETs often instrument to reach other outcomes if within e.g. health or education programmes, apart from pure energy sector projects);
- M&E activities often having little emphasis on real insight and learning from projects but more on donor compliance;
- no coherent framework and limited capacity for technical monitoring (including awareness about remote monitoring methods and community participation in monitoring);
- partly interrupted or dysfunctional communication chains within or across implementing and technical partners;
- underestimation of costs / under-budgeting of projects so that all money is spent on implementation and nothing left for proper M&E;
- restricted responsibility of contracted installers and M&E not part of their contract.

The willingness for information sharing was generally good; however it apparently differs depending on the interest of the stakeholder category. It was important to explain the purpose of the inventory study to the stakeholders to obtain their confidence in submitting honest data. Occasionally it as important to emphasize that the data gathered would not be used to "check" on the projects by the Government. Some people expressed concern that that the data gathered could result in them being penalized, for example, through additional taxes raised by Malawi Revenue Authority or regulatory restrictions which would disadvantage the project/community.

This observation makes it worthwhile considering if it would be more conducive or even necessary for a true and complete inventory to accommodate the data collection and updating process within a "neutral" organization, e.g. an academic or para-governmental institution or a non-governmental expert organization in close collaboration with the dedicated government entities, based on Memorandum of Understanding.

Generally, **technical data** on the installation is best sourced from the contractors who normally have knowledge of problems or faults of the system, particularly within the one year warranty period which is obligatory for installers registered with Malawi Energy Regulation Authority (MERA)[22], or if a maintenance contract was part of the installation. The contractors also have detailed information on true installation costs split in material and labour. This separation is necessary to determine rather stable (e.g. material costs) and rather installer/location-depending parts of the costs (e.g. transport, margins, etc.). Such detailed information is a precondition to calculate average costs per kwh and compare technologies in an upgraded inventory. This information is often not easily available from the project implementers as it would require them to search in their archives for the detailed quotation from the chosen contractor on which the overall project budget was based. This is sometimes adjusted in the final invoice as the project funding is often approved much later than when it was planned.

Data on community involvement, beneficiaries, sustainability and socio-economic aspects is usually available from the overall project implementers, although this is not always the case. The implementers are normally the ones who originally developed the concept and applied for the project funding. They determine the particular outputs and outcomes and supposedly plan in particular methods and levels of community participation and ownership, maintenance, income generation, as well as exit strategies. To get specific data on projects which are still running and have extension staff of the implementing organization in the field is easier to obtain than detail data on projects which have phased out. It appears that several project concepts foresee that the hand-over of the installation to the community forms the end of the project, hence the community is left alone with a very new self-responsibility and no additional follow-ups are budgeted into the project funding. An important observation was that many projects don't seem to be based on site-specific baseline assessments, but rather on general statistics for the Districts (which can otherwise be sourced from the District Offices or socio-economic profiles of the District, where available). The detailed inhabitant figures and socio-economic profiles on community or Traditional Authority level can only be sourced from the Village Headmen and Traditional Chiefs either through implementers' staff, phone or personal visit. This kind of data is very important to get a clear understanding of the benefits of the individual projects.

Real benefits, impacts and challenges as well as reasons for malfunctioning of technical systems are best sourced directly on the ground, however the understanding is of course influenced by the time and circumstances of the visit and the counterparts and interviewees.

4.3 Need for Data Verification

As stated above, it proved nearly impossible to compile complete and reliable data only based on impersonal and unsolicited data requests and from only one of the involved stakeholders. Especially regarding the data on community ownership and sustainability,

[22] MERA registered contractors are the only ones who can respond to procurement tenders by the big-scale NGOs and funding agencies. However, there are a number of smaller projects working with non-registered contractors.

the information that implementers give naturally differs in many cases from what the beneficiaries report, and often implementer data is not up-to-date due to long intervals or complete lack of M&E follow-ups at later stages of the project. Thus it is hardly possible to obtain a fully trusted/useful set of inventory data without visiting the site at least once. This has to be considered when planning the time, staff and monetary resources for an up-scaling of the inventory process.

However, a single visit can in most cases still not bring the whole truth and all complexity of the ownership system to light, especially when there are hidden conflicts. Hence the idea was born to leave simple but helpful monitoring sheets in vernacular language (Chichewa) with the designated responsible person(s) for the system in the visited communities and possibly follow-up with beneficiaries directly (by phone, if repeated visits unlikely) in semi-annual or annual intervals, to witness the truth on the ground and newer developments in the installation environment.

We would also like to stress the importance of presenting the purpose and scope of the inventory properly to the beneficiaries. It is crucial not to create wrong expectations on the data collectors/inventory team to become involved in the problem solving which will influence future readiness within the community to respond to questions.

Travelling to remote villages where the RETs are predominantly installed takes up immense time resources. This is because rural roads in Malawi are usually un-tarred and in a state of disrepair and have to be driven slowly and carefully in order to avoid accidents as well as protect the vehicle from being seriously damaged. For example, reaching a site about 10 km from the tar road can take up to 45 minutes on a typical narrow mud road. During the rainy seasons, it can take longer and many roads become impassable and hazardous. Several sites with RET installations, however, are 60-70 km from the main road, meaning about 2-2.5 hours drive from the main road, and not always are there several sites connected through the same road.

To get a realistic insight into the functionality of the system and possibly have a demonstration, and to get together and talk to a number of beneficiaries and possible committee members or others involved in a culturally acceptable way in order to receive honest answers and learn about challenges, takes on average at least one to two hours. If the village is very remote and does not often receive visitors, it is sometimes necessary to follow invitations of the Chief to his house which takes up additional time. Since dusk starts between 5.30 and 6 p.m. depending on the season and it is not commendable to travel in the dark, journeys have to be started well before normal office hours

Considering the huge resources if time, funds and human resource necessary to verify data for all future sites on the ground, an improved and coherent system of data collection and project monitoring involving all stakeholders is crucial to capture future installation from the beginning in a more efficient and cost effective way.

One idea would be to introduce an obligation for all RE installations to obtain a license beforehand or be registered with the database by the installer or project implementer once the installation is done. This could be take up in existing policies like the MERA

registration duty for solar installers, who are up to now not yet forced to report each installation to the authority. Other sources of energy supply like biogas digesters or improved biomass stoves are not yet included in the monitoring of MERA by now. However, putting bureaucratic hurdles on community renewable energy projects could actually reduce the motivation of project implementers to implement renewable energy projects as it would be connected to considerable additional time and human resources as bureaucracy is generally slow-paced in Malawi. Hence, a system needs to be put in place which simultaneously

- makes it simple and fast for implementers and contractors to report frame data on the project to the database once a new installation is installed (and possibly in the planning stage)
- involves remote monitoring of the technical system functionality data through data loggers, to be monitored for each site by the responsible technical monitoring responsible, and centrally by the coordinating agency who maintains the database and the beneficiaries
- involves remote M&E of general project performance in terms of real benefits, challenges and lessons learnt, in which beneficiaries and local leaders are engaged through standardized forms and facilitated by government extension staff e.g. a specific District Energy Officer or existing outreach staff who gets the responsibility to regularly collect and forward the data to the inventory agency.

Under these circumstances, the necessity for personal visits and related costs and efforts could be reduced to a sampling of sites for verification on an ongoing basis.

4.4 Required Resources for Data Collection and Verification

A significant amount of time and perseverance are prerequisite in order to collect data on this detailed and comprehensive scale, and particularly for the quality controls of the data in the field as described above.

Based on the budget allocated to undertake this study by the consultant, a period of only 15 days was available. The human resource allocated to the project was restricted to the RENAMA consultant and the M-REAP Project Coordinator at WASHTED. In reality, significantly more time is necessary for stakeholder identification, data collection, ground-truthing and report writing. Had data and experience from the RENAMA database not been made available, the comprehensiveness of the pilot would have been seriously adversely affected. For up-scaling the inventory exercise, the real cost of accessing data based on efforts from other agencies must taken into account.

The existing RENAMA database is based on ongoing desktop research, stakeholder meetings and pro-active networking since 2010, and is estimated to have captured 90-95% of renewable energy stakeholders in the country.

A few smaller organizations undertaking pilot projects as well as privately initiated community installations are still occasionally discovered through word-of-mouth from within personal networks, as well as new players coming in which sometimes only become visible after some time of operation.

However, knowing the stakeholders and finding basic data on the projects is only the starting point. Average information published in reports, Public Relations publications or on websites often don't contain much more than the District and Region within which the project is located, the main purpose of the project, and the beneficiaries (type, and sometimes number). However, these sources are by nature mostly focused on either informing the public about a freshly started or ongoing project, or on presenting positive information on the success of the project in order to attract more funding while neglecting challenges and details.

The typical data sourcing process per installation from the point of knowing the stakeholder and the name of the project was as follows:

1. 30 – 60 min for checking all available data on the Internet and, if available, extract all relevant information on the project; shorten and copy it into the appropriate gaps in the database format;
2. 5-15 min to call the organization and identify the person with the best ability to deliver data on the project, possibly through several other people
3. 15 min for an introduction of the data collector and inventory exercise and agree on best way to get data – either by meeting, e-mail follow-up or other contact

4.a) If e-mail data delivery agreed:
30 min to create an individual table for this organization/project with the already sourced data on the project – and send it off with a few appropriate lines via an email template
30-60 minutes on average for mail and phone follow-ups to clarify on data and insertion of delivered data, depending on the responsiveness and quality of data received

4.b) If meeting agreed: depending on location of counterpart, pure interview time on average 35 min (for simple, user-restricted installations) to 75 min (for installations with community involvement or complex structures).

This must be complemented by data quality checks through site visits, where possible. Given the time requirements for this as outlined above, maximum two or three sites a day can be visited with satisfactory results, if these are close together. There are hundreds of sites in the country. If we would just assume about 1000 sites, this would mean that a person dedicated to ground-truthing data at all sites once and visit two sites per day, s/he would be busy every working day for more than 1.6 years.

The chronic scarcity of fuel in Malawi affected the efficient planning and undertaking of site visits for the pilot inventory case studies. Travelling was constantly restricted in these last months and the actual reach of the vehicle during a multiple-day-trip to a certain region cannot be pre-determined as the situation of fuel availability changes

weekly and does not follow predictable patterns. Hence it is hard to combine all sites in a geographical zone in the most cost-effective and time-saving way. Instead, several trips might have to be planned to reach sites in one area, for which additional time and money resources have to be planned in. Such a survey also requires overnight accommodation, sometimes in very remote areas without access to lodges.

This again leads to the need for inclusion of remote M&E system that anticipates data collection needs before new projects are installed in order to reduce the need for visiting each new site personally. As this system has not been in place for existing sites, the majority of these will still need to be visited and an M&E system introduced by the inventory team as in many cases the implementers' responsibility for those sites has already phased out.

4.5 Grouping of Data Sets in the Database

It turned out tricky to differentiate between **"programme", "project" and "installation" levels** in the database, as they are often used by stakeholders interchangeably. There are several broader development programmes under which a variety of projects can take place, partly spread over several communities and districts with different baseline indicators and target groups. Installation of RE systems or distribution of RET devices are often components within such programmes or even within projects. For example, a certain donor might have supported the installation of solar systems in 50 health centres as part of a broader maternity health programme. To just capture this information on the programme level might inform the reader of the inventory about the most experienced funding or implementing stakeholders, but will create challenges to even know basic details on the particular projects (location? which part of the budget went into the actual RE components? specific target groups for the RE component? etc. Even if all systems were based on the same technical inputs, this information would not provide insight into any project-specific experience, lessons learnt, challenges faced etc. on any other than the purely technical dimension. Hence it is necessary to break down each programme into individual projects, and where these consist of more communities, sites or technologies, it makes sense to split these again into individual installations to understand the impacts and challenges better.

At the same time, an RE installation can even be done without being part of a so-called development project, e.g. if an individual person decides to purchase a solar-powered irrigation system for his home village, which is maybe installed by a local company. The data provided for this installation will most probably be purely technical and is somewhat different from a comprehensive development project which involved community training, monitoring and ongoing support through embedding in a wider activity with the same community. However, exactly the self-organization skills that the community will have to develop in this model may be interesting to look at.

In this inventory, each single installation, set of installations or distribution intervention (in case of individual portable systems) which is set up in one community at one time under one initiative will be considered as an individual project in the sense of the

inventory and get an individual entry in the database, with each entry being grouped under the wider programmes they have been part of, if applicable, and sub-grouped under the project intervention they are part of (see Appendix B).

4.6 Software Requirements of the Database

As for this pilot inventory, the Excel format was chosen due to compatibility reasons as mentioned above. However, already in the context of the comparably small volume of data sets, it proved extremely tedious to keep an overview of the entered and missing data as there are many columns/questions, which makes it hard to connect data from columns that are far apart in the table. For a comprehensive long-term database, it is strongly recommended to use a common but professional form-based software because of the following reasons:

a) lower risk of irreversible data loss or mixing up of data through human mistakes
b) user-friendly data entry as changes for repeating information bits are automatically replicated
c) easier overview without scrolling around in endless Excel sheets
d) user-friendly and target-tailored presentation options through automated forms and reports
e) possibility to involve stakeholders in remote data entry to ease regular update of database
f) possibility to share information with other stakeholders without creating extra workload

The RENAMA database is being built on Microsoft Access infrastructure.

5 Recommendations on the Way Forward

There have been different efforts in the past to create frameworks for coordination of renewable energy activities, both by the Government of Malawi and the private sector/main installers. However, none of them have proved sustainable. UNDP under the BARREM programme had financed a specific position to support GoM in its coordination role for REs, but with the phase-out of funding, the same phased out as well. The Renewable Energy Industries Association of Malawi (REIAMA), a national membership association comprised of private companies (mainly solar suppliers and installers registered with MERA) was initiated under the National Sustainable and Renewable Energy Programme (NaSREP). It is currently dormant, reportedly due to conflicting interests of different stakeholders and lack of resources.[23] This experience suggests that sharing the coordination task, especially involving a neutral agency without particular conflicting interests and rather independent of single-sided funding, to bring together implementers, contractors, research and government authorities, might have a greater chance for long-term sustainability, efficiency and support.

[23] https://pure.strath.ac.uk/portal/en/projects/malawi-scoping-study(5309d7c8-3d62-41f4-9358-c664b2429285.html

This raises the question as to which organization should be "holding" the database, e.g. Department of Energy or another office under MNREE/GoM, MERA, an independent expert agency? There are different options thinkable regarding who should be responsible for the updating, upgrading and long-term maintenance of the database, e.g. internal GoM capacity or long-term collaboration based on MoU with a contracted consultancy company, academic institution, or non-governmental partner organization(s) with related goals and activities. To make a careful choice on this is crucial to the success and sustainability of the inventory! Long-term requirements in terms of secured human capacity, the organization's mission and focus, avoidance of conflicts of interest, easy access to reliable data based on confidence of stakeholders, and available/potential funding resources must be considered. Another relevant question to ask is how and who in existing GoM structures could contribute and might hold responsible to collect data from stakeholders which can then be regularly compiled/updated, e.g. District Offices in the absence of MNREE staff on District level?

Rather than developing an inventory for the sole use of the GoM, multiple benefits can indeed be derived from embedding the inventory into a vivid, inclusive network of Renewable Energy stakeholders which is publicly accessible. This would enhance the RE project implementers' dedication to contributing reliable and updated information to the inventory as they can themselves benefit from the learning experience and partnership potentials this would offer. This should also be considered when deciding on the best agency to maintain the database.

As mentioned above, the beginning of M-REAP coincided with the ongoing endeavors of Renew'N'Able Malawi to create a publicly accessible information sharing, coordination and learning platform for all stakeholders involved in RE interventions in the country. This initiative evolved based on the understanding of the current apparent lack of coordination and shared learning, which has been reconfirmed by governmental or non-governmental/humanitarian players, private sector and donors. RENAMA had also started partnering with WASHTED (as the Centre is in the process of scaling up its Appropriate Technology Development section) and other research institutions in order to enhance the exchange and involvement of Malawian academia and research, which is often not used in renewable energy project design in the field to the full potential, despite the abundant capacity available at the University of Malawi and other colleges.

Prior to the instigation of the M-REAP project, RENAMA introduced to the Department of Energy and potential donors a concept of a networking portal based on the Internet, which contains interesting information for RE stakeholders in Malawi. It was suggested that this should be made accessible in a concentrated "one-stop" portal (e.g. new evaluation reports, baseline studies, technology news, best practice compilations, toolkits and manuals in English and Chichewa, recent calls for proposals, tender announcements, partnership requests, discussion forum, newsletters etc.). Via the same portal, peers themselves can also register and access the database using a dedicated password, and can even submit additional data, reports, pictures etc. of their projects to the database through a web-based form. The concept foresees that users can only register after a certain minimum of own data (in terms of quantity and quality) has been

contributed to the network by them so that it is a peer-to-peer network of high information value and attraction to participating stakeholders. This approach would help to reduce efforts of data collection by the inventory team and ease the overview of DoE on all new developments in the sector.

RENAMA continually consulted members of the Department of Energy in the process of its research and conceptualization of an overarching RE network and database, and partnership was already endorsed. Within the Department of Energy, one staff member has recently been dedicated to improving the RE overview and coordination function. A number of potential financial supporters for a wider ranging database and networking exercise have already been identified and some have been contacted to prequalify for submission of a funding proposal.

Furthermore, a range of Malawian networks and associations are in existence e.g. in relation to topics like climate change mitigation and adaptiation, environmental protection, improved biomass energy use[24], and policy development in the same sectors. Linking up with these initiatives can enhance access to data and widen the outreach of the inventory in broader learning networks.

The following are the recommended actions to be taken to push forward a comprehensive national database for RE projects.

5.1 Create Alert System for Reporting of RE Projects by Involved Stakeholders

As reasoned in 4.3, it is commendable that an alert system should be installed that regularly reminds stakeholders to report on new and planned RE related projects. All stakeholders should be encouraged submit their data at regular intervals, so that the database can be regularly updated and as few projects as possible are neglected. This could be done either through serial mailings and follow-ups from the inventory team using links to a web-based form that automatically feeds into the database.

5.2 Establish M&E Standards and Policy Guidelines for RET Project Implementers, Installers & Beneficiaries

As reasoned, in 4.4, only through a coherent monitoring and evaluation on the side of the project implementers and/or RET installers in the field is it possible to assess and compare impacts of those projects over longer periods. Any inventory team cannot visit all sites repeatedly within short timeframes without requiring an unfeasible burden in terms of human and financial resources. However, an inventory showing that "so and so many kwh" of electricity from renewable energies is generated, while a high percentage may not be functional any more after only 2 years, would be totally misleading.

[24] E.g."MBAULA" - Movement for Bio-energy Advocacy, Utilization, Learning & Action – facilitated by RENAMA via www.renewnablemalawi.org/mbaula.htm

Hence a set of sample forms and guidelines/manuals for standardized data capturing in the framework of monitoring RE sites should be developed and distributed to implementers and installers and periodically collected. Project implementers and installers trained and advised on their usage (this could even be done over a distance) by the inventory agency and enforced by related policy frameworks. Incentives in form of e.g. access to information and preferred consideration for particular programmes may be considered to motivate the implementers to deliver high-quality data on their projects. As most of the projects have a phase-out date, it can thus at least be ensured that all basic data on the project are in the database before and then the community/Distrcit-based monitoring system can add on further developments facilitated through follow-ups by the inventory team.

To enhance participation of the community at site / beneficiaries and local leaders, specific forms concentrating more on the benefits, social and sustainability aspects of the projects can be created in vernacular language and these could be introduced e.g. by District Office outreach staff when new projects start, be filled in regular intervals and collected at site visits and scanned or posted to the inventory agency, so the perspective of the community can be incorporated in addition to that of the implementing organization.

In terms of monitoring of technical problems in project communities, another idea would be to hand out drawings when the project community trainings are held, based on which people can indicate the type of breakdown through numbered option, and also give an indication of how long the system was out (particularly for sites which are not based in schools/clinics and where basic literacy or confidence in written language may be lower). These sheets could be used as a standard tool by implementers and contractors to determine common problems. The possibility of using a mobile phone to submit details based on the form to the maintenance responsible needs to be explored in more detail.

5.3 Identify/Develop Appropriate Remote Technical Monitoring System for Installations

One of the most common problems discovered at RET sites as outlined in chapter 3 is that no follow-ups are done by the implementers after a certain time-frame (which is exactly when most technical problems tend to occur). Often, responsibility for maintenance is generally unclear after the end of the project, especially if no prolonged maintenance contract has been agreed with installers. Even in case there is a maintenance responsible outside the community, communication channels do not work and the community has problems to identify the particular problem or describe it over a distance, though they are very often of simple nature and could be solved through distance advisory if known.

Another aspect found was that technical breakdowns or cuased by preventable misuse of systems, in most cases constant battery overload/drainage. One way of preventing this would be if alerts would be automatically created to inform a responsible in the

community as well as the installer about the system status, so it is known by the beneficiaries that their system is under supervision and that it will break down if they go on using it as they do. I would also allow a central operator, project implementer or maintenance responsible to know if a system is offline and take quick measures to restore functionality.

A range of commercial companies offer tools for remote monitoring of RE installations, however the cost is normally high and there are certain compatibility issues which need to be considered as the range of products used in RET installation in Malawi is naturally varied.

However, there are promising studies on remote monitoring of RET sites, in these days a common and highly relevant need in many developing countries with simlar preconditions for rural energy supply and hence being heavily researched. Some suggest that remote monitoring of certain technical performance data captured by data loggers and transmitted through GPRS modems / mobile phone technology can be done based on simple technology at low-cost.

A system needs to be thought through regarding who is responsible at which stage of the project to install these devices, and who pays for them. For new projects, this could go together with the previously raised idea of encouraging implementers/contractor to register new projects at the database – e.g. if they do it in advance, they get data-loggers installed for free from the DoE which will also enhance their own performance monitoring and donor reporting. Possibly, on District Level a number of dedicated persons should be trained to install these devices and be at site when the installation is just done.

As the M-REAP programme has a component on remote monitoring, hopes are that an appropriate system can be identified in collaboration of the DoE with the programme partners in this context.

5.4 Develop and Maintain a Comprehensive National RE Inventory

A possible way forward for GoM towards the rapid creation of a more comprehensive and useful inventory on Renewable Energy Projects in Malawi could be the following:

STEP 1)
Review the pilot inventory database structure and Case Study information and discuss additions/adjustments according to the needs of the GoM, if necessary

STEP 2)
Outline the main goals and benefits which GoM and its particular involved Departments would target with such an inventory, so that its layout and handling later matches the purpose

STEP 3)
Determine who should be responsible for and administer the database (see discussion in the introduction to chapter 5) and based on what agreements

STEP 4)
Plan time, human and monetary resources to perform the up-scaling exercise and maintain long-term updating, report creation and publication

STEP 5)
Identify potential funding sources and application for funding (in cooperation with partners, if applicable)

STEP 6)
Set up the final database system, design data submission forms and identify which reports are needed in which periods and by whom – if so decided, establish website for web-hosted database and network management

STEP 7)
a) Incorporate existing data from pilot inventory & RENAMA network into database
b) Start upgrading/complementing and collection of new data
c) Develop M&E tools for data contributors and ground-truthing team

STEP 8)
Train and send out data quality checking staff for site evaluations based on standardized evaluation tools and systematic identification of sample sites

STEP 9)
Officially launch data inventory: inform all RE stakeholders about the launch of the new database and possibility to submit data, contribute, and seek partnership support through PR activities

STEP 10)
Distribute standardized M&E tools to project implementers and installers for periodical submission, and follow up

STEP 11)
Circulate regular update newsletters to involved stakeholders to keep the momentum running and motivate eager data contributors with special incentives, like featured articles in the newspaper and/or newsletter, etc.

STEP 12) (optional)
Organize regular stakeholder meetings, RET networking events, national or regional trainings/workshops for data contributors/network members, etc.

5.4.1 Time implications:

See section 3.3 for an estimate of time resources spent per site. In summary, a realistic assumption is that each site will take about 3.5-5 hours to capture basic data on it (not included travelling time if meetings are involved, plus the time needed before-hand to find out that the project exists, plus the time for technical detail confirmation from a contractor (if applicable), plus the time for completing/verifying data on the ground which can be considerable. Thus, the whole process by installation, depending on location of the site and the implementer, can take between one and three days. Assuming that there are at least 700-1000 installations expected to be in Malawi at this

point in time, many of which have the same technical specifications and similar ownership models but different performance history and sustainability levels, at least 3 persons fully dedicated to the data collection and administration process would be needed to make the inventory somewhat complete and reliable within a year.
In any case, the need for remote monitoring to reduce the resources needed for "ground-truthing" and the carbon footprint of travelling to all sites cannot be over-emphasized.

The experience from the pilot inventory and its pre-works has shown that desktop research can bring about basic information on installation sites, but covers only a percentage of existing installations. It often requires inquisitive step-by-step research through a variety of stakeholders to find out more about remote projects particularly of smaller organizations, which often involve communities particularly much, and considerable amounts of time and perseverance are needed to get hold of detailed information. Evaluation reports are not publicly accessible for most installations, especially when they are part of a wider programme or implemented by smaller NGOs or private initiatives.

The success of a coherent and complete inventory hence also depends on an extensive network of acquaintances in the field. Instead of starting from scratch with an inventory team who has not been involved in related activities in Malawi for some time, it would thus make sense to build on the existing network and pilot inventory expertise so that already spent resources can be fully utilized.

5.4.2 Cost Implications:

The following are estimated equipments and human resources needed to create a comprehensive inventory within a year, as well as structures for its sustainable maintenance, updating and incorporation into information sharing networks.

This estimate builds on the suggested remote monitoring of sites functionality through mobile devices and on decentralized data sourcing from implementers as well as District Offices through community M&E reports to make it feasible and reduce costs and time of travelling, but also involves the necessary personal ground-truthing / verification of data at a percentage of sample sites every year by inventory project staff.

Equipments and infrastructure for inventory database:

- Purchase of database software (if not yet owned)
- Website development and hosting costs
- Availability of office infrastructure for 6-7 staff
- Availability of 6-7 PC workspaces and broadband Internet connection for database & website hosting and data administration
- Landline/mobile phone communication costs (in the first months of setting up the database high, then lower levels for updates and new project capturing)
- Project vehicle (4x4/off-road) for site visits, mainly in remote villages
- Costs related to publication and distribution of printed reports and other documents, and PR

- Organization overhead costs, where applicable (depending on scenario)

Equipments and infrastructure for remote monitoring and decentralized data compilation from sites:

- Purchase of data loggers for installations (depending on the chosen approach)
- GPRS devices/network infrastructure (depending on the chosen approach)
- M&E Material development in English and Chichewa, printing and distribution to installers, implementers and communities
- Availability of infrastructure to host training sessions for implementers and contractors (the ladder could be trained in the logical framework of MERA)

Human Resources:

- Salary for 1 database specialist or other person with very advanced knowledge and experience in MS Access or similar software to
  - set up the database structures, forms and reports
  - train the data entry responsibles on user functions and provides ongoing support and problem solving on the database
  - overlooks data entries and quality check on the database
  - maintains linkages with the web-entry forms
  - set up an alert function system for new installations with all known potential implementers/installers and overlooks its implementation
  - adjusts new contents when necessary
  - creates monthly reports for stakeholder updates

- Salary for 3-4 staff for collection, entry and administration of data who will, among other tasks (depending on chosen approach):
  - research, capture, enter, sort and follow-up on required data and maintain the database
  - create specific monitoring tools for RE installations to support specific data provision through RE implementers on the long run
  - undertake site visits for data verification
  - regularly circulate requests to stakeholders to update their data (either web-based or through e-mailed forms or based on phone interviews, where no Internet available) and follow up on the returns
  - regularly create and circulate update reports to GoM-related stakeholders like Department of Energy, MERA and other identified recipients, create newsletters and publish data summaries for RE networks and publications
  - create and update mailing lists with contact emails of registered network participants
  - support the fundraising for and preparation of further RE coordination activities e.g. stakeholders meetings, M&E trainings, network events, etc.

- Salary for 1 management staff who
  - overlooks the database set-up and maintenance process,

- supervises the database administration and support staff,
- ensures timely reports and communication to stakeholders,
- identifies strategies for further potential RE coordination activities like stakeholders meetings, M&E trainings, network events and funding thereof
- coordinates Public Relations, etc.

- Salary for 1 accountancy & finance staff who administers the finances of the project and supports fundraising activities

- Upgrading of existing District Office extension staff or Employment of District Energy Officers? (depending on chosen approach)

Trainings:

- Costs connected to training and logistics related to
  - making existing government extension workers in rural development (e.g new "District Energy Officers" or upgrading of existing District Officers and extension staff e.g. in health or education) become reliably involved in data sheet collection in project communities, especially after project implementers/contractors draw out
  - setting standards for RE project reporting and monitoring for implementing organizations and communities.

6 CONCLUSIONS

The Government of Malawi has expressed concern for the prioritization of renewable energies complementary to the existing dependence on grid electricity from hydro power which is yet insufficient, and has identified this as a decisive step towards creating better livelihoods especially in the rural, largely non-electrified areas of Malawi. Apart from this, concern is raised by the alarming rate of deforestation and increased vulnerability of rural communities through climate change impacts, so that alternatives to inefficient and harmful biomass burning are needed and respective policies are in place.

The compilation of detailed evidence on renewable energy interventions and community energy provision concepts, in a coherent and comprehensive inventory would support the Government of Malawi's crucial role, and particularly that of the Ministry of Natural Resources, Energy and Environment, in overlooking the status of and coordinating renewable energy related projects by enabling staff to:

- ✓ Get better overview of main stakeholders in the field and use their experience in technological/community ownership/sustainability aspects of renewable energy project delivery to build strong partnerships

- ✓ Be able to link organizations with complementary strengths and weaknesses up in order to accomplish more successful, sustainable energy projects for more Malawians
- ✓ Identify promising concepts and pilot studies for up-scaling and be able to make informed suggestions to development aid agencies based on demonstrated facts of successful approaches
- ✓ Attract more funding for renewable energy projects based on visible dedication of GoM to learn from past lessons and improve project outcomes
- ✓ Get regular updates on the development of the renewable energy sector in Malawi and, in the long term, be able to indicate correct share of RETs in energy mix based on real and actual information, enabling better policy and strategy formulation
- ✓ Identify well-working technology components, ownership concepts as well as most reliable, quality-driven installers through comparison of failure rates over the mid and long term, and be able to grant incentives for proper project conceptualization
- ✓ Ensure technological quality through better knowledge on useful systems and support regulation and standardization of quality in RETs
- ✓ Become widely acknowledged for good knowledge sharing facilitation and pro-active support of renewable energy development, incl. rural electrification, climate change mitigation, reduced deforestation through more efficient biomass use and environmental protection, as well as related business stimulation

The present pilot inventory study and existing database has shown that a comprehensive and up-to-date inventory is possible in order to reach the above goals and enhance learning and information exchange, however it is connected to a number of constraints and preconditions which need to be tackled, as highlighted in section 4 of this report. The requirements in terms of minimum time, money and human resources have been outlined above in section 5.

In order to take forward the pilot inventory to a Malawi-wide operation, the recommendations made here need to be taken forward in a coherent manner. The presented elements of the up-scaling exercise and all critical questions incl. options for scope, scale, ownership etc. should be given thorough consideration by the responsible government stakeholders, so that a well thought-through full proposal can be prepared in collaboration with chosen partner organization(s). This shall result in a sustainable network and database widely and actively supported by all kinds of stakeholders due to its benefits on many fronts, and well linked into related, existing and new networks to make it a known, trusted and useful tool for the Malawi energy sector coordination.

APPENDIX

A Data Collection Format: Suggested Data Categories and Questions

B Pilot Inventory - Excel Sheet

C Set of Sample Case Study Sheets

D List of Key Stakeholders

E Presentation for the Programme Steering Group

F Terms of Reference IOD Parc to WASHTED, 23rd March 2012

G Revised Contract, IOD Parc to WASHTED, 2nd April 2012

Project Overview	**Status: COMPL (project phase over), ONGO (project ongoing but not yet evaluated), START (under construction); PREP (funding approved but not yet fully installed); PLAN (funding not yet approved); OOO (Past project, installation out of order and no plans for rehabilitation)**
	Programme Name
	Programme Description
	Intervention #, if under wider programme
	Project Name
	Short Description
	Main Implementing Organization
	Type of Implementing Organization
	Initiator
	Type of Initiator Organization
	Implementing Partners
	Technical Installer / Contractor
	Funding Body
	Sector
	Total Budget*
	thereof: labour for installation**
	thereof: material costs for installation***
	Funds Spend to Date
	Unplanned/unbudgeted costs for replacements or maintenance
	Start Date (overall project)
	Start Date (technical installation)
	Hand-over Date of Installation
	Project Phase-Out Date
	Project Timescale (in months)
	Exit Strategy

Technology	**Technology Category: Solar PV, Biogas, Wind, Solar PV-Wind-Hybrid, Improved Biomass Stoves, Bio-fuel, Solar-Thermal, Geo-Thermal, Hydro-Electric, Hydro/Tidal, Hydro/Wave, Magneto-Electric, Other (specify)**
	Technology Details (No. Of panels/batteries/inverters/digesters/turbines etc.), Rating, Voltage, Type, Ah/KwH, AC/DC, Ah/Size, digester size m3, etc.
	Intended Use
	Manufacturer(s) of main components
	Country/ies of Origin of main components
	Manufacturer Warranty Period
	Fuel Type, if any
	Energy Output Capacity (nominal)
	Energy Storage Capacity (nominal)

Device Performance & Maintenance	System design and operation adequate to intended use and environment?
	System performance status (working as planned, partly working, dysfunctional)
	If deficient: Faulty Parts
	Reasons for malfunction (e.g. Theft, misuse e.g. Constant overload, technical/system fault)?
	Maintenance responsibility and funding
	If any maintenance contract with installer - until when?
	Estimated average cost of maintenance p.a.?
	Expected average life-spans of main parts if used properly (in months)

ommunity InvolvementC	**Ownership of system**
	Operations responsibility
	Training (format, topics, who, how many)
	Training participants: Male / Female Split
	Security responsibility/ replacements for theft?
	How was need identified / awareness raised?
	Community Participation - how?, who?, governance arrangement: specific community body for project?
	If responsible body: how identified/ chosen?
	Community Participation: Male / Female split
	Ownership system successful so far? high/med/low

Finance on Community or Beneficiary Level	**Monetary contribution of beneficiaries (value, period)?**
	Community cashflow management by whom / how?
	How identified/chosen?
	Involvement of SACCO, MFO, VSL Groups?
	Cash contributions used for?
	If individual sales: no of products sold
	Price per unit
	Repayment Period, if applicable

Benefits Beneficiairies	**Energy provided per user**
	No of End User Beneficiaries
	Specific target groups, if any
	Targeted benefits
	Main real benefits

IGA Commercial Viability	**Income Generation (how, who, how much?)**
	New Entrepreneurship on community level
	Repayment of system or ROI period

Carbon Accounting Environment	**Carbon accounting**
	Carbon Saving (Tonnes total and/or per unit/year)
	Average household saving on energy spending (fuel type, quantity, from which use e.g.. lighting/cooking/business)
	Other environmental impacts

Scope of Project	**Site Location (Village, T/A)**
	Rural/Peri-urban/Urban
	Scope
	Target Population
	Number of Households in Target Area
	Region
	District
	District Population
	District Population Density
	T/A
	T/A Population
	T/A Population Density
	Poverty Categorisation
	Specific Baseline of Energy Infrastructure & Services available y/n? (If yes, link in Media section)

Evaluation / Outlook	Accomplishment of project targets? High/med/low
	Main Challenges/ Lessons Learnt
	Future Outlook/ Upscaling Options

Media	**Own Links n documents (incl. Baseline study, reports etc.)**
	Other links, press etc.
	Sample Picture(s)

Contact Details	**Contact in Main Implementing Org - Name**
	Designation
	Contact Email
	Contact Telephone
	Org Address
	Alternat Contact (e.g. contractor) - Name
	Alternat Contact Organization
	Alternat Contact Phone
	Alternat Contact Email
	Community Contact Name
	Community Contact Position/Relation to Project
	Community Contact Phone
	Community Contact Phone 2

Data Verification & Quality	**Site visit by database team last conducted on (date, initials)**
	Data drawn from: own reports (OR), independent evaluation report (IER), telephone interview (TI), written data submission (WDS), site visit (SV), beneficiary interview off-site (BIOS), other (specify)
	Level of reliability of data so far: high/med/low
	Main Data entry complete/incomplete
	Case Study Sheet created (y/n), if yes: date

*A problem was encountered connected to the budgetary data under the PROJECT OVERVIEW section. In most cases, implementers only have the budget figure for the whole programme or project and the mere costs dedicated to one installation component may be hard because there are transport, staff, material, possibly sub-contracting and other costs involved which cannot reliably be associated to a single installation in case of bigger projects (e.g., several installations can be done in a certain areas so transport costs are shared between them without reflecting the real distance to the project; margins of contractors are apparently lowered in bigger programmes compared to a single installation; community training for the operation, maintenance, financial skills etc related to the energy installation are hard to seperate from other trainings which can be part of the project, etc.). Hence the table foresees to indicate the Total Project Budget and to indicate the **pure installation-related labour costs and the ***pure installation-related material costs (meaning materials incl. all procurement-related: either buying price if sourced locally or landing costs at the city of the implementing or installing organization incl. transport, duties, taxes etc., if imported) as these data is crucial to compare site-independent costs of different RE technologies per user and per kwh.

Case Study 1, Overview:
Community Rural Electrification and Development Project, Chikhwawa District, Southern Region

Project Overview

Main Implementing Organization: University of Malawi Polytechnic, Department of Electrical Engineering

Funding Body: Scottish International Development Fund

Part of Programme: Community Rural Electrification and Development

Development Sector: Energy

Initiator: University of Strathclyde / Scotland, Electrical & Electronic Engineering Dept.

Installation Hand-Over:

Technology Overview

Technology Category: Solar PV
Installation Size: 150 -300 Watts

TechnologyDetail s/Installation Components: Mono/Multicrystalline solar panels, 12 A Steca Tarom Charge controller, Raylite/ Deltec Deep Cycle Batteries (50 AH for Teachers houses, 96 AH for health centres, 102 AH for lighting in schools), 300 Watts inverter

Technical Contractor, if applicable: ECOPOWA Ltd, Blantyre & Radio Link Communications, Lilongwe

Warranty (months): 12

Performance

Energy Output Capacity (nominal): 300 Watts

Energy Storage Capacity (nominal): 600 Ah

Performance Status: Good

If malfunction, caused by:

Mainly due to damaged battery bank

Ownership & Community Participation:

How was need identified?
Sensitization meetings took place and workshops were held to identify energy priorities.

Ownership & Operations responsibility: Community own the system and Energy Committees operates & maintains the system

Training (how/how long/who/what): Training organized by Project Managers at the Polytechnic to Energy Committee s covering basic electricity concepts & safety

Main challenges/lessons learnt: Theft, Inadequate maintenance fund, Poor accountability of funds

Sustainability issues

Maintenance Responsibility (and period), communications chain for fault reporting: Energy committees operate & maintain (O&M, Field Coordinator oversees O & M and reports to Project Managers at Polytechnic for their input

Financing of maintenance & replacement: Since maintenance fund is inadequate, UoS still finances significant part of maintenance work

Who was trained and how in community? Energy committees were trained by Polytechnic Project Managers. Field Coordinator awarded scholarship to study City & Guilds Electrical courses.

Project Exit Strategy/Future Outlook: Complete handover to local community and up-scaling the project through M-REAP

Case Study 3, Overview:
Bondo Micro-Hydro Site Project, Mulanje District, Southern Region

Project Overview

Main Implementing Organization: Mulanje Renewable Energy Agency

Funding Body: European Union, Practical Action (Zimbabwe)

Part of Programme:

Development Sector: Renewable Energy

Initiator: Mulanje Mountain Conservation Trust

Installation Hand-Over: Not Yet

Technology Overview

Technology Category: Micro Hydro

Installation Size: 75-100 kW

Technology Details/Installation Components:

Intake area: 27 m long, 1.5 m deep, 25 kVA transformers: Input 11kV and output 400 V, Penstocks, Power house with turbines

Technical Contractor, if applicable:

Warranty (months):
TBA

Performance

Energy Output Capacity (nominal):

75 kW

Energy Storage Capacity (nominal):
Not Applicable

Performance Status: Yet to be tested

If malfunction, caused by: Not Yet

Ownership & Community Participation:

How was need identified? Sensitization meetings took place with Traditional leaders and vision workshops were held to identify energy priorities

Ownership & Operations responsibility: To develop Mulanje Energy Generation (MEGA) with a clear operational structure to carry out O & M: General Assembly with User's board

Training (how/how long/who/what):

Envisaged that MEGA will conduct periodic training to operators and administrators periodically once operational

Main challenges/lessons learnt: Financial constraints to complete the project

Photo 1

Photo 2

Sustainability issues

Maintenance Responsibility (and period), communications chain for fault reporting:

User's board will be responsible for O & M. Comprised of operators and maintenance team

Financing of maintenance & replacement:

Fees will be collected from electricity users and will be used for maintenance of the system

Who was trained and how in community?

Selected individuals were trained through exchange visits with Practical Action (Zimbabwe) on Micro Hydro installation

Project Exit Strategy/Future Outlook:
Hand over to the community for O & M

Case Study 3, Overview:
Bondo Micro-Hydro Site Project, Mulanje District, Southern Region

Project Overview

Main Implementing Organization: Mulanje Renewable Energy Agency

Funding Body: European Union, Practical Action (Zimbabwe)

Part of Programme:

Development Sector: Renewable Energy

Initiator: Mulanje Mountain Conservation Trust

Installation Hand-Over: Not Yet

Technology Overview

Technology Category: Micro Hydro

Installation Size: 75-100 kW

Technology Details/Installation Components:

Intake area: 27 m long, 1.5 m deep, 25 kVA transformers: Input 11kV and output 400 V, Penstocks, Power house with turbines

Technical Contractor, if applicable:

Warranty (months):
TBA

Performance

Energy Output Capacity (nominal):

75 kW

Energy Storage Capacity (nominal):
Not Applicable

Performance Status: Yet to be tested

If malfunction, caused by: Not Yet

Ownership & Community Participation:

How was need identified? Sensitization meetings took place with Traditional leaders and vision workshops were held to identify energy priorities

Ownership & Operations responsibility: To develop Mulanje Energy Generation (MEGA) with a clear operational structure to carry out O & M: General Assembly with User's board

Training (how/how long/who/what):

Envisaged that MEGA will conduct periodic training to operators and administrators periodically once operational

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Fees will be collected from electricity users and will be used for maintenance of the system

Who was trained and how in community?

Selected individuals were trained through exchange visits with Practical Action (Zimbabwe) on Micro Hydro installation

Project Exit Strategy/Future Outlook:
Hand over to the community for O & M

Private Sector / Contractors:
Butwamalinda Micro-Solar, LL
Bestobell Ltd., LL/BL
Charles Construction, LL
Clioma Ltd., LL
Development Technical Assistance Ltd, Mzuzu
Global Solar Ltd., BL
Hestian Rural Innovation Development, LL
Kauma Stove Co.
Mawelera Enterprises Ltd., Mzuzu
Phukaphuka Ltd., LL
Power Link Ltd., LL
Solateck Ltd., BL
Su-Kam Energy Systems Ltd., LL

NGOs:
Centre for Environmental Policy & Advocacy, (CEPA), BL
Concern Universal, BL
Cooperazione Internazionale (COOPI), LL
Eva Demaya, Rumphi (met in LL)
Kondanani Orphanage, Bvumbwe/Thyolo D.
Mary's Meals, LL
MUREA, Mulanje
Self Help Africa, LL
SolarAid, Mzuzu
Total Land Care, LL

Research Institutions
Centre for Renewable Energy Testing (TCRET) at the University of Mzuzu
Department of Forestry, University of Mzuzu
Malawi Industrial Research and Technology Centre (MIRTC)
National Commission of Science and Technology

Donors and Diplomatic Bodies
GIZ, LL
CIM representative at Mzuzu City Council, Mzuzu
Embassy of Germany, LL
Embassy of Japan, LL
Embassy of Norway, LL
Irish Aid, LL

PILOTING AN INVENTORY FOR RENEWABLE ENERGY PROJECTS IN MALAWI

Outline

1. Background
2. Objectives
3. Pilot Inventory Process
4. Pilot Inventory Screenshot
5. Key Findings
6. Critical Lessons
7. Recommendations for the Future

1. BACKGROUND

- Scoping study funded by the Scottish Government International Development fund undertaken in 2011
- Various stakeholders established that Malawi RE projects are fragmented and not well coordinated
- Absence of national inventory of 'off grid' energy installations which could be catalyst for more efficient 'off grid' energy sector
- Pilot Inventory as part of the Institutional Support Programme (ISP)
- Renew'N'Able Malawi in cooperation with WASHTED sub-contracted to compile a pilot database and draft report on a potential up-scaling process



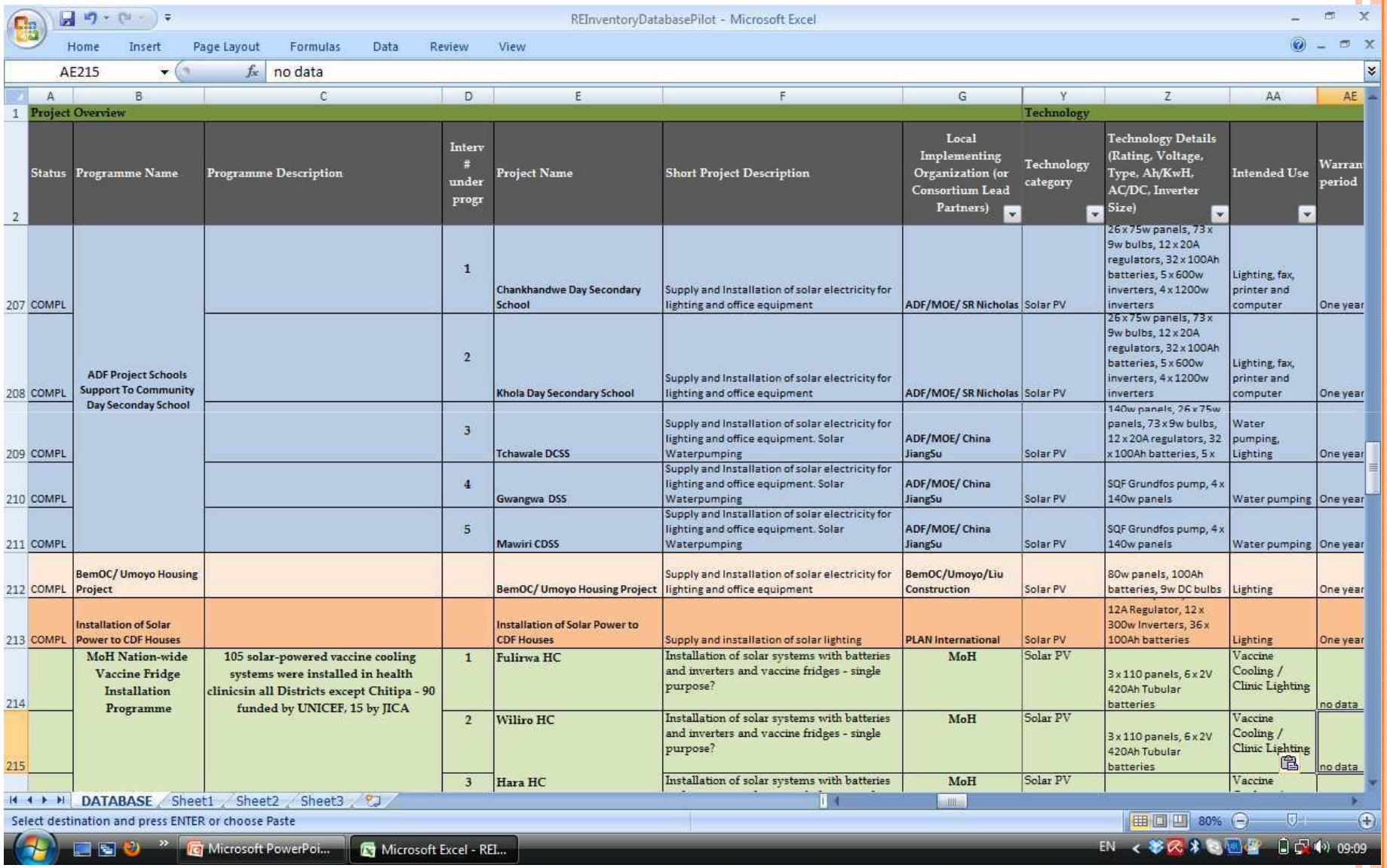

2. Study Objectives

- To address significant gaps in knowledge management around off-grid in the country and contribute to more sustainable maintenance of renewable energy projects
- Inform GoM and other stakeholders on a possible inventory process, needed prerequisites and resources, potential constraints
- Develop recommendations on how to scale-up and administer a wider RE inventory for Malawi

3. Pilot Inventory Process

- Development of questionnaire
- Consultation of key stakeholders,comprising projects of at least the main implementers in different fields of RE technologies
- Collection of data through questionnaires, interviews and phone follow-ups
- Creation of a data base format
- Data compilation and verification through stakeholder meetings and site visits, interviews with beneficiaries

4. Pilot Inventory Database - Screenshot



REInventoryDatabasePilot - Microsoft Excel

Home Insert Page Layout Formulas Data Review View

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	A	B	C	D	E	F	G	Y	Z	AA	AE
1	Project Overview							Technology			
2	Status	Programme Name	Programme Description	Interv # under progr	Project Name	Short Project Description	Local Implementing Organization (or Consortium Lead Partners)	Technology category	Technology Details (Rating, Voltage, Type, Ah/KwH, AC/DC, Inverter Size)	Intended Use	Warran period
207	COMPL	ADF Project Schools Support To Community Day Seconday School		1	Chankhandwe Day Secondary School	Supply and Installation of solar electricity for lighting and office equipment	ADF/MOE/ SR Nicholas	Solar PV	26 x 75w panels, 73 x 9w bulbs, 12 x 20A regulators, 32 x 100Ah batteries, 5 x 600w inverters, 4 x 1200w inverters	Lighting, fax, printer and computer	One year
208	COMPL			2	Khola Day Secondary School	Supply and Installation of solar electricity for lighting and office equipment	ADF/MOE/ SR Nicholas	Solar PV	26 x 75w panels, 73 x 9w bulbs, 12 x 20A regulators, 32 x 100Ah batteries, 5 x 600w inverters, 4 x 1200w inverters	Lighting, fax, printer and computer	One year
209	COMPL			3	Tchawale DCSS	Supply and Installation of solar electricity for lighting and office equipment. Solar Waterpumping	ADF/MOE/ China JiangSu	Solar PV	140w panels, 26 x 75w panels, 73 x 9w bulbs, 12 x 20A regulators, 32 x 100Ah batteries, 5 x	Water pumping, Lighting	One year
210	COMPL			4	Gwangwa DSS	Supply and Installation of solar electricity for lighting and office equipment. Solar Waterpumping	ADF/MOE/ China JiangSu	Solar PV	SQF Grundfos pump, 4 x 140w panels	Water pumping	One year
211	COMPL			5	Mawiri CDSS	Supply and Installation of solar electricity for lighting and office equipment. Solar Waterpumping	ADF/MOE/ China JiangSu	Solar PV	SQF Grundfos pump, 4 x 140w panels	Water pumping	One year
212	COMPL	BemOC/ Umoyo Housing Project			BemOC/ Umoyo Housing Project	Supply and Installation of solar electricity for lighting and office equipment	BemOC/Umoyo/Liu Construction	Solar PV	80w panels, 100Ah batteries, 9w DC bulbs	Lighting	One year
213	COMPL	Installation of Solar Power to CDF Houses			Installation of Solar Power to CDF Houses	Supply and installation of solar lighting	PLAN International	Solar PV	12A Regulator, 12 x 300w Inverters, 36 x 100Ah batteries	Lighting	One year
214		MoH Nation-wide Vaccine Fridge Installation Programme	105 solar-powered vaccine cooling systems were installed in health clinicsin all Districts except Chitipa - 90 funded by UNICEF, 15 by JICA	1	Fulirwa HC	Installation of solar systems with batteries and inverters and vaccine fridges - single purpose?	MoH	Solar PV	3 x 110 panels, 6 x 2V 420Ah Tubular batteries	Vaccine Cooling / Clinic Lighting	no data
215				2	Wiliro HC	Installation of solar systems with batteries and inverters and vaccine fridges - single purpose?	MoH	Solar PV	3 x 110 panels, 6 x 2V 420Ah Tubular batteries	Vaccine Cooling / Clinic Lighting	no data
				3	Hara HC	Installation of solar systems with batteries	MoH	Solar PV		Vaccine	

DATABASE Sheet1 Sheet2 Sheet3

Select destination and press ENTER or choose Paste

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Microsoft PowerPoi... Microsoft Excel - REI...

EN 09:09

5. Key Findings

- Information from the inventory useful for a variety of purposes connected to coordination, management, planning and long-term sustainability improvement of RE installations and projects
- Common reasons observed for Project failure

5. FINDINGS 1: EXAMPLES OF INFORMATION DERIVABLE FROM THE DATABASE AND ITS POTENTIAL USE/USERS

Type of Information	Potential User /Use
Technical performance indicators & average success rates of different manufacturers and technologies	Contractors as evidence to clients/project implementers; decision makers in procurement positions in GoM, NGOs and funding agencies
Success rates / reliability of contractors engaged in RE installations in the past	
Geographic spread of RETs in Malawi	GoM for holistic development planning: e.g. OPC, Ministries: Rural Development, MNREE, ESCOM; decision-makers in funding agencies
Areas of renewable energy use – most apparent needs for energy (e.g. health, education)	
Average cost of certain systems, installations and interventions per site, beneficiary etc. in Malawi	Project implementers: for design and as evidence to donors; decision-makers in funding agencies, project evaluators
Success rates and challenges of different ownership model	
Comparative cost advantages of different technologies	
Percentage of energy supply from off-grid energy in comparison to grid energy in Malawi	GoM for infrastructure / energy planning: MNREE, ESCOM
Carbon emission reductions from off-grid energy projects	GoM: MNREE, esp. Dept of Environmental Affairs for planning, policy adjustments and reporting to International Frameworks

5. Findings 2:
Some common reasons for system failures

- Design of systems undertaken by inexperienced or non-technical persons
- Roles and responsibilities of local community not clearly defined and published
- Monitoring mechanisms mostly based on implementing organization's capacity – limited to undertake regular follow-ups & visits to remote sites
- No clear communication chain: who reports to whom in case of system failure
- Community ownership systems - no clear, agreed leadership
- Inappropriate Training
- Inadequately planned or no maintenance funds
- Inappropriate precautions against theft...

6. Critical lessons

- Data availability – often a variety of stakeholders possess different elements of data set (e.g. contractors: technical data, NGOs: data on community training, real operation: beneficiaries, etc.)
- Need for data verification on the ground for existing projects as no coherent M&E system in place
- Report gives recommendations on useful, user-friendly format and data grouping based on inventory experience
- High cost and time implications for data sampling and verification

7. Recommendations for the future

- Better, standardized M&E systems urgently needed for future projects to ease follow-ups also without visiting sites repeatedly as costs and efforts are very high – establish standards and tools for RET Project Implementers, Installers & Beneficiaries!
- Appropriate Remote monitoring systems for technical operation need to be identified/developed and implemented – alert system feeding back centrally to e.g. DO, GoM and inventory partner(s) to facilitate instant maintenance visits, ideally under inclusion of GoM structures e.g. District Energy Officers
- Extend Policy Guidelines to encourage advance or regular reporting of RE projects by involved stakeholders (contractors, project implementers)
- RENAMA and DoE were discussing proposals how to potentially develop an maintain an up-scaled database and network which would be publicly accessible by registered RET stakeholders in Malawi

7. Future Strategy

- Clarify needs and responsibilities for a nation-wide comprehensive inventory
- Plan according to time requirements
- Secure funding according to cost reqirements
- Up-scale and maintain the Inventory
- Adjust policy environment to actively involve stakeholders in data collection and standardize reporting mechanisms
- Incentivize active contributors/stakeholders and keep momentum for information exchange and common learning through a dedicated RE network and events

7. Steps to develop a comprehensive inventory database and information sharing platform

Step	Description
1	Review the pilot inventory database structure and Case Study information and discuss additions/adjustments according to the needs of the GoM, if necessary
2	Outline the main goals and benefits which GoM and its particular involved Departments would target with such an inventory, so that its layout and handling later matches the purpose
3	Determine who should be responsible for and administer the database (see discussion in the introduction to chapter 5) and based on what agreements
4	Plan time, human and monetary resources to perform the up-scaling exercise and maintain long-term updating, report creation and publication
5	Identify potential funding sources and application for funding (in cooperation with partners, if applicable)
6	Set up the final database system, design data submission forms and identify which reports are needed in which periods and by whom – if so decided, establish website for web-hosted database and network management
7	a) Incorporate existing data from pilot inventory & RENAMA network into database b) Start upgrading/complementing and collection of new data c) Develop M&E tools for data contributors and ground-truthing team
8	Train and send out data quality checking staff for site evaluations based on standardized evaluation tools and systematic identification of sample sites
9	Officially launch data inventory: inform all RE stakeholders about the launch of the new database and possibility to submit data, contribute, and seek partnership support through PR activities
10	Distribute standardized M&E tools to project implementers and installers for periodical submission, and follow up
11	Circulate regular update newsletters to involved stakeholders to keep the momentum Running and motivate eager data contributors with special incentives, like featured articles in the newspaper and/or newsletter, etc.
12	Organize regular stakeholder meetings, RET networking events, national or regional Trainings /workshops for data contributors/network members, etc.

7. A COMPREHENSIVE INVENTORY CAN SUPPORT GOM TO…

- Get better overview of main stakeholders in the field and use their experience in technological/community ownership/sustainability aspects of renewable energy project delivery to build strong partnerships
- Be able to link organizations with complementary strengths and weaknesses up in order to accomplish more successful, sustainable energy projects for more Malawians
- Identify promising concepts and pilot studies for up-scaling and be able to make informed suggestions to development aid agencies based on demonstrated facts of successful approaches
- Attract more funding for renewable energy projects based on visible dedication of GoM to learn from past lessons and improve project outcomes
- Get regular updates on the development of the renewable energy sector in Malawi and, in the long term, be able to indicate correct share of RETs in energy mix based on real and actual information, enabling better policy and strategy formulation
- Identify well-working technology components, ownership concepts as well as most reliable, quality-driven installers through comparison of failure rates over the mid and long term, and be able to grant incentives for proper project conceptualization
- Ensure technological quality through better knowledge on useful systems and support regulation and standardization of quality in RETs
- Become widely acknowledged for good knowledge sharing facilitation and pro-active support of renewable energy development, incl. rural electrification, climate change mitigation, reduced deforestation through more efficient biomass use and environmental protection, as well as related business stimulation

THANK YOU FOR YOUR ATTENTION!

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