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# Malawi Renewable Energy Acceleration Programme (MREAP)

MREAP is led by the University of Strathclyde and funded by the Scottish Government. It has operated over 2012 - 2015.



# Evaluation of Off-grid Community Managed Renewable Energy Projects in Malawi

## Dedicated Study

**MREAP Strand:** Institutional Support Programme (ISP)

**Produced By:** Catherine Currie, Godfrey Banda, Hatty Dinsmore, Simon Henderson, Robert Kafakoma, Sheelagh O'Reilly and Sadie Watson, IOD PARC

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**Abstract:** The Evaluation of Off Grid Community Managed Renewable Energy Projects was undertaken as part of the Institutional Support Programme of the Malawi Renewable Energy Acceleration Programme (MREAP). This evaluation developed a set of 12 case studies covering the 3 regions of Malawi and included a range of renewable energy technologies (RETs) that are being used at the community and household level. These case studies were complemented by key informant interviews and a 'round table' with members of the Government of Malawi in March 2012. The analysis and lessons from this evaluation were designed to help inform the implementation of the MREAP itself, the ongoing development of grassroots level RET activities as well as the documentation of robust evidence and experiences that would help inform the possible development of a Renewable Energy Strategy for Malawi.

MREAP is led by the University of Strathclyde and funded by the Scottish Government  
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# Evaluation of Off-grid Community Managed Renewable Energy Projects in Malawi

As part of the Institutional Support Programme of Malawi Renewable Energy Acceleration Programme (MREAP)

## Final Version

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Prepared for // Scottish Government

Date // 6<sup>th</sup> June 2012

By // Catherine Currie, Godfrey Banda, Hatty Dinsmore, Simon Henderson, Robert Kafakoma, Sheelagh O'Reilly and Sadie Watson.

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# Contents

Tables, Figures and Boxes List	iii	
Acknowledgements		iv
Acronyms		v
Working definitions	vi	
Executive Summary		vii
Grassroots Level Recommendations	vii	
Development of an Enabling Environment in Malawi	viii	
Evidence Based Policy and Investment Decision Making in Renewable Energy	ix	
Section 1: Background & Scope		1
Section 2: Approach & Process		2
Evaluation Process	2	
Key dimensions of the Evaluation Process	4	
Section 3: Inventory Pilot		6
Objective of developing an inventory of RET in Malawi	6	
Inventory Process	6	
Section 4: Relevance of off-grid RET projects		9
The ‘Energy Gap’	9	
A People Centred Approach to RETs	10	
Critical Lessons	14	
Recommendations	15	
Section 5: Relevance of Policy		17
Current Policy Context in Malawi for Renewable off-grid energy	17	
Energy and Economic Development in Malawi?	18	
Recommendations	18	
Section 6: Efficiency		20
Operating Efficiency of Case Study installations	20	



Relative Efficiency of the Case Study Installations	22	
Private Sector Support	23	
Lessons on Efficiency	23	
Recommendations	24	
Section 7: Effectiveness - with a focus on management		25
Benefits of Access	25	
Recommendations	29	
Section 8: Sustainability		31
Sustainability as a process	31	
Enabling environments contribution to sustainability	32	
Financing for sustainable renewable off-grid community energy	33	
Technically appropriate systems for whole life operations	37	
Sustained Capacity Development	39	
Section 9: Conclusion		42

## Annexes

Annex 1: Evaluation Questions	
Annex 2: Terms of Reference	
Annex 3: Documents Reviewed	
Annex 4: Inventory Terms of Reference	
Annex 5: Inventory Report	
Annex 6: Policy Analysis Paper: Energy Enables	
Annex 7: Learning Note: Off-grid community energy projects: What can they learn from other sectors	
Annex 8: Sampling Strategy	
Annex 9: Case Study Draft Guidance	
Annex 10: Roundtable Attendees, Lilongwe	
Annex 11: Theory of Change	
Annex 12: Institutional and Policy Framework for Renewable Energy in Malawi	
Annex 13: Climate Change and Carbon Tracking	



## Case Study Annex

1. CRED Project Chikwawa Case Study
2. Choma Case Study
3. Biogas Energy Production Case Study
4. Social Enterprise Development Case Study
5. Provision of Soft Infrastructure Case Study
6. Solar Villages Case Study
7. Solar Aid- Catalysing the Market Case Study
8. Senga Bay Case Study
9. Bondo Micro Hydro Scheme Case Study
10. Fixed and Portable Stoves Case Study
11. Milonde Youth Club Business Case Study
12. MuREA Case Study

## Tables, Figures and Boxes List

Figure 1: Evaluation Process	3
Table 1: Recommended/adequate data sources and data reliability rating based on source	7
Box 1: MREAP: Statement of Intent on Socially Excluded, Poor and Vulnerable Groups	11
Table 2: Summary status report around community engagement from case study sites	13
Table 3: Sample of operating performance among case study technologies examined	21
Table 4: Outcomes reported (anticipated) by case study users	26
Table 5: Financial sustainability in case studies examined	35



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# Acronyms

BIF	Business Innovation Facility
BoS	Bureau of Standards
CREDE	Community Rural Electrification & Development Project
DA	District Assembly
DEC	District Executive Committee
ESCOM	Electricity Supply Corporation of Malawi
FHH	Female Headed Households
FOREX	Foreign Exchange
GoM	Government of Malawi
IEG	Independent Evaluation Group
ITDG	Intermediate Technology Development Group
JICA	Japan International Cooperation Agency
MGDs	Millennium Development Goals
MEGA	Mulanje Electricity Generation Agency
MERA	Malawi Electricity Regulatory Authority
MGDS	Malawi Growth and Development Strategy
MMCT	Mulanje Mountain Conservation Trust
MREAP	Malawi Renewable Energy Acceleration Programme
MuREA	Mulanje Renewable Energy Association
NGO	Non Governmental Organisation
NSREP	National Sustainable and Renewable Energy Programme
O&M	Operations and Maintenance
PLWD	People Living with Disabilities
PLWHIV	People Living with HIV/AIDS
ProBEC	Programme for Basic Energy Conservation
PV	Photo Voltaic
REFLECT	Regenerated Freirean Literacy through Empowering Community Techniques
REIAMA	Renewable Energy Industries Association of Malawi
RENAMA	Renew'N'Able Malawi
RET	Renewable Energy Technology
SADC	Southern African Development Community
SHS	Single Household System
SG	Scottish Government
SWAp	Sector Wide Approach
TCRET	Test & Training Centre in Renewable Energy Technologies
UNDP	United Nations Development Programme
VDC	Village Development Committee
WASHTEDE	Centre for Water Sanitation and Health and Appropriate Technology
WB	World Bank
WHO	World Health Organisation



## Working definitions

For the purpose of clarity, it is important to define the following terminology:

- **Energy Gap:** This is the difference between the current level of supply of modern energy services (electricity, bottled gas, energy efficient stoves etc) and the demand that is present.
- **Electricity Demand:** This is the current unmet demand for electricity services that could be supplied by the grid if available or by off-grid systems where these could be installed. The demand for electricity is high within households. Lighting, communication services, battery charging within households, for schools to provide lighting for out of hours study and where possible support IT provision; for health services to provide lighting, fridges for vaccines/medicines, small scale medical testing and local procedures especially for maternity clinics. There is wide spread demand for solar pumps for boreholes to reduce labour, and to enable water to be available even when fuel shortages are an issue.
- **Biomass:** Any material used for production of, usually heat, for cooking. In Malawi this is usually wood based including charcoal. This can include material that is used to produce biogas through digestion processes, in which case it includes crops grown for this purpose, waste from agro-industrial processes e.g. sugar cane and material from animal production, especially dairy cows, chicken, pigs which are kept in corralled conditions.

# Executive Summary<sup>1</sup>

The Evaluation of Off Grid Community Managed Renewable Energy Projects was undertaken as part of the Institutional Support Programme of the Malawi Renewable Energy Acceleration Programme (MREAP). This evaluation developed a set of 12 case studies covering the 3 regions of Malawi and included a range of renewable energy technologies (RETs) that are being used at the community and household level. These case studies were complemented by key informant interviews and a ‘round table’ with members of the Government of Malawi in March 2012. The analysis and lessons from this evaluation are designed to help inform the implementation of the MREAP itself, the ongoing development of grassroots level RET activities as well as the documentation of robust evidence and experiences that would help inform the possible development of a Renewable Energy Strategy for Malawi.

The evaluation has established that there are a number of critical activities that could form part of a broad approach to action based research and innovation (including pilot technical programmes, scaling up, evidence gathering) with the aim of increasing the evidence around the appropriate technical, social and economic options situated within an effective enabling environment that would facilitate Malawi’s path towards ‘Sustainable Energy for All’ by 2030. These activities are set out from the grassroots level to the policy arena because the grassroots evidence and capacity is fundamental for informing policy and investment decision making that takes into account the context in which the majority of communities and households in Malawi are based. MREAP has a catalytic role in piloting innovative technical, social and capacity development programmes alongside the documentation of robust evidence around what works, for whom, where, why and under what conditions.

## Grassroots Level Recommendations

*Develop an evidence base and capacity to prove the concept of RETs and inform policy making*

Specific activities for MREAP and other development focused programmes or agencies include:

- **Setting coherent multi-dimensional baselines** that examine current energy usage at household, community and District level and enable monitoring of the process and changes that access to RET fosters;
- **Managing expectations.** There is a need to develop, with stakeholders including communities, at the design stage clear expectations about what the system will deliver over what timeframe. Use of appropriate participatory tools as being piloted by agencies such as Concern Universal could help to reduce the gap between expectations and delivery.

Specific activities for MREAP include:

- Understanding **how differentiated social capital leads to different** outcomes and how MREAP’s operational design can maximise positive outcomes whilst minimising negative outcomes, particularly for vulnerable groups;
- As part of the Capacity Development Programme facilitate, linked to the proposed investments as well as ongoing RET installations, a **set of multi-disciplinary case studies** which enable technical, social, economic and environmental assessments to be undertaken during the lifetime of the MREAP (and beyond if possible);

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<sup>1</sup> Please note that this report was prepared before the demise of Bingu Wa Muthakari and the change of Presidency.

- **Officially adopt the gender and vulnerable groups' statement.** Strategic grant projects could officially adopt the 'do no harm' systematic approach and set gender aware outcomes which target the poorest and most vulnerable groups.

#### Specific activities for RET designers, installers and operators (including Private Sector):

- Work together in a coherent manner to **develop the appropriate 'soft infrastructure' around managerial and technical capacity for RETs.** This may include the development of appropriate courses (short and longer term), training material for training through formal institutions including TCRET, WASHTED and technical training colleges;
- **Develop an effective cadre of academics** who can support innovation in the RET sector and provide effective evidence to feed into Government Policy processes around RETs;
- **Develop a clear operations and maintenance framework.** This would enable greater clarity around who is responsibility for what, including the long term financing arrangements for the maintenance (including replacement parts) of the system over time;
- For pilot systems, ensure that there is **real evidence generated around technical efficiency, financial inputs (and benefits) as well as social/economic outcomes.** This evidence provides greater input into policy makers when making decisions regarding policy frameworks and investments. What works, where does it work, who benefits, how and over what time frame should be critical questions of any monitoring and evaluation system.

#### Development of an Enabling Environment in Malawi

*The development of an enabling environment will be critical to facilitate the development of innovative and diverse approaches to solving the 'energy gap' within Malawi. To ensure that the policies and systems are built in an effective manner, within the decentralised government framework, there is a need to ensure that the Government of Malawi, donor community, key stakeholders:*

- Operate a coherent and transparent **multi-stakeholder dialogue** that is facilitated by the Government of Malawi in conjunction with key donors, the private sector, civil society and technical specialists from within Malawi and outside (regional and international);
- MREAP Programme Steering Group (PSG) agree input into the **development of a Renewable Energy Strategy for Malawi**, that explicitly addresses community and household modern renewable energy service supply and energy efficient use of biomass if an appropriate focus for the MREAP;
- Preparation of a **Policy Development Process Map** for consideration by end July 2012 that would outline which organisation within the different stakeholders is facilitating which element under a central coordination team (Government, donor, academic, private sector and NGO);
- Undertake **an Energy Policy Review** to synthesise the current existing documentation, including from World Bank, UNDP and Government of Malawi, in country to provide a 'baseline' from which the policy process can move forward;
- MREAP to facilitate, in conjunction with the PSG, **dialogues with other interested funding partners** (for cash inputs, technical support inputs etc) around a funded (ideally) process for development of a Government of Malawi Renewable Energy Framework and accompanying financing framework, including options around international climate finance.



## Evidence Based Policy and Investment Decision Making in Renewable Energy

*To meet the ‘Sustainable Energy for All’ target, as well as Malawi’s Growth and Development Strategy 2 (draft) and Vision 2020, the **Government of Malawi** could develop frameworks and structures:*

- **To develop greater knowledge around the incentive structures** and the ability to manage and coordinate the different regulatory elements into a coherent and transparent system;
- **To ensure that all projects pass through the normal decentralised decision making process - the District Council** and to **investigate how to promote local ownership of energy issues** within the decentralisation framework. As well as promoting the use of modern energy services in **every infrastructure development** and ensuring that there are systems and processes, including skilled staff, at the District level to maintain the systems, with communities as appropriate;
- **To connect** all appropriate and useful **evidence into one framework**;
- **To price energy for on and off grid systems**; perhaps by way of a national level renewable energy forum;
- To develop, within the Renewable Energy Policy Development, **a comprehensive multi-stakeholder capacity needs assessment** that addresses requirements from grassroots level, Government, private sector and academic institutions, around RET system design, installation, operation, monitoring and research.

Government of Malawi could drive the sustainability of RETs by:

- **Seeking appropriate funding to develop the Bureau of Standards (BoS)** within Malawi (or linked site e.g. TCRET) to enable the BoS to be internationally recognised in the area of testing of RET;
- **Facilitating learning within Malawi around community off-grid RET within Southern African Development Community (SADC)** and other REC areas in Africa and beyond. For instance at the grass-roots level Practical Action (working with MuREA) are taking a strong role in Southern Africa’s expansion of RET implementation;
- **Developing clear mechanisms for transparent use of ‘fair trade’ and ‘climate finance’** for development of community and household RET systems;
- Recognising that the **approach for community service energy provision and that for households is likely to diverge in terms of technical systems, delivery systems and funding strategies**. For household systems the Government of Malawi will need to ‘facilitate’ the development of private sector value chains that enable the sale of quality products at prices ordinary Malawians can afford and that give proven returns on their investments;
- **Providing clear guidance on who bears the operations and maintenance (O&M) responsibility for RET infrastructure** where the Government of Malawi (at national and district level) is responsible for investment decisions (including donor funding).

# Section 1: Background & Scope

In May 2011, the Scottish Government (SG) funded the ‘University of Strathclyde - Supporting Community Energy Development in Malawi’<sup>1</sup> hereinafter referred to as the Scoping Study. The Scoping Study further developed a picture of community renewable energy projects following the Community Rural Electrification and Development Project (CRED) implemented by the University of Strathclyde, also funded by the SG.<sup>2</sup> A number of stakeholders from the Malawian energy sector identified significant gaps in knowledge around off-grid energy management in the country. In particular, it was noted that there were a reasonable amount and variety of small-scale interventions being undertaken – for example solar photo voltaic (PV), hydropower, energy efficient cookers – but that there was no clear or shared understanding around the relative merits of each approach. Moreover, there was no overall national ‘inventory’ of off-grid energy installations in existence – it was felt that the absence of such an inventory could be weakening regulatory oversight, and increases the risk of a fragmented, inefficient off-grid ‘sector’.

In early February 2012 the University of Strathclyde was commissioned by the Scottish Government to undertake the MREAP. MREAP is a Research Grant made up of four separate work-streams. IOD PARC is sub-contracted to deliver the Institutional Support Programme, which includes conducting the Evaluation and the pilot inventory.

The MGDS2 (draft) has six main themes which include sustainable economic growth; social development; social support and disaster risk management; infrastructure development; improved governance; and Cross-Cutting Issues. Under the infrastructure development, the government sets its medium term strategy on energy which states that the country intends to have a well-developed and efficient energy system that is vital for socio-economic development. The MGDS2 (draft) also indicates that energy is a **Key Action Area** which will help to drive economic and social development within the country.

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<sup>1</sup> <http://www.scotland.gov.uk/Topics/International/int-dev/strathclydeuniscopingstud>

<sup>2</sup> <http://www.strath.ac.uk/malawi/projects/communityruralelectrificationanddevelopmentered/>

## Section 2: Approach & Process

This section outlines the evaluation process from which certain pivotal elements are selected and then described. It then sets out the limitations of this evaluation. The inventory approach and process is outlined in the following chapter. The Evaluation Terms of Reference (ToR), Evaluation Questions and Sampling Strategy produced for case study selection can be found in Annexes 2, 1, and 8 respectively.

### Evaluation Process

Initially, the team members familiarised themselves with Malawi's Energy Sector, carried out background reading and received briefing papers from the Value for Money and Gender and Social Exclusion experts on the Evaluation team. A case study guidance note (Annex 9) was developed to support consistency in approach and data collection from the 2 teams (one Northern/Central and one Southern/Central).

This background work helped to inform the setting of the criteria for the selection of the 12 case studies which structured the focus of the field work. The detailed sampling strategy, using clear criteria, (Annex 8) ensured that a diversity of projects and types of interventions, at different scale and with different partners were explored prior to confirming the final projects selected for visit during the field trip.

The objectives of the field visit, from February 25<sup>th</sup> 2012 to March 10<sup>th</sup> 2012 were to:

1. Collect primary data on the system operation and performance; and
2. The socio-economic impact of the system on the beneficiaries; to inform the development of case studies.
3. Carry out key informant discussions with Government of Malawi officials and donors present in country
4. Meet and communicate key findings of field trip to Programme Partners<sup>1</sup>

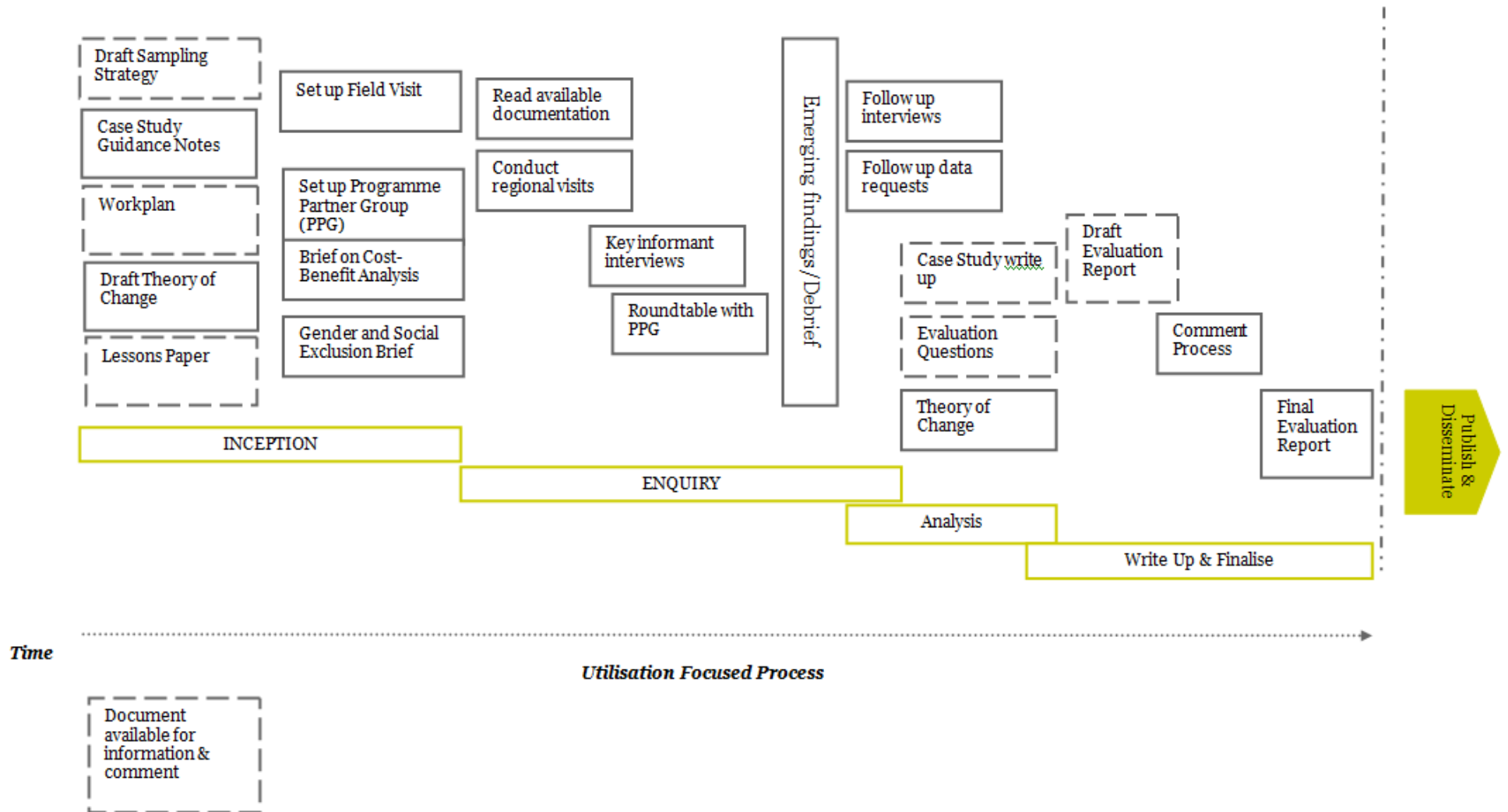
The team has actively managed, sorted and produced the data gathered over the two week period. Meetings with RET projects involved group discussions, focus groups, key informant interviews with the communities, management committee members and individuals with specific responsibilities (Midwife, Headmaster, Religious Leaders etc.) in relation to the projects (all those consulted during this process are noted on the case studies). Where feasible and appropriate, first meetings were held at the district level to inform the district authorities of the objectives of the study and also to seek clearance to meet with the community. During the second week interviews and discussions were also arranged with United Nations Development Programme (UNDP) and Department for International Development (DFID) Malawi and culminated in a Government round table discussion which was opened by the Director for Development Planning, Ministry of Finance and Planning (a list of all participants can be found in Annex 10). The final resultant 12 case studies have been peer reviewed internally and fact checked by the organisations involved (please see the Case Study Annex).

The diagram on the next page depicts the methodological process that has been followed for the evaluation. It shows how the team moved from inception, through enquiry to producing the final draft of this evaluation report.

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<sup>1</sup> Programme Partner group substituted for the uninitiated Programme Steering Group.

Figure 1: Evaluation Process



## Key dimensions of the Evaluation Process

### *Learning Note*

The short learning note <sup>1</sup> (Annex 7) provides an opportunity to highlight important process learning from other sectors. It has a focus on how differentiated social capital can influence infrastructure management alongside how, within the wider operations and maintenance continuum issues of transaction costs, decentralised financial management and planning can affect project outcomes.

### *Theory of Change Paper*

The Theory of Change paper (Annex 11) suggests firstly a generic Theory of Change around modern energy services and development in Malawi. This includes highlighting a number of specific issues that also have emerged from the evaluation case studies. It then takes the elements of the generic Theory of Change and for the action research programme that is MREAP, puts forward an Outline Theory of Change for that programme.

### *Gender and social exclusion*

Poor rural communities are not homogeneous and consist of different groups of poor. Using the data collected by the team, an initial analysis has been conducted of the extent to which the projects were designed with specific groups in mind, and the extent to which they are benefiting.

*For gender and social exclusion the analysis focuses on:* who are the very poor within the communities? who has influence over the use? who has access to services (services defined as water, electricity, health, education) within an understanding of the political and cultural economy that leads to these situations.

### *Value for Money and Results*

Value for Money is a unifying measure that incorporates issues of relevance, efficiency, effectiveness and sustainability. It is also a relative measure, which implies comparison with alternative ways of providing the same services. To assess the value for money of the cases examined, we applied a working framework based on: Are the technologies operating as planned? How do the benefits of the technologies compare with the costs? Are there feasible, alternative energy options that might provide greater (net) benefits? Is the value being created likely to be sustained?

### *Limitations and Bias*

*Data Quality:* It can be remarked that while the quality of data is paramount and significant attention has been paid to data quality in terms of data we received and collated, it was challenging to find objective secondary data evaluating projects or primary data from monitoring systems against each section of the case study framework, which were used in the evaluation. However, the team was prepared for this challenge and has transparently sourced and reported on all data used. Furthermore, the team has adjusted the case study framework so that they are able to report back on the type and quality of evidence that has been found.

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<sup>1</sup> This paper has been informed from a number of sources including: Elinor Ostrom, Larry Schroeder & Susan Wynne. (1993) Institutional Incentives and Sustainable Development. Infrastructure Policies in Perspective. Westview Press; WB & DFID Northern Mountain Poverty Reduction Project (Vietnam), Local Government Capacity Building; DFID Research into Use Programme and IOD PARC Evaluation of the Global Water Initiative.



Finally, data limitations have made it difficult to make a comprehensive assessment, however some informed indicative conclusions can be drawn. In particular the data limitations have made it difficult to examine the *risks* to value for money (VFM); we are not providing summative judgement on the VFM of these investments.

Due to the lack of evidence on efficiency revealed through the case studies, which could be a by-product of a general trend in the development arena to dedicate inordinately less time to systems efficiency data gathering and lesson learning, it is not possible for this short study to produce rigorous analysis or recommendations on the financial sustainability of systems. Rather, we propose that over the next two years, MREAP looks into the question of RET system efficiency and supports efforts to understand what the most financially sound RETs are and how this argument can feed into a wider economic focus on off-grid value chains.

The review team also faced significant data challenges in addressing effectiveness, as well as ‘how the benefits compare with the costs’ given the absence of systematic data from systems installed. In the time available, a major primary data collection exercise was not possible; fieldwork had to rely on readily available secondary data and interviews with a limited number of users and key informant interviews. In addition, where information is collected it is forward looking in relation to an individual system. However it would also be appropriate for economic analysis to look at the overall ‘opportunity costs’ of **not** developing modern energy services in relation to the impact on poor people’s lives.

*What are relevant data?* The energy gap discussed here is in relation to access to modern energy services. In Malawi this constitutes four areas:

- a. electricity access on or off grid for rural areas, even with the current projects (for example Rural Electrification programme supported by the Japan International Cooperation Agency (JICA), which is focused on trading centres to grid);
- b. the inefficient use of fuel wood/charcoal for cooking/heating;
- c. use of fuel wood/charcoal from unmanaged locations, usually primary or secondary forest although there is now a few moves to woodlots; and,
- d. limited access to alternative fuels for heating/cooking e.g. bottled gas, biogas.

The case studies looked at electricity access (a) and the inefficient use of biomass (b) generally and then the limited access to alternative fuels was considered in one case study - Biogas Energy Production, (d) however, the case studies did not capture the use of fuel wood and charcoal from unmanaged locations<sup>2</sup>.

Of those case studies which looked at the energy gap from (a) and (b), the objective was to raise important factors vis à vis relevance of technologies in off grid community management schemes to address the energy gap. These were therefore not technical systems analyses.

### *Key Informants to the Evaluation*

It was not always possible to meet with the appropriate district authorities prior to interviewing project implementers and/or community members. Therefore, any future/ongoing action would require meetings to gain more insight into the other development projects being pursued and the possibilities for synergies.

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<sup>2</sup> Biomass Energy Use In Malawi, IIED, 2010; Can Biomass Power Development?, Keith Openshaw, IIED: gatekeeper 144, 2010; and, Section 2.1 Biomass Energy Use in Malawi, ‘Role of biomass energy in poverty reduction and household livelihood improvement’, IIED, 2010.

## Section 3: Inventory Pilot

### Objective of developing an inventory of RET in Malawi

During the Scoping visit in August 2011, the team, with the Government of Malawi, identified the need to develop a clearer understanding of the scope and scale of off-grid energy management in Malawi. 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, 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'. A trusted inventory could also be used as a management tool for planning and management of any 'scale up' process around community and renewable energy by the Government of Malawi and partner organisations.

### Inventory Process

MREAP, through the engagement with WASHTED at the Malawi Polytechnic and RENAMA, an NGO with a detailed specialism in off-grid energy, has piloted an inventory process for off grid community based renewable energy in Malawi. IOD PARC worked with WASHTED and RENAMA to finalise the Terms of Reference and to assist in setting 'boundaries' for the pilot inventory. These are presented in Annex 4. The pilot inventory approach was taken to enable testing of the inventory process, including ground truthing, to ensure that there was clarity around what data was available and its quality. The process also enabled an understanding of the operational challenge of managing a national inventory (to be determined), especially as sites are often small and located in remoter areas of Malawi.

The final process of undertaking the work around the pilot inventory encompassed the following steps:

1. Development of an appropriate set of questions for the collection of inventory data.
2. Selection of stakeholders approached for data collection
3. Creation of an inventory database file (can we have a summary of this in the study findings?)
4. Data gathering, comprising projects of at least the main implementers in different fields of Renewable Energy Technologies (RETs).
5. Data sampling/verification through stakeholder meetings and live visits at a number of selected sites and/or contacting of project beneficiaries.
6. Creation of a set of single-page Case Study Profile Sheets which visualise the basic features of projects and lessons learnt.

A critical issue for any inventory / database is the likely source of data and the reliability of the information obtained. Table 1 indicates key data types, sources and reliability.

*Table 1: Recommended/adequate data sources and data reliability rating based on source*

<b>Data Type</b>	<b>Data Source</b>	<b>Indication of Reliability</b>
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 interviews with beneficiaries	High
Technology-specific Details	Contract documents, installer/contractor 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

### *Interim Results*

This pilot inventory (please refer to full report in Annex 5 for full details) has managed to scope out more than 270 installation sites which were undertaken by more than 30 development programmes or projects. These installations are spread out across Malawi's 28 Districts. The installations include Solar PV (single and multiple installations), Biogas (community, household and institutional scale), Improved Biomass Stoves, and Micro-Hydro.

### *Initial Learning and Recommendations from the inventory*

The work of the pilot programme has been incredibly intensive involving visits to sites across all three regions in Malawi as well as interviews with a wide range of key stakeholders from Government, private sector, programme managers as well as academics. The full inventory report is available in Annex 5 but a number of critical issues are highlighted here as they have implications for future work (within MREAP and beyond) around the establishment and management of a national inventory of RET installations and programmes in Malawi. The benefits to Malawi of a coherent national inventory to aid effective planning and management (including possible certification) could be important. As long term approaches to climate finance are developed globally Malawi's position as a country that has strong documentary evidence of the provision of modern energy services primarily from renewable sources (on and off grid) may be important to substantiate the development of financing strategies for expansion of the RET service provision in Malawi. However for the inventory to be effective a number of issues will need to be addressed including:

- Collecting, verifying and managing data. The Government of Malawi with the RET installers/programme managers need to consider processes for initial installation documentation and mechanisms for on-going operational status.
- The process of 'Ground truthing' in remote areas is problematic. There needs to be further 'research' on mechanisms to facilitate automated monitoring of the status of installations.

This might be at the District level or at a national site. Whether this could be done through linked mobile phone technology e.g. sending routine texts to an automatic monitor when working and then being 'flagged' when off line would seem to be a priority for this system to work. Otherwise site visits in remote locations will be expensive to undertake even say on a two yearly cycle. Gains from use of RET may be lost in fuel emissions for monitoring! Note that MREAP will be piloting the use of monitoring systems using mobile phone technology which would then inform the ongoing design of a National Inventory.

- There is a need to consider whether the inventory is based on individual installations, installations by community/District, by programme or by Service Agency?
- Installers / programme managers need to think more clearly about how the longer term monitoring and evaluation of installations is to take place. This would enable 'installed' and 'operational' capacity to be monitored and an increased understanding of the efficiency and effectiveness of different installation types to be documented.
- There is a need for the inventory but there are questions of the 'ownership', transparency, maintenance and use of the inventory over time. Managing an inventory of installations and keeping data up to date in a decentralised country such as Malawi requires some careful understanding of different approaches. Funding, training and appropriate technological solutions need to be found.
- Information is valuable when used by development agencies (government and donor) to maximise learning and efficiency gains from appropriate strategic planning and cooperation.

The pilot inventory process discussed in this chapter highlights the scope and breadth of installations across Malawi. Having information on the installations at different sites presents a real step change in knowledge in Malawi around RETs once the pilot database has been completed and analysed. However the information contained within the inventory only presents one type of information.

The evaluation itself also undertook a number of detailed case studies (see Case Study Annex), which along with a number of key informant interviews and document analysis provides a broader evidence base. This evidence base is used in the following sections to provide some answers to the evaluation questions that were agreed with the Scottish Government (please see Annex 1).

In these sections we firstly, assess the relevance of the technology and policy of off grid community managed energy projects. Next, we consider what the evidence permits us to say about the value for money of the pilots and the effectiveness of these pilots from a management perspective. The key findings on sustainability are then highlighted, with some further insights on coverage, evidence base and the poverty focus of the pilots.

## Section 4: Relevance of off-grid RET projects

### *Evaluation Questions*

1. To what extent do off-grid energy management interventions contribute to national energy strategies and objectives?
  - a. Is there a current energy gap in Malawi? If so, is there likely to be an energy gap in the foreseeable future 5-20 year horizon?
  - b. How does this energy gap affect the quality of life in Malawi based on the evidence from the case studies?
2. What evidence is there that the intervention has considered a “people centred” approach and a focus on excluded groups?
3. What evidence is there that the intervention has benefited specific groups?
4. What are the outcomes for these groups, and is there evidence that this is being monitored?

The first section examines the current ‘energy gap’ in Malawi and the second section is dedicated to understanding how the RET case study projects contribute to improving development outcomes for poor rural communities, and specifically vulnerable groups within those communities. It is based on the assumption that within poor rural settings, there are specific groups of people who are often more vulnerable than others (see Box 1 below). In Malawi these tend to be people living with HIV and AIDS (PLWHIV), orphans and vulnerable children, landless, female headed households (FHH), the elderly and disabled (PLWD). The assessment has looked at the extent to which an intervention has taken a “people centred” approach and more specifically a focus on marginalised groups in its design. It then goes on to present some of the evidence that these groups have benefited from the intervention as well as the quality of the data. Table 2 summarises the 10 projects visited. We have not included the soft infrastructure case study or the institutional case study– but it is hoped that this evaluation will provide lessons that can be disseminated throughout ongoing capacity development activities.

### The ‘Energy Gap’

The argument put forward here is that it is highly relevant to provide access to modern energy services as a response to reducing poverty. In fact, it could be said that access to energy for basic needs services is a public good. As part of the commitments to the Sustainable Energy for All programme, Ban Ki Moon, Secretary General of the UN states that, by 2030 everyone should have access to electricity. Malawi has substantial short and longer term targets to set linked to Malawi’s Growth and Development Strategy 2 (MGDS2) to meet the objectives of Sustainable Energy for All, whereby all households have access to electricity by 2030.

Currently electricity supply is not meeting demand and the existing generation and distribution system urgently needs new capacity. This translates into a widespread energy deficit to meet household and institutional requirements at the community level. The draft MGDS2 cites that 9% of households have access to electricity, of which 98% is grid-supplied hydro-power generated electricity. 60% of the power distributed by ESCOM is supplied to consumers in the southern region (WB, 2011) which is somewhat more industrialised and has a higher population density. In the northern region, the inadequacy of the supply is posing a major threat to the economic development of the area. 80% of Malawians live in rural areas where access to modern energy services is less than 1%. (WB, 2011). Infact, generally in Malawi,

‘This lack of reliable power is a key constraint to development ... Unavailability of access to modern energy services contributes to low economic activity and productivity, lower quality of life and deters new investments across the country, in particular affecting key sectors of mining and manufacturing.’ (MGDS2, 2011:83, draft)

Providing energy to a community that has no prospect of being connected to the Malawian national grid in the next 5-20 years or those who may remain ‘off-grid’ for even longer is therefore a legitimate and high impact way of closing the ‘energy gap’ in Malawi. Without such a strategy, the current ‘energy gap’ will widen further and present increasing challenges to development in Malawi. It is also possible, that as with mobile phone technology, the need to have energy through a ‘national grid’ may not be required as off-grid technology develops.

All of the communities involved in the off grid RET projects for this evaluation were being given access to electricity for the first time. In many cases this meant meeting basic needs through service provision for institutional requirements, such as lighting for a school, lighting for a health clinic and power for refrigeration, or for meeting household requirements, for example a simple household lamp. More complex energy generation systems were viewed at Bondo Micro Hydro Scheme and also in the Solar Villages. Such community managed renewable energy systems aim to (not currently operational) meet greater demand for basic energy, so connecting more households, a school, clinic and a trading centre which includes maize meal grinding, barber shops, entertainment, mobile phone charging etc. There is very high demand for these services in each location visited.

### *The implications of the ‘energy gap’ in Malawi*

At this stage, it is important to introduce the two groups which are affected by the current energy gap. The issue of targeting is addressed later; however the funding from the Scottish Government is aimed at poverty reduction. Within the two groups discussed below the majority are likely to be without access to basic services. Even for those households that have a more reliable income stream, if the basic demand for modern energy services is not met Malawi will be unable to meet their MDGs, particularly in health and education. The two primary groups are:

- **Firstly, the un-serviced, rural, poor households living in small villages or scattered settlements.** These are not a homogenous group and include most vulnerable groups (e.g. those living with HIV/AIDS, subsistence and small market farmers, small business people (especially near trading centres), school students, teachers and rural health staff and patients.
- **Secondly the urban and peri-urban poor** (and not so poor, including businesses that employ poor people) who are unable to link reliably to current modern energy services due to market failures, supply failures or lack of opportunity. In some cases these groups may well be contributing to the unsustainable use of bio-energy resources i.e. wood-fuel and charcoal from rural locations.

## A People Centred Approach to RETs

In line with the 2003 National Energy Sector, renewable energy technologies have been introduced with the overarching objective of providing energy to satisfy public need, including poor rural areas as well as contributing to poverty reduction in Malawi.

*Box 1: MREAP: Statement of Intent on Socially Excluded, Poor and Vulnerable Groups*

MREAP projects will ensure<sup>1</sup> that poorer and socially excluded groups (including women) benefit from renewable energy technology through:

- Not assuming that the “community” is a homogenous group, and that benefit are automatically distributed evenly
- Adopting a “do no harm approach” – doing sufficient research and ground work to ensure, as far as possible, that poorer and marginalised groups are not adversely affected by the intervention
- In communications with groups and communities, ensure that poor and marginalised groups are specifically considered and targeted
- Ensuring that where possible and appropriate, poorer groups are the beneficiaries of the interventions
- Through the monitoring and evaluation processes tracking all of the above, and learning from the above.

All of the projects but one can be said to have been designed with community benefits in mind. These include educational, health and income generating benefits in the communities. It has to be noted, however, that most of the technologies were not operating to their intended capacity (please refer to Table 2). However, only four out of the ten projects have a specific design focus towards helping vulnerable groups within the community. As an example, the Social Enterprise for Development for Support of Widows and Orphans has been designed directly to benefit widows and orphans who will run the service. On the whole there is limited disaggregated data being collected or monitored by the administrators of the projects, and where there is, it was anecdotal. For example at the Senga Bay Baptist Medical Clinic there was some evidence of improved nutrition and wellbeing for PLWHIV but limited hard data available.

Amongst the other case studies, intended beneficiaries include women, PLWHIV and youths. There is no evidence of specific targeting, or designing the project to be inclusive of ethnic groups, elderly people or people living with a disability, and the majority of the projects are designed to benefit the wider community. For example, the provision of power at the hospital at Choma Health Centre is designed to focus on health benefits within the community as a whole, including provision of maternal services, with no specific analysis of who this is benefiting within the community. The case of the provision of power at Elunyeni and Chagunda likewise adopts a blanket approach which targets school children in the locality. While in MuREA’s Biomass Project the households seem to have been selected on the basis that they were available for the training. PLWHIV/PLWD and very poor would not necessarily be available for the training. There was also a question raised as to whether or not the more expensive stoves were appropriate to very poor households. However, it was noted of the ‘Stoves projects’ that labour time was saved from collecting fire wood which primarily benefited women (whose job it was to collect firewood).

As noted above, overall the benefits realised are primarily health and education through the improvement of community facilities (health centres and schools). Other than sex disaggregated data, there is no disaggregated data as to who within the community are benefiting from these (there is evidence of improved enrolment rates at for example the CRED project school for both boys and girls). Whilst poorer households may not directly benefit from some of the projects, there is an

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<sup>1</sup> Please note: This statement has to be agreed with the Programme Steering Group (PSG).

assumption that they are benefiting from the community assets. However, this assumption needs to be tested for example within the MREAP installations.

In summary, the projects that promote the use of **clay stoves** on the whole are targeted to women at the household level (although they did not specify whether these were FHH) with the following social development outcomes:

- Improved health outcomes
- Time / labour saved for women and therefore time for more productive activities.
- Income generation for producers and vendors (who are mostly not specified)

Whether or not these have been achieved is unclear, although there are early indications that they had not generated the income as anticipated.

The projects that promote **Solar PV installations** on the whole target groups such as youths, teachers, health workers, school children and the following social development outcomes are noted:

- Small enterprise and income for specific groups
- Improved health outcomes (through health staff retention, refrigeration for vaccination, water pumps, lighting in hospital)

Some income was being generated, although the extent to which this is received by the poorest and most vulnerable is unclear – it is usually being used for paying the guard/operator. There was however, an indication that some of these had wider community benefits such as using the centres for HIV prevention messaging.

There was some evidence of health staff and teacher retention due to the installation of solar PV power. The extent to which this in turn influenced health or education outcomes is unclear. There was some evidence that the number of children going to primary and secondary school had increased over two case studies (which may be a result of more stable staffing).

**Smaller solar PV pumps for irrigation** had more potential to benefit very poor or vulnerable groups. For example the project in Senga Bay reported improved food security of the target group (PLWHIV).

The projects that promote **Biogas**, on the whole, target the better off farmers and were not considered suitable for the poor or very poor as the cost of the systems were so high.

From the case studies, there was limited evidence of negative impacts on vulnerable groups other than girls being excluded and gender stereotyping. The lack of evidence on this may reflect the fact that the projects have not adopted a systematic assessment process to ensure that their intervention does no harm. The following table analyses design, targeting, benefits, and evidence against each case study.



*Table 2: Summary status report around community engagement from case study sites*

	Design focuses on community benefits	Design focuses on most vulnerable within community	Vulnerable groups have influence over technology use	Community benefits	Benefits received by most vulnerable (direct)	Benefits received by most vulnerable (indirect)	Evidence of negative impacts on vulnerable
CRED	Yes	No	No, however project is run by VDC	Education outcomes for 1,800 to 2,000 girls and boys in 7 villages	No evidence (but NB charge for attending school)	No evidence	No evidence
Hospital at Choma Health Centre	Yes	Design focus on health benefits in community	No	Health benefits for community, including women	No disaggregated data	No disaggregated data	No evidence
Biogas for individual households based on dairy farming	No	No	No	No	No	No	No
Social Enterprise for Development for support of widows and orphans	Yes	Yes – widows and orphans	Yes – widows and orphans will run service	Yes	N/A	N/A	N/A
Solar Villages at Elunyeni and Chgmanda	Yes – school children and 150 households	No	No (although women are included in management committee)	Yes	No evidence	No evidence	No evidence
Solar Aid, Mzuzu	Yes – schools/clinics	Yes (previous strategy) vulnerable and less vulnerable (designed to work with different income groups), plus PLWHIV, orphans and vulnerable women	No	Yes	Some, however, most products bought by men, and 47% in formal employment	No evidence	No evidence
Senga Bay Baptist Medical Clinic work on use of Solar pumps for small scale irrigation	Yes through clinic	Yes – PLWHIV and AIDS, orphans, widows	Yes – farmer clubs (incl PLWHIV and AIDS)		Some evidence of improved nutrition and well being for PLWHIV and AIDS, but limited data available  No data on health benefits	Limited data	Some potential for “stigmatisation” if groups only consist of PLWHIV and AIDS – especially when products are being marketed. This is being explored further.

	Design focuses on community benefits	Design focuses on most vulnerable within community	Vulnerable groups have influence over technology use	Community benefits	Benefits received by most vulnerable (direct)	Benefits received by most vulnerable (indirect)	Evidence of negative impacts on vulnerable
MuREA, Micro-hydro Scheme  Community Phase 1. NB Not operational at time of case study	250 households within the community, education and health benefits	No – project targeted those with a steady income	No evidence that vulnerable groups were involved in planning, however gender was considered	None yet. Women benefitting from transport to local market from MuREA's office vehicle.	None yet	None yet	None yet
Fixed and portable Stoves	Yes – labour saving time for women, health benefits	Yes – women's groups (incl FHH) – with a focus on empowerment (through IGA)	Women's producer groups formed	Yes – specifically women	Some – women and FHH but no evidence that vulnerable groups (eg PLHIV)		
Milonde Youth Club, TA Mabuka, Mulanje	Yes – IGA,	No data	Boys and girls of the youth clubs do (but no evidence about which social grouping they are from)	None yet	None as yet	None	Anecdotal evidence that girl are being excluded

In summary, there is an 'energy gap' around provision of modern energy services in Malawi which the off grid RET projects are piloting possible solutions to. The RET objectives are highly relevant but, there is little evidence of outcomes and impact of the initiatives, and in particular for vulnerable groups – partly because a number of the sites have only been operating for between 1 – 3 years. There is some evidence to suggest that these off grid RET projects will improve the lives of the rural communities, but less so that they will improve the lives of the very poor and excluded groups (i.e. little targeting of PLWHIV/FHH etc). The case studies that currently do have more of an impact on vulnerable groups are where they are piggy-backing on an existing project (e.g. Senga Bay). However as previously stated, some projects remain non operational or are operating below capacity – providing however important lessons for long term operation of off-grid renewable energy.

## Critical Lessons

Building on this analysis, it is possible to highlight what we believe to be the important factors to consider when looking to improve the relevance of off grid RETs in Malawi.

1. **An explicit understanding of how this 'off grid' technology fits within the district's decentralised understanding of energy policy, roles and responsibilities** and therefore within the wider energy mandate;
2. **Local ownership of the process & implementation, which is congruent with the national level thinking on RETs** – going forward for example, it will be important to situate current Stoves projects within a broader framework for biomass;
3. **Need for a diversity of approaches and assessment of appropriate approaches** – Understanding of what the intended outcomes of the intervention are, given the different contexts and potential technologies, require a diversity of design and management approaches;



4. **Scale of solution is important** – giving access to appropriate technology within market supply chains will allow households to decide on what system is appropriate for them. Decision making may be affected by stage in the lifecycle of the household, finance available as well as products on market;
5. **Transaction Costs - For some individuals, households and communities, committing or interacting with a project means costs of a social, economic, environmental nature may ensue.** The case studies demonstrated that in certain instances, for example the women's stove producer groups, engaging with RET projects can leave people disempowered and/or without a voice when commitments are left unfulfilled;
6. **Differentiated view of the community.** Being clear about whom within the community is benefiting, and who is not benefiting from the outset, and then monitoring how the intervention is impacting on different groups; and,
7. **More evidence required to demonstrate institutional access to modern energy services bring broader benefits for community** as a whole e.g. improved services in clinics and greater access of school students to after school facilities.

## Recommendations

Whilst it is clear that different elements of RETs are of direct relevance to different groups in Malawi there are a number of areas where improvements in understanding, including around processes for design, implementation and management need to be addressed. These include:

### *For MREAP Implementation*

- Officially adopt the gender and vulnerable groups statement.
- Strategic grant projects could officially adopt the 'do no harm' systematic approach and set gender aware outcomes which target the poorest and most vulnerable groups.
- Be flexible in the design of the strategic projects and grants, actively employ a diversity of approaches, so that at the end of MREAP, we are able to test whether there is any crucial learning from different approaches.
- Develop smart systems to gather data across all workstreams on how a differentiated view of the community (includes women, men, PLWHIV, FHH, PLWD, girls, boys and elderly) provides clearer evidence for who benefits from different types of interventions (including testing the assumption that access to energy at the institutional level provides community benefits for all).
- Report on this evidence and demonstrate, as far as is possible, how outcomes are and are not met in relation to the poorest and most vulnerable as well as to the community more widely.
- Develop with other RET installers and operators 'evidence and learning notes' on current approaches for wider dissemination and communication. These notes are developed based on two key principles:
  - a. We are mindful of the issue of differentiated social capital in the contest of Malawi
  - b. Secondly, that along with this a gendered analysis will be taken and designed into the MREAP M&E system.



For an action research programme, it is important to understand how differentiated social capital leads to different outcomes and how MREAP's operational design can maximise positive outcomes whilst minimising negative outcomes, particularly for vulnerable groups.

#### *For RET Installers and Operators*

- Current RET Operators including private sector organisations could learn and adapt the various models of community engagement and programme design that are being used in off grid RET projects. For example considering trialling a district wide adoption of a methodology: Concern Universal's successful design and implementation of projects using REFLECT methodology merits closer analysis. Secondly, RETs as part of a broader programme of economic development seems to build on current good practice: Concern Universal use RETs as one dimension to addressing poverty, gender equality and increasing community resilience to climate change.

#### *For Government of Malawi*

- Government of Malawi at all levels could look to develop greater knowledge around the incentive structures and the ability to manage and coordinate the different regulatory elements into a coherent and transparent system. This could include the issue of installation by registered contractors and post-installation inspection regimes.
- At a macro level the Government of Malawi could dedicate time to investigating how to promote local ownership of energy issues within the decentralisation framework.

## Section 5: Relevance of Policy

### *Evaluation Questions*

1. What is the current policy framework in Malawi for off-grid renewable energy development for community / households (public / private)? How is this policy framework enabling:
  - c. Engagement with regional development of markets and supply chains in renewable energy technologies and energy efficiency technologies?
  - d. Effective access to carbon financing mechanisms for public and private sector approaches?
  - e. How do current issues such as tax regimes, standards, capacity and decentralisation affect current and possible future coordination in Malawi?

### Current Policy Context in Malawi for Renewable off-grid energy

The current policy framework in Malawi is both complex (including policies from sectors outside energy including forestry and Local Government) and incomplete as there is no single policy encompassing off-grid renewable energy at the community and household level. The main policy framework for energy in Malawi dates from 2004 when community / household renewable energy systems were not easily available so this is not entirely unexpected<sup>2</sup>. In the last 10 years the move to RET off-grid has moved apace. The current 'permissive' environment (aside from real problems with the tax regime) has been effective in facilitating a large number of pilot programmes. However, as the off-grid renewable energy sector in Malawi begins to mature it will be necessary to consider the development of an effective and enabling regulatory environment. This will need to address coherently issues of standards (technology, installation and maintenance); capacity at all levels in government, private sector, academy and civil society and a range of other issues as highlighted in Annex 6. A maturing RET sector in Malawi does provide the opportunity for effective off-grid energy services to contribute to the development of a range of 'basic services' which are essential to enable Malawi to meet the MDGs, Vision 2020 and the aspirations in MDGS2 (draft).

#### *Responsiveness of current policy to community / household demand?*

The case studies show that there is a clear demand for modern energy services at the grass roots level, both for community service infrastructure and for households themselves. The development of community 'off-grid' systems show that there is an important contribution that communities can make in the long term operation and management of systems if they are engaged at an early stage in all elements of design, technology choice and management system. The same applies to the development of policy.

#### *Energy Pricing and new models of generation?*

Where a larger community based system is being developed e.g. MuREA, there is a clear need to have a transparent process around energy pricing and clarity on how this might link to wider developments, for example around agribusiness production of energy from biomass. Feed in tariffs (for systems that join the main grid) or supply energy through mini-grids (Solar Villages) where ESCOM may play a role (if the system is deemed technically sound) in long term management need to be set at realistic levels to facilitate capital cost recovery. Current energy policies from 2004 were not, as indicated above, designed to cope with the explosion of new technologies and for this market to develop appropriate facilitative policies need to be put in place.

<sup>2</sup> Please see Annex 12 for a fuller picture of the Institutional and Policy Framework for Renewable Energy in Malawi and Annex 13 for Climate Change and Carbon Finance background in Malawi

## Energy and Economic Development in Malawi?

The paper 'Energy Enables' has been developed as part of the Institutional Support Programme workstream 4: Policy Support, and is included as Annex 6. This paper is the product of discussions, key informant interviews, meetings with donors in Malawi, in Scotland<sup>3</sup> and the round table during the second week of the field visit held in Lilongwe<sup>4</sup>. This work further builds on the 'learning note' in Annex 7 which indicates that the development of the renewable energy sector which focuses on community (and household) off-grid energy supply in Malawi needs to explicitly learn lessons from other sectors. This is particularly important to enable sound governance arrangements for the whole of the operations and maintenance continuum for infrastructure that may be economically and structurally operational for 20 years or more to be developed and implemented. By taking a long term perspective near the beginning of introducing this technology within Malawi, it may well be possible for Malawi to avoid the problems often seen around non-functional water supply systems. The failure of critical infrastructure is not only a drain on scarce resources, but it places an ongoing burden on often vulnerable citizens and contributes to a climate of disenchantment with donor and government projects.

## Recommendations

### *For the Government of Malawi*

The Government of Malawi has already indicated that it has an interest in developing a Renewable Energy Policy for Malawi. This process, as indicated in Annex 6 'Energy Enables' will take time, but should situate community/household off grid energy services within the wider framework of renewable energy within Malawi. By so doing Malawi may be able to direct its energy infrastructure for electricity, service provision as well as cooking/heating away from an oil based, import reliant (and increasingly expensive) direction to one that is more rooted within the countries' own resources base (even if in the shorter term imports of the systems is required).

The development of a Renewable Energy policy than includes a clear focus on community and household energy will need to ensure that the process is:

- Considered in a manner that is fully in line with the constitution of Malawi and policy processes, including those that support Local Development and role of Chiefs in development activities;
- Operated through a coherent and transparent **multi-stakeholder dialogue** that is facilitated by the Government of Malawi in conjunction with key donors, the private sector, civil society and technical specialist from within Malawi and outside (regional and international);
- Able to address managerial and technical capacity issues, at national, district and community levels to facilitate long term system management; and,
- Is based on coherent evidence of system operations as well as findings around the key barriers to adoption of modern energy services by communities / households and how the private sector may address these barriers alongside public sector investment and the creation of effective enabling conditions.

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<sup>3</sup> This includes a meeting with Stuart Mills

<sup>4</sup> Please see Annex 10 for a list of Roundtable Attendees

*For MREAP and other programmes*

- To work together in a coherent manner to develop the appropriate ‘soft infrastructure’ around managerial and technical capacity for RETs. This may include the development of appropriate courses (short and long term), training material for training through formal institutions including TCRET, WASHTED and technical training colleges;
- To develop an effective cadre of academics who can support innovation in the RET sector around technology and processes;
- To develop applied research teams who are able to provide effective evidence to feed into Government Policy processes around RET; and,
- Publication of appropriate ‘best practices’ based on evidence from pilot installations that highlight engineering challenges, social/cultural challenges and economic performance issues.

## Section 6: Efficiency

### Evaluation Questions

1. What does an analysis of the case study evidence suggest on the efficiency of different types of installations?
2. How well co-ordinated and managed are *individual* off-grid energy management interventions?
3. How well co-ordinated and managed are off-grid interventions across and between actors *at the national level*?
4. Is there sufficient understanding of the household market requirements for solar versus the community requirements and how the private sector supports each?
5. What is the role of the private sector in developing renewable markets in Malawi? Are there any further relevant observations on the role of the private sector developing other RET markets in Malawi? Lessons from solar and lessons from other.

It is critical to understand how the efficiency of these systems will be analysed, and within what framework. The value of modern energy services are beyond those that are easily addressed within monetised value for money frameworks and care will be required in considering the benefits from a various perspectives. Data will need to be quantitative – financing costs/benefits, but also an increased understanding of the process/ social and community benefits that are available from modern energy services. Currently in Europe, the approach to the development of the use of renewable energy (on and off grid) is often supported, particularly in the early stages, in order to stimulate the investment and bring down the costs per item<sup>1</sup>. Therefore, how do we want to situate the arguments around the **necessity** of ‘off-grid’ electricity supply in Malawi to facilitate provision of services and attainment of the MDGs? Are these a ‘public good’ that requires support for investment even as they bring private benefits to households and individuals? Ultimately these decisions rest with the Government of Malawi (and financing partners) as to how the provision of modern energy services, in the short and long term, is prioritised and hence funded within Malawi. However current pilot programmes, and the evidence that they can provide around technical, social, economic and environmental benefits needs to be part of that decision making process. The evidence from this evaluation is presented below, and recommendations for how this evidence base can be developed are made.

### Operating Efficiency of Case Study installations

Operating efficiency, based on quality technology and installations, is at the core of financial sustainability. Malfunctioning or non-operational technology, or technology unable to generate design power, or technology which cannot meet demand will reduce the benefits obtained by users and could potentially damage people’s longer term confidence in the technology.

Our analysis suggests that in only two cases does the technology appear to be operating as intended (i.e. “good” rating), with a further three cases operating reasonably well, but limited to some extent by technical issues. Three cases are rated ‘partial’ which implies a significant difference between intended and actual operation. Interestingly, in these cases theft of equipment is as important a

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[http://en.wikipedia.org/wiki/Feed-in\\_tariffs\\_in\\_Germany](http://en.wikipedia.org/wiki/Feed-in_tariffs_in_Germany)



reason as technical factors explaining the sub-optimal performance observed. Operations have not yet started in two cases, but it is noted that design/cost concerns raise questions as to whether the systems in these cases will operate as planned.

*Table 3: Sample of operating performance among case study technologies examined*

Case study	Users	Operating performance	Notes
1. CRED, Mikolongo Primary School	- 2 classrooms and office - 1800 – 2000 pupils	Good (trending down as replacement lights are not available)	Estimate of users is approximate Based on observations at one school visited
2. Choma Health Centre, Zimba District	- 1 Community health Centre and 4 staff houses	Partial	Thefts have meant the solar vaccine fridge and emergency radio mast are inoperable Battery failures have mean SHS for staff houses not working
3. Biogas Energy Production Case Study	- Individual household(s) (a household of 10 people and another one with 8 people) (unspecified)	Partial/Good	A design flaw in one system results in operation below maximum methane capture. A further site under construction was visited but at risk from livestock disease Others not seen operating effectively.
4. Social Enterprise, Development	- Commercial use (restaurant cooking, TV, phone charging, water heating)	Not operating as incomplete	Project construction has stopped because costs have exceeded budget.
6. Solar Villages at Elunyeni	- 128 households connected (85% of target) in 6 villages plus 1 school + offices, Teacher houses (unspecified) & solar pump	Partial	2 out of 3 wind turbines broken Around 40% of batteries not operational Design/installation problems likely to have increased system losses
6. Solar Village at Chigmunda	- 123 households in 5 villages, 1 school, 5 teachers' houses, water pump for borehole to tank	Partial/Good	Batteries need testing, 1 wind turbine is broken, Design concerns and subsequent local expansion of the grid raises questions about system losses
7. SolarAid	- Staff at Choma Health Centre and maternity wing (unspecified)	Good	Supply reportedly insufficient to meet growing household demand
8. Senga Bay Baptist Medical Clinic	Site 1: 2.7ha & 20 households (HIV/AIDS affected) Site 2: 1.5ha & 20 households (HIV/AIDS affected)	Partial/Good	Limited operational data available, May be problems with depth of boreholes - at times in the dry season, water is reportedly not as good as expected.
9. Bondo Micro Hydro Scheme	- 250 households (of which 47 households have already wired their houses), 1 school, 1 health clinic and trading centre (maize mill, video show, battery charge, welding shop, entertainment centre, barber shop/salon, church and office)	Not commissioned (due to be commissioned in May 2012)	Concerns about the design on grounds of potential tensions over role of community and the operationalisation of MEGA;
11. Milonde Youth Club Business Centre	- 10 youth groups (business & info centres), access to TV/DVD for local communities, small business development?	Partial	Based on observations at one centre visited, where system has not provided lighting (inappropriate battery or lights?) and cloud cover reportedly affects supply reliability

## Relative Efficiency of the Case Study Installations

This issue is addressed in two parts: whether conventional energy sources might be more attractive; and even if not, whether the optimal RET option has been selected.

### *Community RETs – what is the true economic comparator?*

Off-grid renewable energy technologies are often compared with grid-sourced electricity when assessing their relative attractiveness. In such cases, returns to off-grid RETs are typically found to be lower than grid-sourced electricity because the cost per kilowatt hour supplied is usually higher while the scale of benefits is usually lower (given the lower capacity delivered). This is found to be true in Malawi because ESCOM are using facilities, and hence a pricing structure, that has already seen a write off of capital. This raises questions about the current business model to enable future investment. However in Malawi, the cost comparison should contain an assessment of the ongoing disadvantages that households and community services face through the lack of modern energy services. On-costs include an inability to provide effective local health services (e.g. vaccination, basic medical testing or maternal clinics) which moves the cost onto individuals through the need to travel for service provision or an increase risk of serious illness or death through poor service provision.

It should be noted that such analyses tend to ignore the long-term, downward trend in the cost of RETs compared with increased potential for volatility and increases in the cost of fossil-fuel based energy sources, or in the case of Malawi possible increased risks from climate change and water availability for hydropower. Economic analyses have in the past also ignored the potential value of RETs in the context of national environmental and energy security strategies and the need for balanced development strategies. Many RETs investments could be justified in these terms as small-scale, pilot programs that enable learning by doing, which, together with general cost reductions and technological developments, will make off-grid electricity more competitive.<sup>2</sup> However, this argument assumes a level of coordination around the investments and subsequent lesson-learning that needs to be positively addressed through programmes such as MREAP.

For poor people and remote communities, the more important issue here is that comparison with grid-sourced electricity is largely spurious. In all of the cases reviewed, extension of the grid to the affected communities is simply not a prospect in the short- to medium-term or would require significant financial investment from, for instance, a School Management Committee for connection and monthly electricity charges. In these situations, the comparator technologies are more realistically kerosene and car batteries. The discussion in the section on effectiveness highlights the potential attractiveness of small household solar systems on cost-savings (kerosene and phone-charging) alone. It is worth adding here, that the analysis in that section does not take into account taxes and duties on RETs and any subsidies on kerosene (plus recent availability issues). Adjustment for these would likely serve to increase further the relative attractiveness of RETs.

That said, even if in many cases RETs can offer significant savings on these traditional energy sources, the investment costs of even the smallest system may still restrict access by the poor in the absence of subsidies or financing assistance.

### *Technology selection – issues to be considered?*

The second part of our question requires consideration of whether the technologies observed in the case studies reflect an optimal choice of RET. The particular circumstances of each of the cases examined make comparative assessment of technology choice difficult. Nevertheless, there are some 'rules of thumb' which allow us to draw some broad conclusions.

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<sup>2</sup> World Bank (2008) The welfare impact of rural electrification: a reassessment of the costs and benefits. Independent Evaluation Group (IEG), Washington D.C.

World Bank guidance<sup>3</sup> suggests that where users are relatively few in number and dispersed, and their main electricity use is domestic lighting, individual systems, usually Single Household Systems (**SHS**), are common. The single **institutional solar PV installations** (schools, clinics) included in the case studies by definition largely meet this criterion, though their larger systems facilitate a greater range of uses. The examples of self-purchased SHS systems also appear to fit well, notwithstanding users' desire for greater capacity. In contrast, **micro or mini-grids** are often justified where a large number of users are sufficiently concentrated to make the system technically and economically viable. The planned micro-hydro scheme in Mulanje district appears a good fit in this case but the solar villages (Elunyeneni and Chigmunda) are more questionable, given the dispersion of the connected households and concerns about the cost and losses from the distribution system.

In the solar villages, which include use of **wind turbines**, there a suggestion that energy sources may be insufficient given the requirements for efficient wind-generation. That said, in most cases, the systems were either only partially functioning due to damage from a hail storm or through technical breakdown. Furthermore, the scale of the wind turbines was relatively small compared to the larger, more efficient turbines normally seen in the North. The latter may provide more effective energy generation for both connection to the grid and for small District town / settlement mini-grid systems where they could provide a higher level of energy for small scale industrial use perhaps.

For the TCRET **biogas** project, the exploration of systems based on plastic tanks rather than the large concrete constructions may provide benefits at both lower costs, and for a wider range of households as the feedstock requirement would be lower.

## Private Sector Support

Current facilities for supporting household and community requirements by the private sector are minimal. SolarAid's example dominates the institutional landscape in the north of the country, outlined in **Case Study 7 – SolarAid – Catalysing the market**, with an ambition to make Malawi a kerosene free country and to provide one light to every Malawian student.

It will be important going forward for SolarAid, as an NGO in the sector, to monitor and report appropriately on the outcomes that arise following household light system etc. purchases. Products currently marketed by SolarAid range considerably in price thus facilitating households to be able to access systems that are suitable for different stages in the lifecycle. Data from such a system could highlight the costs and benefits associated with technology of different scale to people with different socioeconomic status.

All cases presented suffered from an inadequate amount of available data to analyse operating efficiency and value for money to an acceptable level of detail. It is assumed that the work of Business Innovation Facility (BIF) to develop Mulanje's Electricity Generation Agency's (MEGA) business case is being built on the basis of more detailed local metrics; metrics which will model the different tariffs, operating efficiency as well as cost/benefits etc.

## Lessons on Efficiency

Key challenges for any governance or institutional organisation hoping to address the 'energy gap' through RETs will be to match the needs of its population to an appropriate technology and understand the cost and benefits associated with such a choice.

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<sup>3</sup> World Bank, (2008), Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices. Operational Guidance for World Bank Group Staff, November, Washington D.C.

Further points of note include:

1. **The efficiency of the system and the ease with which it can be maintained by local people/service providers.** If the technology is complex then what provision is there for technical support/purchase of spares? Given the FOREX problem this is of significant concern. Technologies should be robust, require minimal maintenance and ideally not lock people in to obsolete technology (over the 5 – 20 yr period). Design of RET technologies must consider the changing needs of the households at community level (for example today their demand is lighting only but tomorrow they will need to own a fridge and other high energy equipment). This is an area where further work should be done and where MREAP has an important role to play, given initial indications from the inventory are that many schemes are not working.
2. **Looking at smart subsidies for RET so that the structure and fee for RETs when compared to the national para-statal ESCOM are consistent and fundable.** So, while current customers of ESCOM do not pay any additional fees for breakdowns/ replacement or environmental costs (given it is hydro-power), RET customers may have to contribute to operation and maintenance (O&M).

## Recommendations

*For the Government of Malawi*

- **Consider the role of energy as a basic service** along with the respective roles of the State, private sector and communities in energy pricing, delivery and system maintenance.
- **Review the appropriateness of the current ESCOM business model to enable future investment in RETs.**
- **The pricing structure for energy should be for on and off grid systems;** perhaps by way of a national level renewable energy forum, as well as the multi-stakeholder process for the development of the Renewable Energy Strategy for Malawi.
- **Develop systems/approaches to gathering data from pilots** to provide a longer term view of benefits and costs of RETs.
- **Focus on climate compatible development** – when implementing MGDS2 (draft) seek a balanced development strategy which acknowledges the vulnerable and poorest's costs.

*For current RET operators, the Government of Malawi (GoM) and microfinance providers*

- **Strengthen linkages for RET promotion.** The biggest challenge for RET promotion is the high installation costs that are involved. Financing for RET at community level is a big issue considering that most people in the rural areas live below the poverty line. It is important therefore that financing for RET should easily be accessible for rural households.

*For MREAP implementation*

- Develop M&E systems which gather data that can look into the question of RET system efficiency and support efforts to understand what the most financially sound RETs are and how this argument can feed into a wider economic focus on off-grid value chains.

## Section 7: Effectiveness - with a focus on management

### *Evaluation Questions*

1. What are the most effective off-grid energy management interventions overall? (*Taking into account social, economic, environment and developmental factors, in addition to technical performance*)
2. To what extent are off-grid energy management interventions contributing to development outcomes?
3. Are the organisations involved in the development and implementation of the systems engaging with communities in an appropriate manner which enables effective design and community ownership of the projects?
4. If one considers electricity as a service, rather than a source of energy, what implication(s), if any, does this have for management? What role does the Government currently play in the management and how does this differ at the national, regional, district, community and household level?
5. What support is there for the development of soft infrastructure to enable communities to have appropriate skills and for technical support skills to be certified?
6. What is the current quality of the evidence base for technical efficiency?
7. What is the current quality of the evidence base for the social/economic changes and hence pathway to impact from the different schemes?
8. What opportunities are there for the academic/ civil society / private sector / government agencies / donors to facilitate longitudinal studies both historic (e.g. cook stoves) and current (e.g. biogas, solar schools) to enable greater understanding of the pathways to impact?

It is proposed here that when considering issues around the effectiveness with which modern energy services are delivered factors around the principle of energy as a service are considered. This approach would see the provision of energy (usually electricity) for community services (health and education in particular) on a par with the provision of water. The provision of water and energy as **basic services** enables the effective management of health and educational institutions through which effective development outcomes are achieved more cheaply and effectively.

### Benefits of Access

Table 4 summarises users' views on the benefits of access to electricity provided by the technologies. The table distinguishes between reported and anticipated benefits, with the latter indicated in parentheses.

The benefits of electrification identified by users follow similar patterns seen elsewhere. For the purposes of review, we have divided these according to financial/economic, social and environmental. We adopt this approach, rather than a functional classification, because different functions can be associated with more than one benefit stream (for example, better lighting may enable cost-saving as well as education benefits).

Table 4: Outcomes reported (anticipated) by case study users

Case study	Financial/economic			Social				Environmental	
	Cost savings	Leisure (TV)	BD	Staff retention	Quality of services	Social outcomes	Safety / security	Reduced deforestation	Other
1. CRED, Mikolongo Primary School	✓	(✓)	(✓)	✓	✓	✓	✓		
11. Milonde Youth Club Business Centre		✓	✓			x (✓)		(✓)	
9. Bondo Micro Hydro Scheme	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	
2. Choma Health Centre, Zimba District				(✓)	✓				
Private household supply (Zimba)	✓	✓			✓				
3. Biogas Energy Production	✓					✓			
4. Social Enterprise, Development		(✓)	(✓)						
6. Solar Village at Chigmunda		✓	✓		✓	✓			x*
8. Senga Bay Baptist Medical Clinic			✓			✓			

\*Battery replacement and hence disposal issues

### Financial/economic Outcomes

Cost savings for the individual household are realised primarily as a result of the shift from traditional to modern lighting – typically from kerosene lamps and candles to electric lights. Cost savings on mobile phone charging were also identified and additionally, access to electricity was associated with time savings for the households affected – in terms of the time saved from travelling to purchase fuel, charge mobile phones, collect water and – in the case of TCRET biogas – to collect firewood (for cooking).

Estimates obtained during fieldwork of expenditure on kerosene and candles for lighting range from around MK350 to MK3,000 per month. These ranges reflect different consumption patterns and the lower end estimates almost certainly reflect cash constraints on poorer households.

In the absence of detailed data on consumption and expenditure patterns, we estimate that kerosene for one lamp to be operated for 2.5 hours each night costs MK400 per month. The cost of charging a mobile phone is estimated at MK300 per month<sup>1</sup> giving total expenditure on these items of about MK700 per month. In comparison, the cost of the Solar Aid system with LED lights and phone

<sup>1</sup> It should be noted that these estimates reflect local 'ability to pay' rather than 'willingness to pay'



charger (based on information from staff at Choma Heath Centre) equates to approximately MK360 per month over five years (at a real interest rate of 10%).

This implies savings of approximately MK340 per month (around 50%). However, this figure is an underestimate of the full benefits. In comparison to a single kerosene lamp, the Solar Aid system provides greater quality and quantity of light – in the case of the latter, we assume 4 hours each night, compared to 2.5 hours of the lamp. Adjusting for the differences in both the quantity and quality of light suggests that unit lighting costs with solar electricity are less than 10% of the unit cost of kerosene-based lighting.

Time savings could not be estimated in detail during the rapid review exercise but the benefits of any time savings should be included in the analysis. Conventionally, time saved can be valued in terms of the average wage, though care is required to identify genuine time savings – for example, travel to charge mobile phones undertaken solely for that purpose might be included but not if incorporated into routine trips to town. These benefits would be in addition to the cost savings identified above.

Data available from the case studies were not sufficient to estimate the benefits arising from increases in access to TV enabled by the introduction of RETs, but in principle, these can be assessed in a similar way as above, by estimating users' willingness to pay based on a comparison of the costs of running TVs from car batteries and from RET supplied electricity.

*Business development* effects of grid-based, rural electrification have been found elsewhere to be generally limited, though the exception is with household-level or micro-enterprises, such as phone-charging, or small-scale refrigeration services encountered in the case studies<sup>2</sup>. (A detailed review of the impact of off-grid electrification on business development is not readily available). In addition, business promotion associated with access to electricity has tended to perform better where support is provided. The small-scale irrigation project in Senga Bay provides such an example, given the project support that operates alongside the solar technology.

The value of electricity in these productive endeavours is represented by the incremental net benefits that result, from either new business opportunities opened up, higher yields or longer operating hours.

### *Social Outcomes*

Given that the case studies included schools and health centres, social benefits have surprisingly not been identified by users. Users identified the positive effects on the quality of services, such as access to drugs that required refrigeration and, interestingly, the ability to attract and retain health workers and teachers locally. In addition, some users reported improvements in health and educational outcomes.

For staff retention, respondents from the primary schools in Balaka district cited 20% improvement in teacher retention to date in schools where solar electricity had been installed. Across both health and education installations, users identified the role of electricity in reducing staff travel time (as they are prepared to reside locally) and enabling staff to undertake preparatory work during the evening, with the effect of increasing contact hours available for service users. Valuing this effect poses some interesting challenges. In schools, for example, valuing any improvement in student outcomes attributable to greater availability of staff may capture this effect (see below). However, as an interim measure, it would be interesting to assess the price premia staff are prepared to pay (in terms of additional travel and accommodation costs) to have access to electricity.

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<sup>2</sup> World Bank (2008) The welfare impact of rural electrification: a reassessment of the costs and benefits. Independent Evaluation Group, Washington D.C.

For Case Study 1 on CRED, it was reported that since the solar system was installed in 2009, the pass rate of pupils in all the classes has increased. For example, in 2008, the pass rate for Primary School Leaving Certificate examinations was 50% out of 41 pupils but no one was selected to secondary. In 2009 when the systems started operating, the pass rate improved to 75% and 4 students were selected to secondary schools. In 2010, the pass rate for primary school leaving certificate examinations was 100% and 19 students were selected to secondary school out of a total of 38 pupils who wrote the primary school leaving certificate examinations. The increase in pass rate of pupils is also taking place in all the classes at the schools – teachers attribute at least some of this to better lesson preparation and having a light and safe environment for early morning/post school study.

Users also identified outcomes (both actual and anticipated) in terms of better student results/progress and positive health benefits (in the case of HIV/AIDS-affected households in Senga Bay). In the case of student outcomes, these were ascribed to electrification in the school. A further possible way that RETs may affect student outcomes, not cited but based on experience of rural electrification elsewhere, is at the household level where electricity enables additional hours of study in the evening. Where children of electrified households do better at school, this in principle should translate into higher future earnings. The present value of incremental future earnings can be calculated as a monthly figure as a means to value these benefits.

In terms of potential health outcomes, in addition to the Senga Bay case mentioned above, the TCRET biogas case study identified users' preference for biogas over firewood for cooking given it is smokeless. Although not reported by users, kerosene lamps also emit particles that cause air pollution and these particles do not disperse indoors, resulting in concentrations that can exceed significantly WHO standards. The World Bank has estimated that as a consequence, adult work days lost average 3 per year, and the additional under-five mortality is 2.2 per 1,000. Substituting electric lighting for kerosene lamps, therefore, has a quantifiable health benefit.

### *Critical lessons*

Where the funding for basic service provision is significantly limited due to budget constraints at the national level or, where decentralised service provision is managed at the District level, **how can the roles and responsibilities for service provision be effectively delineated?**

Within the Government of Malawi there are opportunities to **promote** the inclusion of modern energy services (electricity or even biogas production from waste material to enable cooking for school meals using material supplied by WFP). This can take place in a realistic manner through the inclusion of modern energy services within the standard designs for schools and clinics. This could ensure that all new construction (funded by Government through the SWAp) was linked to provision of energy directly. The development of an increasingly large set of infrastructure (see inventory) sites with RET included will then need to have **an institutional mechanism, including trained technicians**, to support the maintenance of the system. **Planning and financial allocation processes** will need to be developed to support system management to ensure that the capital costs are not wasted when elements (whose life span may be much less than the 20 years for the panels) break down and are not replaced.

Furthermore, within the Government of Malawi there is a need to clarify who would bear the **additional expenses (if any) of off-grid services compared to on-grid services?**

For **households** however the government is more likely to play a **facilitative role**. By this is meant that it would enable the private sector, and appropriate NGOs who are engaged in catalysing local markets for energy related products (generation and efficiency) to import, produce, sell and maintain systems suitable for individuals through to total household systems. The government would have a role in ensuring that the market delivers high quality products i.e. reducing the risk that poor customers will spend money on counterfeit products which do not deliver effective services, and increase the risk that if they have borrowed money to finance the capital purchase they are not able to repay this from the savings made.



Furthermore, what are the **incentive structures** around the ability to manage and coordinate the different regulatory elements into a coherent and transparent system? This includes the issue of installation by registered contractors and post-installation inspection regimes.

**Tracking of systems within Malawi** – this has implications for understanding not only what has been installed but who has responsibility for ongoing maintenance. For instance currently the Ministry of Education indicates that there are only 18 schools in Malawi with solar installations. However SolarAid itself has been involved in installing in 50 schools (and 20 clinics). Government financial contribution to installation of RET is often not in place leading to major delays and resulting in cost increases. For school based systems SolarAid expect a 10% contribution and for Government managed infrastructure generally around 40%.

**A household energy audit** (and for a school / clinic clarity on what energy supply could enable e.g. fridges for vaccine, sterilisation equipment, high powered lights for small medical procedures) would therefore be a very important step towards understanding the different uses for energy in the household and the most appropriate substitutes for biomass by different vulnerable groups. Of the case studies used as an evidence base for this evaluation, very few established appropriate or proportional baselines which included a view of energy use and access at the household or community level. Various reasons exist for this including a lack of finance and capacity. With this type of data available, the relevance of different types of technology in different circumstances to close the energy gap could be systematically reviewed. With an eye to the longer-term benefits and sustainability, such a baseline could also include an assessment of users' willingness and ability to pay. Linked to this picture could also be the 'energy flows' within the community / District. Rural communities may be net providers of energy to other areas through trade in fuel wood and charcoal. This trade may provide important resources into households.

As indicated in the 'learning note' Annex 7 it is critical that pilot programmes, such as the 12 case studies, provide coherent evidence around the 'proof of concept'. This latter can include (as indicated in the Theory of Change) issues relating to the technical/engineering concept, the social concept (delivery to poor remote communities) as well as the economic concept around delivery of the basic modern energy services. Evidence to support the development of these areas is required to enable decision makers to understand the benefits (for whom, where, how and why) that energy services provide towards meeting Malawi's development goals. At present little robust evidence is being presented in a systematic way. Without this critical understanding from what might be seen within Malawi as **trusted sources** (e.g. the Polytechnic and University) it will be problematic to a) development a clear renewable energy strategy that enables community and household RET system development and b) fosters good practice around the planning and financial allocation for scale up processes.

## Recommendations

### *For MREAP and other programmes*

- **Set coherent multi-dimensional baselines** that examine current energy usage at household, community and District level. This approach can allow both quantitative and qualitative data to be gathered. This then allows the measurement of change through:
  - long term formal case studies that uses a robust methodology to facilitate comparison between case studies;
  - use of participatory tools such as Most Significant Change to discuss with stakeholders at all levels the critical process of change as well as documentation of the actual changes at output and outcome level;
  - Participatory story telling using photographs whereby local people themselves (school management committees, energy management committees etc) document the changes

that take place within their communities before/after the advent of modern energy services.

- documentation of the operational efficiency of the system.
- economic analysis of the costs/benefits for different stakeholders. This could include use, in selected sites of approaches such as Social Return on Investment which can facilitate documentation of non-monetary benefits within a coherent and robust framework.<sup>3</sup>
- **Managing inflated expectations** from the outset. For community systems there is a need to consider whether the size and scale of the system can provide energy beyond the institution gates. For instance, the Solar Villages were designed to provide wider power through mini grids, as are the hydro systems at MuREA. At the same, a realistic appraisal of the level of community mobilisation required ensuring effective installation and management/maintenance is also essential.

*For Government of Malawi*

- **Develop a strategic framework into which all appropriate and useful evidence connects.** While the pilot inventory is a first step towards mapping the renewable energy organisations and their projects, it is the connection of all the activity to a broader strategic framework which will create the real value for Malawians.
- **Ensure that all projects pass through the normal decentralised decision making process - the District Council.** Define the roles and responsibilities for promotion and coordination of RETS at district level. Create a national and district level forum, National Sustainable and Renewable Energy Programme (NSREP II) for coordination and discussion of RETS. For this to be a success there is a need to strengthen the capacity of the decentralised structures at district and community levels for RETs coordination and promotion.

We believe that current opportunities exist to enable greater understanding of the pathways to impact and therefore this section fully endorses the recommendations laid out for the Government of Malawi as well as MREAP and other programmes under the Relevance of Policy Section.

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<sup>3</sup> See New Economics Foundation <http://www.neweconomics.org/projects/social-return-investment>

# Section 8: Sustainability

## Evaluation Questions

1. How is the issue of sustainability approached in the pilots that were visited for the case studies?
  - a. Quality control, supervision throughout the operations and maintenance continuum (from design, through installation and maintenance, contracting, warranty).
  - b. Roles and responsibilities for operations and maintenance between the service site (school, clinic, water site, generation centre) including the financing of O&M?
  - c. How do academic and other partners learn and adapt current technologies used in Malawi?
2. Based on the case studies, are there any avenues that further research could look down to explore the benefits which may be associated with RETs?
  - a. How can 'soft infrastructure' be built and maintained, including at the District level?

## Sustainability as a process

The concept of 'Sustainability' when considering the development of off-grid renewable energy at the community and household level needs to be explored further to ensure that there is a common understanding around its usage in this evaluation. **Sustainability implies a degree of continuity around the intervention, and in hardware/software systems that are being commissioned. However sustainability should not be considered a static concept** i.e. how long the hardware will last but it should, in a sector that is seeing innovation and change, also **include the notion of the level of adaptability to future changes**. These changes could be both technological e.g. new improved solar panels, climate change related e.g. increased hailstorms through to changing expectations of citizens of Malawi.

**The understanding of sustainability is therefore as a combination of process resilience and adaptability that is linked with the issue of the viability of hardware systems within the context in which these systems are being installed.** So when considering 'sustainability' we therefore must consider the following elements:

- **Ability of the enabling environment to adapt to changing circumstances** e.g. new technologies, financing opportunities e.g. from international climate funds. This would also include the ability of the government sector, at all levels, **to coordinate activities within government and with other key actors** around RET including private sector, NGOs and CSOs;
- **Ability to achieve clarity around financing arrangements.** This would include short and long term, capital and revenue financing mechanisms as well as clarity around feed in tariffs (if applicable for larger systems);
- **Technically appropriate systems which can be managed at local levels with appropriate support.** The RET market is changing fast as innovation, particularly in the solar market around both household systems (single light through to small scale solar) and panel efficiency. Ensuring coherent standards that are responsive to innovation are in place will assist in supporting effective private sector value chains and possible new entrants. Some system life expectancy would be 20+ years (solar panels, biogas and micro-hydro) with careful maintenance, whilst others e.g. household solar lights may only be 3- 5 years;
- **Sustained capacity development.** A critical issue for Malawi is around both training qualified engineers to undertake research and development in the RET sector, but right

through to training qualified technicians to design and maintain systems of all shapes and sizes. These technicians may need to include people from the grass-roots level with current limited formal education but with a strong willingness to take responsibility for the management of local infrastructure ('barefoot engineers?').

With Malawi, with a high focus on the role of District government and Chiefs, it should be recognised that this decentralised structure has a very important role in promoting and facilitating renewable energy technologies in the country since all development activities are implemented through this structure. This structure strengthens the participation and decision making processes at the local level which in turn strengthens ownership of any project.

When examining the case studies it was noted however that most of the renewable energy projects bypassed this district level structure since most of the decisions were made from the centre to the communities. This is a big challenge to the sustainability of most renewable energy projects in the rural areas. Another challenge is that the Department of Energy (responsible authority for promotion of renewable energy in the country) is not decentralised and has no district offices and no technical officers based in the districts while other government departments have personnel at both district and community levels working through the decentralised structures.

Maintaining the state and efficiency of the technologies and structures is complex and demanding. This should not be a burden to the poor over the longer term. In all the communities visited, it was evident that the capacity to manage and maintain the RET installations more especially the solar and wind installation is very limited.

The four areas that are critical to sustainability i.e. **enabling environment, financing, technical viability and capacity** will be explored on the basis of the evaluation finding (from case studies, key informant interview and the 'round tables' with Government of Malawi representatives) so that there is clarity around the key issues that will influence the viability of installations and the sustainability around the use of renewable off-grid energy services for current, and future, interventions around community and household energy in Malawi.

## Enabling environments contribution to sustainability

In order for Renewable Energy Technology to be viable and to contribute in a sustainable manner to social-economic development in Malawi there needs to be a number of important elements in place. Figure 2 of the Theory of Change indicates the breadth of issues to be addressed. The development of an effective Renewable Energy Strategy for Malawi is a critical element for the development of viable and sustainable renewable energy off-grid systems at community and household levels throughout Malawi. As indicated in the pilot inventory report there are off-grid renewable systems in all 28 Districts in Malawi but a number are not functioning due to issues around the roles and responsibilities for operations and maintenance. The development of the enabling environment would ensure that a number of the issues raised around financing, technical appropriateness and development of sustainable capacity are addressed in a coherent, coordinated manner by stakeholders within Malawi.

### *Recommendation for development of the 'Enabling Environment' in Malawi*

Please refer to the paper 'Energy Enables' in Annex 6 for further detail. The following is recommended for the Programme Steering Committee of the MREAP to take forward in conjunction with the Government of Malawi, donor community and key stakeholders.

- **MREAP Programme Steering Group agree that input into the development of a Renewable Energy Strategy for Malawi**, that explicitly addresses community and household modern renewable energy service supply and energy efficient use of biomass if an appropriate focus for the MREAP.

- **Agree the outline of a process within the MREAP funding which includes the following:**
  - Preparation of a **Policy Development Process Map** for consideration by end July 2012 which would outline process and which organisation within the different stakeholders is facilitating which element under a central coordination team (Government, donor, academic, private sector and NGO).
  - **Undertake an Energy Policy Review** to synthesis the current existing documentation, including from World Bank, UNDP and Government of Malawi, in country to provide a 'baseline' from which the policy process can move forward. This could highlight elements on current policies which are relevant, where there are critical gaps and areas that are currently being addressed through other policy processes (for community service provision and household systems Appendix 1 below gives some critical areas for consideration). An appropriate energy policy specialist team from within Malawi and internationally would be required. This review would, in itself, constitute a **capacity development activity** that enables academics and other specialists in Malawi work within a formal policy review process;
  - **MREAP to facilitate, in conjunction with the PSG, dialogues with other interested funding partners** (for cash inputs, technical support inputs etc)
  - An initial **multi-stakeholder round table** in Lilongwe, to agree the process for the effective management around the development of a Renewable Energy Policy based on the baseline and current energy projections (including supply from grid, energy demand scenarios (with rising populations and expectations). **Proposal for this to be linked to the MREAP Programme Steering Group meeting in October 2012;**
  - Agreement of **funded (ideally) process** for development of a Government of Malawi Renewable Energy Framework and accompanying financing framework, including options around international climate finance.

## Financing for sustainable renewable off-grid community energy

This section addresses two important issues. The first discussion related to the important issue of **quality standards, warranties, contract and insurance**. Without clear quality standards no long term installation (and for RETS these can be for lifetimes of 5 – 20+ years) will be able to meet the standard on which it was installed, either in terms of efficiency of output nor around the operations and maintenance continuum i.e. the whole life of the installation (see Tables 1 and 2 in Learning Note, Annex 7 for further detail of this). Poor quality installations provide a lifetime of maintenance problems, and are likely to lead to a reduction in output and an early failure of the system.

The second discussion relates to the fact that many RET systems are to be located in poorer and more marginalised communities, or will be sold to poorer households there is an issue beyond quality standards that relates to the question of **equity in financing for modern energy services**. The Government of Malawi needs to work with stakeholders to ensure that the standards of contribution for the provision of modern energy services are equitable between urban / richer populations. The latter have greater opportunity to connect to the grid electricity run by the State owned company ESCOM, and the level of support that is available for rural / poor populations who need to be supplied by off-grid electricity services. This issue is addressed below around the question of financing for community services.

### *Quality Standards, warranties, contracts and insurance?*

An important element of any long term system is the quality of the technology, the installation design engineers and the long term quality of operations and maintenance. At present the systems for all the

case studies are 'ad hoc' with little attention being paid to quality standards (although MERA has a role in licensing installers), contract design and enforcement of warranties. Specific areas that need attention in the short/medium term would be:

### **Adoption of RET standards in Malawi**

Within Malawi there is currently no internationally accredited Bureau of Standards for the assessment of RET. Whilst the TCRET was initially to be set up as a testing centre under Danida funding, the withdrawal of Danida left TCRET with equipment that they were not able to use. Quality of installation is vital to ensure that this new industry in Malawi develops a positive track record and is not let down by use of equipment that is faulty, with unenforceable warranties (especially with contractors from outside Malawi) and where there is 'oversell' on what the system can actually deliver. Currently system testing for RET takes place in Botswana.

### **Increase attention on technical accreditation and warranty design and implementation?**

SolarAid addresses this issue for their household systems by importing from an organisation (Light Up Africa Foundation) that has an accreditation system in place. However Malawi will need, to ensure compatibility of systems as well as quality, to adopt effective quality standards for hardware (of all types), installation engineers and maintenance technicians and acceptable warranty standards. Without this the RET industry may go the way of the borehole provision where installations are not maintained and warranties are unenforceable by the people most affected by the failure i.e. the school or clinic (see the fate of the borehole at the Mikolongo Primary school where CRED have installed one of their early solar systems).

### **Contracts for installation should include clear role for local management agencies**

When solar systems are located on schools/clinics the contract with the supplier is often held by the Ministry rather than the District (depending on the funding source). In this case the school or clinic as well as the District authorities have no contractual linkage with the installer. This leaves the users of the infrastructure, including the School Management Committee, or the health authority outside the picture when working to ensure that warranties are in place and that contractors fulfil their obligations. For instance the Solar Village installations the Government of Malawi has set up a contract with the suppliers (Su-Kam who installed as a turn-key project<sup>17</sup>) to maintain the sites. However the local community energy committee has no input into the design of these contracts nor has any power to ensure they are enforced. If there are problems then they will use 'political influence' with their MP to help resolve problems. However there is no long term strategy for ensuring the viability of these systems e.g. around battery replacement, or distribution network issues to ensure that the investment meets the potential. Current cost recovery approaches for these systems barely covers the guard and operator costs and will not be sufficient to cover battery replacement costs. Furthermore the need to import spare parts (e.g. windmill blades) means that maintenance is subject to FOREX difficulties which is likely to delay replacement.

### **Insurance for major installations?**

At no site was there insurance in place to deal with catastrophic events including theft of solar panels and batteries (Choma), or weather damage (MuREA and Elunyeni solar village). This problem moves beyond the discussion of operations and maintenance (below) and for larger complex installations (or if what is left of solar systems in more remote locations becomes a problem) then the development of effective insurance might need to be considered and factored into the maintenance costs.

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<sup>17</sup> <http://www.su-kam.com/global-malawi-project.aspx>

### *Closer look at: Capital Costs for Community Service Systems*

Across all the case studies the issue of **capital costs for the Community Service Systems** has been brought up. We thought it would be important to look more closely at this factor within the wider set of factors which impact on the relevance of the technological intervention. There is a need to look more closely at how all critical factors identified above are applied at the household and institutional level.

At the moment these schemes are usually put in with the initial capital costs being met by a donor/government. The question is should the community financial burden include full cost replacement when the scheme comes to the end of its life (assuming it has been maintained efficiently). Evidence from the case studies points to differences in the capabilities of different users to pay, which indicates a one-size-fits-all approach is not likely to be the most efficient. Even allowing for the selection of the least-cost technology option, investment costs may be beyond many of the communities visited.

For the relevance of the RETs, below we set out two possible options to be considered:

1. **For community service providers these are a temporary stop gap until the grid is put in place more widely in Malawi** (possible for a number of areas especially those that are closer to the trading centres, and if Malawi does expand in the next 10+ years the generation and distribution capacity). For those schemes cost recovery pricing may then only focus on O&M and perhaps saving money for the inevitable costs of connection! However for institutions it is not clear to whom the burden falls – District, School Management Committees, MoH, MoE? It is important to ensure that the District Councils are involved right from the onset of the project cycle to ensure that the issues of ownership, maintenance are already agreed upon before the systems are installed.
2. **The Mobile Phone argument:** In the IEA report there is an indication that in many rural areas there is a strong possibility that they will never be connected to the national grid. This will be reasons of technology – new technology making local systems much more viable compared to gridded electricity thus reducing the need for the expansive construction of a national grid, or the costs of extending the grid to the remotest communities is far too costly.

### **Summary of current viability / sustainability of case studies**

We provide below a summary assessment of the sustainability of the case studies included in the analysis. In addressing this question we have considered: whether some form of cost-recovery or on-going financing exists to support O&M costs; the robustness of the management arrangements in place; and access to the skills and spare parts needed to maintain the systems. We found that just three of the systems currently operating are considered likely (or highly likely) to be sustainable. These systems are characterised by strong, self-reliant, institutional arrangements and/or demonstrable willingness or capability to pay among users.

*Table 5: Financial sustainability in case studies examined*

	O&M (incl. replacement) costs		
Case study	Users pay?	Sufficient?	Comments
1. CRED, Mikolongo Primary School	Yes	Likely	<ul style="list-style-type: none"> <li>- Schools responsible: maintenance funds established</li> <li>- Parents contribute MK50 per pupil per term (MK150 p.a.)</li> <li>- User fees for phone charging &amp; TV shows</li> <li>- Local artisans trained on basic maintenance &amp; repair of systems</li> <li>- Unclear what maintenance costs are over time and if the longer term costs are fully understood.</li> </ul>

Case study	Users pay?	Sufficient?	Comments
11. Milonde Youth Club Business Centre	Yes	Unlikely	- User charges for TV/DVD shows and battery charging - Plans to upgrade TV services likely to increase income - Financial management to date has been poor; no evidence of clear approach to O&M
9. Bondo Micro Hydro Scheme	Not operating	Likely (potential)	- User Board established, which will assign a user fee collector - Registration and user fees to be collected - Maintenance committee to be established - Setting up Mulanje Electricity Generation Agency
2. Choma Health Centre, Zimba District	No	Unlikely	- Responsibility of GoM but no formal arrangements - Experience to date suggests unlikely
Private household supply (Zimba)	n.a.	Highly likely	- Users' estimates of annual cost-savings suggest sufficient potential - As user-purchased systems, interest in maintaining considered high.
3. Biogas Energy Production	n.a.	Likely	- Limited information but system applicable to wealthier farmers – suggesting increased likelihood of financial sustainability. - System lasts for an extended period with minimal maintenance (no moving parts).
4. Social Enterprise, Development	Not operating	Likely (potential)	- Potential exists as electricity use for revenue generating activity and group appear well-organised.
6. Solar Village at Chigunda	Yes	Unlikely	- ESCOM refused to take on the sites: concerns about installation quality - Significant rates of non-payment of user fees (c.50% at one site) - No clear O&M strategy in place
8. Senga Bay Baptist Medical Clinic	Yes	Unlikely	- Maintenance costs met by project – long-term availability of project funds uncertain - Users make small contribution to their agricultural clubs, but given their level of disadvantage, scope for cost-recovery appears limited.

These results emphasise the need for the Government of Malawi to work with stakeholders to achieve greater clarity on roles and responsibilities through the decentralised structure.

### *Recommendations for sustainable financing of renewable off-grid community energy*

#### *For Government of Malawi*

- **Seek appropriate funding** (perhaps through WTO funding sources) to develop the Bureau of Standards within Malawi (or linked site e.g. TCRET) to enable the BoS to be internationally recognised in the area of testing of RET;
- **Review procurement and contracting arrangements to ensure that local stakeholders have a clear role in contract supervision**, including the authority to hold the contractor to account for poor installations and operations/maintenance problems within the warranty period.
- **Facilitate learning within Malawi around community off-grid RET within SADC** and other REC areas in Africa and beyond. For instance at the grass-roots level Practical Action (working with MuREA) are taking a strong role in Southern Africa's expansion of RET



implementation. The engagement of Malawi into regional networks will be critical for faster learning and scale up. This could be both around RET use itself, but also around other networks developing around climate financing mechanisms including REDD.<sup>18</sup>

- **Develop clear mechanisms for transparent use of ‘fair trade’ and ‘climate finance’** for development of community and household RET systems.

#### *For Agencies designing, funding and installing RETS*

- **Manage expectations.** There is a need to develop, with stakeholders including communities, at the design stage clear expectations about what the system will deliver over what timeframe. Use of appropriate participatory tools as being piloted by agencies such as Concern Universal could help to reduce the gap between expectations and delivery.
- **Develop a clear operations and maintenance framework.** This would enable greater clarity around who is responsibility for what, including the long term financing arrangements for the maintenance (including replacement parts) for the system over time.
- **For pilot systems, ensure that there is real evidence generated around technical efficiency, financial inputs (and benefits) as well as social/economic outcomes.** This evidence provides greater input into policy makers when making decisions regarding policy frameworks and investments. What works, where does it work, who benefits, how and over what time frame should be critical questions of any monitoring and evaluation system.

### Technically appropriate systems for whole life operations

Currently in Malawi a wide range of systems are being tested including biogas, biomass, solar photovoltaic, hydropower and wind. All 28 Districts are involved, some with more than one pilot type. The diversity of social, economic and environmental context within Malawi is high for a small country. So what does this mean for the relevance of technology to development in Malawi? For the technology, there is a need for diverse systems and these systems need to be tested in a robust manner. Capital costs notwithstanding, the provision of modern energy systems to people in a variety of ways is valid **but** the technology must suit local conditions (e.g. withstand hail storms), technical capacity (real training required for local operators) and the supply of ‘spare parts’ be within country and not reliant on scarce FOREX when things break down. People who are used to supply of electricity do not take kindly to that supply being removed for extended periods!

The approach to household and to community power systems are likely to diverge, with households looking to market based solutions which do not lock them into a technology for a long period (3 – 5 yr lifespan) given the fast changing market in this area. While Institutional services with their requirement for larger power sources will require more sophisticated systems that will require technical support for their O&M. For the sustainability therefore, it could therefore be argued that the **‘Technical Management’** of community systems may have different approaches depending on the planning /timeframe for grid extension, but that sustainability will not work without clear roles and responsibilities around financial matters as well as the technical support.

For households the picture is less nuanced if the private sector in Malawi can be catalysed (SolarAid) and appropriate regulated products brought in for general sale. Where microfinance exists, linkages

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<sup>18</sup> See for instance the SADC REDD network <http://www.sadc.int/REDD/index.php/redd-in-sadc-countries/malawi/>

should be made to support poorer households to invest (capital) in products that will both save them money month by month and increase their quality of life.

### *Roles and Responsibilities for Operations and Maintenance*

The case studies examined present a range of different business models, covering: community owner-operator (e.g. micro-hydro system being installed through MuREA); Government ownership (e.g. solar villages (Central) and Health centre (District)); and 'dealer models' (for SHS photovoltaic systems). While it is important to find the appropriate business model for the circumstances, all require careful consideration as to the technical assistance required to support the chosen model.

In every site visited there was limited attention being paid to clear roles and responsibilities for the long term operations and maintenance of what, in some cases are complex with clear requirements for routine technical maintenance e.g. micro-hydro systems being installed through MuREA; the solar villages implemented by the Government of Malawi or the District Health Centre in Choma with its solar fridge and solar water pump. Whilst it is clear that the formation of MEGA is one high level response to this issue the current status of MEGA provides no firm evidence to date that it will be able to deal effectively with the balance between community ownership, energy generation and long term structures/institutions necessary for system management, and possible expansion.

For community installations (schools, clinics and water systems) the infrastructure is designed to operate over a 20 year period, but with critical elements requiring replacement at regular intervals to ensure ongoing system efficiency. The costs of replacing batteries (essential for solar systems designed to provide power at night), or of replacing solar pumps if not de-silted regularly needs to be 'factored in' to the charges for electricity. Using phone charging as a source of funding is highly limited given the availability of competing sources, including individual systems which 'salaried workers' can purchase.

A failure to address these issues is shown even in small areas such as purchase of low energy light bulbs at Mikolongo school where the School Management Committee does not generate sufficient income from phone charging to replace these items when they fail. **A clear 'business plan' is required for systems that are going to be dependent on local resources for maintenance (even if the initial capital costs are met by government and donors).** Greater clarity on the costs/benefits and how non-tangible benefits including improved school education are paid for. If a school is linked to the grid it appears it is still the responsibility of the School Management Committee to raise the funding to pay ESCOM for the electricity it uses, rather than this being a fundamental element of the funding allocated to the school from central or district resources.

### *Recommendations for technically appropriate systems for whole life operations*

#### *For Government of Malawi*

- **Recognise that the approach for community service energy provision and that for households is likely to diverge** in terms of technical systems, delivery systems and funding strategies. This diversity would be seen as potentially extremely important as it allows households of different status and income levels to source modern energy services that are affordable.
- **To provide clear guidance on who bears the O&M responsibility and costs** for all infrastructure where the Government of Malawi (at national and district level) is responsible for investment decisions (including donor funding);
- **To improve coordination between different levels within the Government of Malawi.** This would include the **promotion of** the use of modern energy services in every infrastructure development and the second would then be to ensure that there was **systems and processes, including skilled staff**, at the District level to maintain the systems with communities as appropriate.

- **Government of Malawi needs to develop appropriate standards for solar PV systems (and other RET)** e.g. size of panels, inverters etc may reduce the spread of incompatible equipment – much as normal 3 pin plugs are standard within Malawi.
- For household systems the **Government of Malawi will need to ‘facilitate’ the development of private sector value chains** that enable the sale of quality products at prices ordinary Malawians can afford, that give proven returns on their investments.

*For Agencies designing, funding and installing RETS*

- **Manage expectations.** There is a need to develop, with stakeholders including communities, at the design stage clear expectations about what the system will deliver over what timeframe. Use of appropriate participatory tools as being piloted by agencies such as Concern Universal could help to reduce the gap between expectations and delivery.
- **Develop a clear operations and maintenance framework.** This would enable greater clarity around who is responsibility for what, including the long term financing arrangements for the maintenance (including replacement parts) for the system over time.
- **For Household systems** link, where appropriate, to the provision of Microfinance so that even poor households can pay for a capital purchase with loan payments made from the savings on kerosene and other conventional lighting sources.

## Sustained Capacity Development

As indicated above both TCRET and WASHTED are a strong resource within Malawi. They are beginning a clear process around developing courses at all academic levels, and to provide training for professionals who wish to move into the renewable energy field. However if renewable energy is to play a major role in the provision of modern energy services, particularly to community services (schools, hospitals and water systems) it is clear, from discussion with key stakeholders in Malawi, that there is a need to develop technical training at a ‘lower’ level that would enable community support staff, as well as District technicians to undertake routine O&M on even the most complex systems. More senior technicians would then provide ‘back-up’ for the more complex problems, but providing community level operator/technicians would enable sites in remote areas to be regularly maintained and small break downs repaired quickly (e.g. de-silting water pumps; replacing light bulbs, resetting ‘trips’ on control panels).

Within Malawi there is a network of technical training centres that need to be formally linked to TCRET and WASHTED, so that their trainers are given formal training and regular competency checks. They would be in a position then to teach agreed curricula for grassroots level operators and community energy management teams. They could then be engaged in this training at the start of the process of design of the installations so that local people are actively engaged in processes on the basis of clear information. This type of process can help to reduce the incidence of ‘inappropriate installation’ by contractors e.g. by using the wrong cement and thus help to increase the quality of installations. Informed and trained energy management committees are more likely to understand the need for routine payment collection, attention to O&M and the implications of inappropriate use of systems (overload) which can reduce technical efficiency.

*Learning from pilot programmes – role of the academy in the enabling environment?*

The case studies used in this evaluation are still operating at the ‘pilot’ level. They are not operating at scale (although if the MuREA programme moves ahead this will be in the near future (2 – 3 years), but is a very site specific context, including the links with the international biodiversity conservation financing arena). The current level of evidence around technical efficiency, social impact, financial viability (even with capital costs covered by government or donors) as well as possible environmental benefits (for forests/woodland; in relation to climate as well as a reduction in household smoke particulate matter) needs to be fully addressed.



Malawi is in a favourable position in that it already has two centres where staff have not only formal qualifications but a very strong interest in the development of innovative approaches to renewable energy within the country. However, the two institutions (TCRET and WASHTED) are primarily staffed by engineers. **There is a need to ‘prove the concept’ of off-grid renewable energy in Malawi through the production of coherent, robust evidence around the efficiency, effectiveness and sustainability of the pilot programmes.**

These two institutions need to link with the wider academy within Mzuzu University and the Polytechnic to bring together multi-disciplinary teams who are able to undertake long term formal case studies that document the technical (engineering) efficiencies of the technology, alongside the financial and economic analysis whilst understanding more clearly the process by which technology is adopted by different individuals and groups within communities. This knowledge is vital to facilitate discussions with policy makers and funding agencies around developing appropriate policies to foster off-grid renewable energy. The areas where evidence may influence policy include issues around the effect on the development of installations from tax regimes, feed in tariffs (for large scale systems e.g. MuREA), financing mechanisms including micro-finance and quality standards. Furthermore the provision of robust evidence by ‘trusted’ partners within country can enable effective dialogue with Government, and other stakeholders, to understand more clearly those elements that the Government of Malawi can promote directly e.g. through requirements for solar installations for all new schools/clinics through to those areas where it can facilitate by supporting private sector initiatives, especially around household system provision.

#### *Areas for further research through MREAP?*

Outlined below are a number of areas where further research / evidence gathering is required not to show that electricity is a ‘good’ in terms of quality of life, but to focus more clearly on issues of equity, viability, resilience and the development of an appropriate enabling environment which includes the capacity of all stakeholders in the off-grid renewable energy arena.

- An important area going forward in relation to off-grid provision of modern energy services is whether the costs / benefits for rural and poor households are ‘on a par’ with those urban /richer households?
- What are the constraints around private sector provision of household electricity systems from single lights through to full solar systems?
- Systematic collection of long term formal case studies on the process, outcomes and impacts of the diverse range of RET (and energy efficiency technologies) during the MREAP process to provide robust evidence on how different technologies affect different people in varying contexts.
- Using the inventory data understand why systems are not working and what is required to facilitate the ongoing use of technology in different socio-cultural contexts.
- Need to establish the energy demand per household and district to serve as a baseline.

#### *Recommendations for Sustained Capacity Development*

Note that a number of these recommendations may be addressed through the MREAP programme capacity development programme.

*For Government of Malawi*

- **To develop, within the Renewable Energy Policy Development a comprehensive multi-stakeholder capacity needs assessment** that addresses requirements from grass-roots levels, Government, private sector and academic institutions, around RET system design, installation, operation, monitoring and research. Furthermore this addresses the need to build the capacity of the institutions in Malawi (e.g. TCRET, WASHTED and technical colleges) to be able to continue to train individuals at all levels to support RET.
- Link the **development of the pilot inventory into the management of RET within Malawi** to ensure good data for ongoing policy and investment decision making.

*For TCRET and WASHTED*

- **Each institution to build on their current strategic plans** to build up multi-disciplinary centres that enable coherent evaluative research to be undertaken;
- **That both centres ‘reach out’ to local technical colleges** to enable technical training courses to be developed that would be suitable for community and district level maintenance providers.

*For MREAP*

- As part of the Capacity Development Programme **develop**, linked to the proposed investments as well as ongoing RET installations, **a set of multi-disciplinary case studies** which enable technical, social, economic and environmental assessments to be undertaken during the lifetime of the MREAP (and beyond if possible). These could provide high quality quantitative and qualitative data within a robust case study methodological framework. This should also include **writing for different audiences** to ensure that those engaged understand the different contexts in which evidence is used including academic research, policy processes, accountability and learning.
- **To work with other stakeholders to ‘prove the concept’ of RET** for community services (and households) and its applicability to Malawi not only at the pilot level but if funding is available for ‘scale-up’.

## Section 9: Conclusion

Malawi stands at a crossroads in relation to the development of modern energy services for all her citizens. Malawi is in an enviable position at present as the electricity that is generated within the country is 98% from renewable sources. However, at the same time, only around 9% of citizens have access to electricity of any type. Malawi has recognised, in the MDGS2 (draft), that the energy shortfall within the country is not only limiting economic growth but also limits the development of key social services including health, education and water supply. In addition households are denied the benefits of modern energy services, in particular electricity, which limits the opportunities for study, communication (phones, radio, TV) and improved conditions within the house. Household use of biomass (wood and charcoal) for cooking poses a health risk mainly for women and young children, whilst also causing extreme stress on the natural environment through a lack of coherent management of resources to feed often highly inefficient cook stoves.

Having recognised in the MDGS2 (draft) that energy is a key action area, and recognised that there is a high level of demand for modern energy services in Malawi, there is a need for the Government of Malawi to develop appropriate strategies to facilitate the development of modern energy services to a greater number of citizens. Malawi is already active in developing approaches to renewable off-grid energy services which can, whilst perhaps larger scale energy sources and the national grid are extended, provide a clear advantage for community services, as well as households. For Malawi to capitalise further on these pilot schemes which are taking place throughout all 28 Districts around biogas, biomass, solar photovoltaic, hydropower and wind, there is a need to develop a clear renewable energy framework which would help to overcome some of the current shortcomings with the pilot programmes and enable their scale up in a financially viable and technologically sustainable manner thus enabling the attainment of clear socio-economic outcomes within households, communities and the business sector.

The evidence from the case studies is that there is **a clear demand from local people and community service delivery agencies (schools, clinics and water pumping) for access to modern energy services**, primarily electricity, but also energy efficient stoves and biogas for cooking. Off-grid renewable energy is visible in many locations in Malawi including customs/police check points.

The ability to meet demand for modern energy services, given the difficulties that the supply of grid energy (even with ongoing work), into remote rural areas brings, will be important to address in a coherent manner. There is a need to both diversify the supply of energy within Malawi (currently hydropower but sites are old and subject to hydrological challenge as based on water in Lake Malawi and Shire river), and increase total electricity supply. A recent report by the IEA<sup>19</sup> indicates that it is possible that in many countries some communities may never be linked to national grids (at least within the 2030 timeframe of the Sustainable Energy for All approach) given the development of RET and alternative approaches to supply of electricity ('mobile phone model'). The case studies presented in this evaluation are based often on a short time frame for implementation. However they do give some key pointers on important issues which need to be addressed to ensure that the use of RET at community and household level in Malawi is viable (financially and technically), adaptable to local contexts and to the challenge of climate change and is recognised as providing a clear contribution to Malawi's economic development. Community/ household RET should not be seen as a 'poor relation' to on-grid supplies but as a mechanism both to meet the current 'energy gap' in Malawi whilst on-grid is developed, and to provide modern energy services into remote communities.

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<sup>19</sup> REF – Energy Access for ALL



Malawi has an opportunity in the next 1 – 3 years to develop a coherent approach to providing ‘Sustainable Energy for All’ by 2030 through both promoting off-grid renewable energy when it is in the driving seat of infrastructure investment, particularly schools and clinics, whilst simultaneously creating an enabling environment for the private sector (profit and not-for-profit) to invest in renewable energy, including systems appropriate for households. Positioning Malawi to take advantage of the global moves to a ‘Green Economy’ is likely to be an important agenda item for the Government of Malawi, civil society, private sector and Malawi’s partners in development over the next few years.

This evaluation has shown that the technologies are available and that people are very interested (and willing to make investments of time and money). What is required now is to create an appropriate policy framework and to continue with pilot and innovative investment that will enable the development of effective evidence around what works, where, for whom and why. This will enable a greater understand of which technologies can be taken to scale to support communities in remote locations move towards sustainable economic development within a changing climate.

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