Renewable Energy Industries Association of Malawi

MALAWI

ROADMAP ON SCALING UP PRODUCTIVE USE OF RENEWABLE ENERGY (PURE)

PREPARED BY
REIAMA

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Acronyms

CARD	Churches Action on Relief and Development
DPs	Development Partners
EGENCO	Electricity Generation Company
ESCOM	Electricity Supply Corporation of Malawi
FGDs	Focus Group Discussions
GIZ	German Development Cooperation
IDIs	In-Depth Interviews
IR	Inception Report
KIIs	Key Informant Interviews
MAREP	Malawi Rural electrification program
MDAs	Ministries, Departments and Agencies
MERA	Malawi Energy Regulatory Authority
NGOs	Non-Governmental Organisations
OGS	Off Grid Solar system
PAYGO	Pay as You Go
PUE	Productive Use of Energy
PURE	Productive Use of Renewable Energy
TORs	Terms of References
UNDP	United Nations Development Programme
LUANAR	Lilongwe University of Agriculture and Natural Resources
RE	Renewable Energy
GESI	Gender and Social Inclusion
IOT	Internet of Things

Acknowledgements

This Roadmap for Productive Use of Renewable Energy (PURE) has been prepared by the Renewable Energy Industry Association of Malawi (REIAMA) in partnership with the Ministry of Energy and GOGLA, with the financial support from The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under its programmes Sun4Water and Energising Development (EnDev) - Putting Energy to Work.

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Executive Summary

The roadmap provides a situational analysis and the needed strategic interventions to leverage the productive use of Renewabel Energy in Malawi. It further provides an analysis of the policy and legal framework, an overview of the PURE applications in the country, and provides a list of challenges, barriers, and opportunities. The national roadmap goes further to provide for financing and implementation actions, a monitoring and evaluation framework and to lay the channels for collaboration between the Government of Malawi, Development Partners, and all sector players to achieve a common vision for the country.

Current Status

There are a number of key milestones that have been achieved to date, these include policy reforms that include the removal of duty and VAT on some PURE technologies, implementation of PURE technologies by development partners, establishment of PURE businesses across the country, improvement of health and education services, increased sales for rural businesses, establishment of PURE mini-grids in rural areas, increased access to modern, affordable and sustainable household energy, improved access to information and entertainment, trained PURE technology suppliers and installers, availability of working capital for importers of PURE as well as input loans for individuals as well as registered groups members on PURE technologies from commercial banks, PURE technicians trained; and developed standards on PURE technologies. .

Barriers and Challenges

Despite registering some successes, the market assessment identified a number of peculiar barriers and challenges in the promotion and adoption of PURE technologies in the country.

Policy framework: Despite the existence of a strong strategic and policy framework for energy access, the implementation of these policies has been slow and inadequate. It is recognized that specific interventions towards PURE technologies were not stipulated under the policy interventions. Secondly, the devolution highlighted in the policy has not been implemented for example recruitment and deployment of district energy officers. The institutionalisation of Rural Electrification Agency (REA) in Malawi had been long overdue for the accountable and transparent utilization of Rural Electrification Funds. REA are already in place in all our neighbouring countries and beyond. In addition, concession agreements have not been signed with operators.

Inadequate enforcement of regulatory frameworks: In addition, the study identified lack of enforcement of standards and regulations on PURE technologies leading to poor quality products on the market. There is lack of testing equipment for PURE products at the borders, inadequate human resource in PURE at district level. This is evidenced by the lack of district energy officers and frontline extension workers.

Coordination systems within RE: There is lack of multisectoral collaboration on mainstreaming of PURE technologies for example gender is not mainstreamed across sectors. Energy is cross cutting, while energy policy generation belongs to Ministry of Energy, its usage and scaling up lies with other MDAs such as Ministry of Agriculture, Trade, Transport, Education, Health, etc., hence the need for multisectoral collaboration and reporting.

Lack of RE targeted financing: An Assessment of the financing for RE depicts a picture of over dependency on subsidies and financing by development partners. Though there exist opportunities from commercial banks for both importers as well as end-users of PURE, these still lack securities for the working capital solutions being offered. For the latter some of them are not organised in say registered cooperatives to access these financing opportunities.

Inadequate Technical Capacity: The technical capacity challenges that were identified during the assessment include lack of practical training in higher education institutions. There is a mismatch between the skills gained from the training institutions and the technology gap in the industry. Lack of capacity to maintain generation facilities of mini-grids, and technology challenges for purchase of units in mini-grids and misadministration of product warranty. In addition, technical gaps have been observed in poor design, supply and installation of systems, lack of back up service by PURE technologies providers.

For example, in the current set up users of PURE technologies for irrigation access advice from general agriculture extension workers rather than from energy officers. The situational analysis also identified lack of research and development in PURE technologies,

Low levels of public awareness about access to information on RE: The assessment identified lack of information and awareness for available finance opportunities, failure to involve community participation during project implementation and lack of networking among stakeholders. Most users of the PURE technologies have no access to information regarding source of finances to procure PURE technologies. The study identified various sources of finance for PURE technologies but they are not being accessed by users due to lack of information and awareness. There is low promotion of cooperatives for PURE in rural areas and lack of end user training.

Strategic Direction

Moving forward, to address the barriers and increase the uptake of PURE, a roadmap has been prepared which has a Vision, Mission, Objectives and Recommendations.

- **Strategic Objective 1:** Review and fully implement the National Energy Policy and regulatory frameworks
- **Strategic Objective 2**: Strengthen and Institutionalise RE Regulations and standards
- **Strategic Objective 3:** Strengthen multisectoral coordination and collaboration among

stakeholders involved in PURE technologies at national and sectoral level,

- **Strategic Objective 4:** Enhance the local capacity and technical skills in PURE
- **Strategic Objective 5:** Ensure sustainable RE financing models
- **Strategic Objective 6:** Develop PURE Information, Education and Communication strategy.

Gender and Social Inclusion (GESI) Integration

The PURE Roadmap recognizes that energy access and productive use technologies impact men and women differently. To ensure equitable benefits, gender and social inclusion considerations are mainstreamed in the roadmap activities. By incorporating GESI into lectures, campaigns, conference sessions, policy advocacy, and media content, the PURE Roadmap demonstrates inclusivity, strengthens its credibility with sponsors, and aligns with modern policy standards for sustainable and equitable energy access.

CHAPTER 1

Introduction and Background

This **"Road Map on Scaling Up Productive Use of Renewable Energy PURE"**. was commissioned by the Renewable Energy Industries Association of Malawi (REIAMA) with support from The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under its Programmes Sun4Water and Energizing Development (EnDev) - Putting Energy to Work.

The roadmap begins with the background to the Road Map, its purpose, overall and specific objectives, methodological approach, the literature review and consultations that were carried. Also included in the report are chapters on successes, barriers and challenges, opportunities, conclusions and Policy recommendations for the productive use of energy in Malawi and the policy brief to feed into the reviewed energy policy under way.

The roadmap will serve as an advocacy tool for the private sector with multisectoral representation from the Ministries, Departments and Agencies (MDAs) led by the Ministry of Energy and members of the Energy Industry.

1.1. Structure of the Roadmap

The executive summary above summarizes salient information contained in the roadmap, including synopsis of findings, conclusions and recommendations, and lessons learnt. Chapter 1 presents the Introduction to PURE- context and background and scope of the Road Map; Chapter 2 presents the situational analysis. The findings are based on factual evidence obtained by the evaluators through document reviews, interviews and consultations with stakeholders and beneficiaries. Chapter 3 contains the Lessons learnt, Barriers and Challenges and Opportunities for PURE, Chapter 4 –presents the Strategic Objectives and Policy Recommendations for policy makers, policy implementers, providers of PURE and users of PURE.

1.2. Project Background

Productive use of Renewable Energy (PURE) is the utilization of energy for activities that enhance productivity, income and welfare through powering devices in commerce, industry and agriculture. PURE is, therefore, a promising sector within the energy and Productive Use of Renewable Energy (PURE) sector for economic transformation and resilient livelihood options. However, the realization of its full potential depends on the presence of favorable market and infrastructural conditions, supportive policy environment, mindset change and awareness of PURE activities and technologies among stakeholders including smallholder farmers. This necessitates intentional and coordinated efforts by the government, private sector, and other stakeholders to identify factors that facilitate PURE growth through tackling significant obstacles and promote the uptake of PURE for productive use.

Different partnership and stakeholder support are available for the promotion of Productive Use of Renewable Energy (PURE). The Technical Cooperation module "Support of sustainable water-, energy-, and climate-adapted solar-based small-scale irrigation systems - Sun4Water" is the partnership and support pertinent to this assignment. Which is financed by the DKTI (German Climate and Technology Initiative) and is part of the BMZ contribution to the International Initiative

Water and Energy for Food (WE4F). The project aims to promote the dissemination of approaches for the suitable and sustainable use of climate-friendly, water- and energy-efficient.

Sun4Water collaborates with existing water energy food nexus projects in its countries of intervention to implement activities around four main pillars:

1) Capacity development for the dissemination and use of climate friendly and sustainable solar powered irrigation systems (SPIS).
2) Development and establishment of context-oriented technical and financial services to improve access to technology.
3) Integration of standards and lessons learnt in the policy framework to foster appropriate SPIS.
4) Participative further development and adaptation of the existing SPIS toolbox.

The EnDev Malawi Programme, under its component 'Putting Energy to Work' project, aims at strengthening the market for needs based, climate-friendly technologies and services for Productive Use of Renewable Energy (PURE) and thereby, contribute to modernization and industrialization of the developing countries including Malawi. Particularly, the programme aims at the increased participation of women, youth, and people with disabilities. The Programme, has the following intended outputs:

1) Strengthened and expanded private sector driven market for PURE.
2) Strengthened participation of women, youth, and people with disabilities in the PURE market.

The roadmap for Scaling Up Productive Use of Renewable Energy (PURE) in Malawi has been developed in close collaboration and partnership with the Ministry of Energy, REIAMA, GIZ and other stakeholders including rural communities. Most importantly, based on the fact that the country is currently looking to undertake a review of the National Energy Policy, 2018, this could be a source of material for the review of the National Energy Policy, 2018.

1.3. Rationale for the Roadmap

In line with the objective of unlocking the potential of PURE, REIAMA, with support from the GIZ projects of Sun4Water and EnDev-Malawi, has set out to create a Roadmap to facilitate the widespread adoption of Solar power as an energy source in different enterprises, including irrigation systems and other Productive Uses of Renewable Energy (PURE) in Malawi.
More specifically, the roadmap aimed to:

Comprehensively review PURE situation in Malawi;

1) Review PURE barriers and opportunities
2) Map key stakeholders involved in PURE in Malawi;
3) Review past interventions in PURE in Malawi;

4) Identify lessons learned and success stories from the past interventions to inform the design of the Road Map;
5) Develop a Road Map for scaling up PURE in Malawi

1.4. Methodology

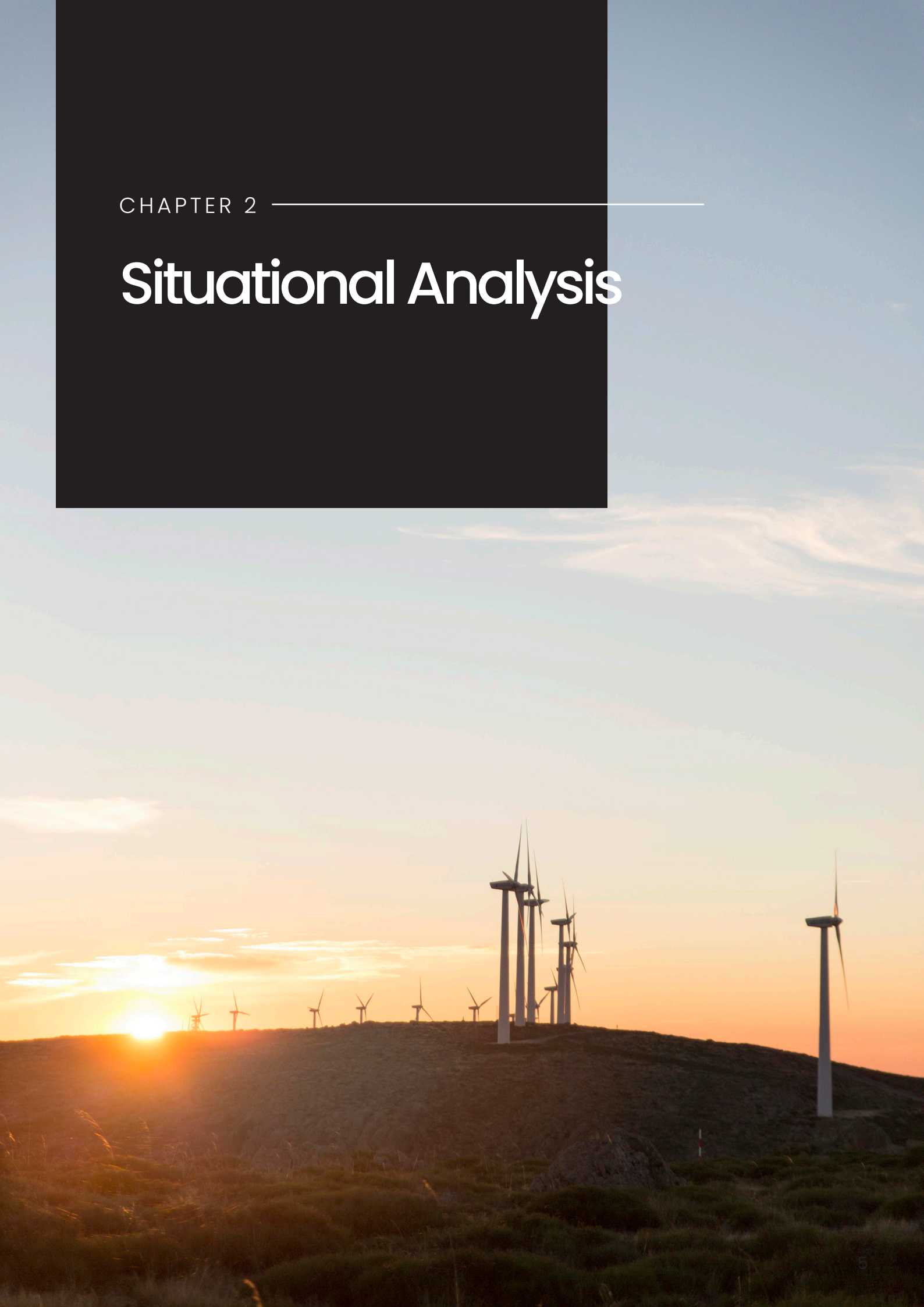
The roadmap situational analysis employed a comprehensive and mixed-methods approach to accommodate the PURE sector's complexity and dynamic nature. The review combined the following steps when being undertaken;

- A desk review of relevant documents/ materials
- Key informant interviews and stakeholder consultations with central government ministries, departments and agencies at national level. Development Partners (DPs), Non-Governmental Organizations (NGOs), and local communities were consulted.
- In-depth interviews with implementers and beneficiary's stakeholders in sampled areas and sites in all the targeted districts covered by the different stakeholders as well
- Focus Group Discussions with beneficiaries and end users.
- A quantitative evaluation of achievements against key performance outputs and outcome indicators
- A thorough analysis of the Energy policies, plans, results, and SWOT analysis. This multifaceted approach enabled a nuanced understanding of the PURE's progress, outcomes, and potential areas for improvement.

This roadmap assessment exercise had some limitations, firstly while it assessed the interactions on RE, especially solar, it did not evaluate other sources of energy such as Biomass, Geothermal and wind sources etc. Secondly, the review was conducted in a context where projects are siloed and fragmented across multiple projects, which are not yet fully integrated. Thirdly, analyzing demand and supply against the set targets required data from the sector's reporting systems, which is not readily available.

CHAPTER 2

Situational Analysis



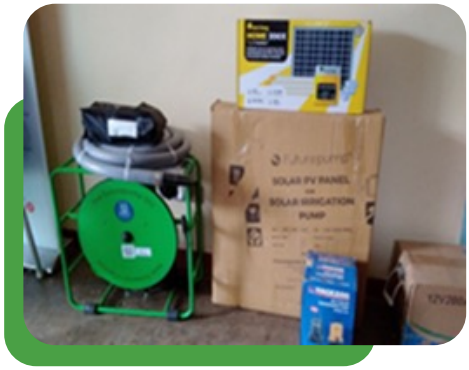
The PURE in Malawi has progressed positively in a number of ways.

Supply Side Analysis

1. The GoM is supportive towards promotion of PURE technologies by enactment of Mini-Grid and Independent Power Producers frameworks for investors and operators in off-grid systems since 2017: The National Energy Policy, 2018-2023, advocates government support for adoption and utilization of PURE technologies through the following policy interventions:
   - Strengthening the exploitation of PURE sources;
   - Promoting use of PURE technologies and manufacture of PURE products;
   - Supporting small scale PURE initiatives by communities or entrepreneurs;
   - Promoting capacity building in all areas of PURE programming, supply and services, as well as in entrepreneurship and management taking into account gender and social issues; and
   - Building strong partnership with the private sector and CSOs to promote the manufacture, distribution, use and financing of improved PURE technologies.

   In addition to the above policy interventions, Ministry of Energy is implementing the Malawi Renewable Energy Strategy, 2017 with a vision of "universal access to renewable electricity and a sustainable bioenergy sector." Most importantly, Energy access is an essential element for the achievement of Malawi 2063 of transforming the country into a more industrialized and prosperous nation. Pillar Number 2 recognizes PURE as an enabler under broader Economic infrastructure and environmental sustainability enablers.

2. Government removed custom duty and VAT on some PURE technologies: GoM has partially removed duty and VAT on some PURE generation technologies. This reduces the price of the products for the end users and increases the number of people who use the PURE generation technologies due to the reduced prices. This has contributed to the availability of Off Grid PURE systems. However, many other PURE appliances (fridges, agricultural value addition processors, hair clippers, incubators etc.) are not exempt. See Annex 3: List of PURE technologies under custom duty and VAT exemption



3. Capacitating of testing department of Malawi Bureau of Standards: GoM through UNDP has capacitated MBS with testing equipment for solar PV panels and solar batteries. This will prevent the proliferation of substandard solar panels and batteries on the market. MBS carries out testing of PURE appliances based on prescribed performance indicators.

4. Malawi is among the countries with highest share of access to solar: According to the World Bank Tracking SDG7 report 2022, Off-grid electrification, which is dominated by solar home

systems (SHS), is growing rapidly and plays a significant role in the Government's electrification plans. Off-grid electrification is led by the private sector, incentivized by favorable Government regulations and fiscal incentives. Malawi is considered an emerging off-grid solar market characterized by both fast-growing sales and a large remaining electricity access gap (World Bank 2022). Private-sector operators like Yellow Solar, Vitalite, Solar works, Sunny Money, Za-Solar, Blue Zone and Zuwa, among others, have increased sales of high-quality SHS of tier 1 and above through the introduction of Pay-As-You-Go (PAYG) contracts, (World Bank 2022). According to World Bank report (2022), it estimates that this contribution will push electricity access rates by 6 percent. This makes Malawi one of the top 20 countries in the world by the share of population with access to solar home system. (See Figure 1).

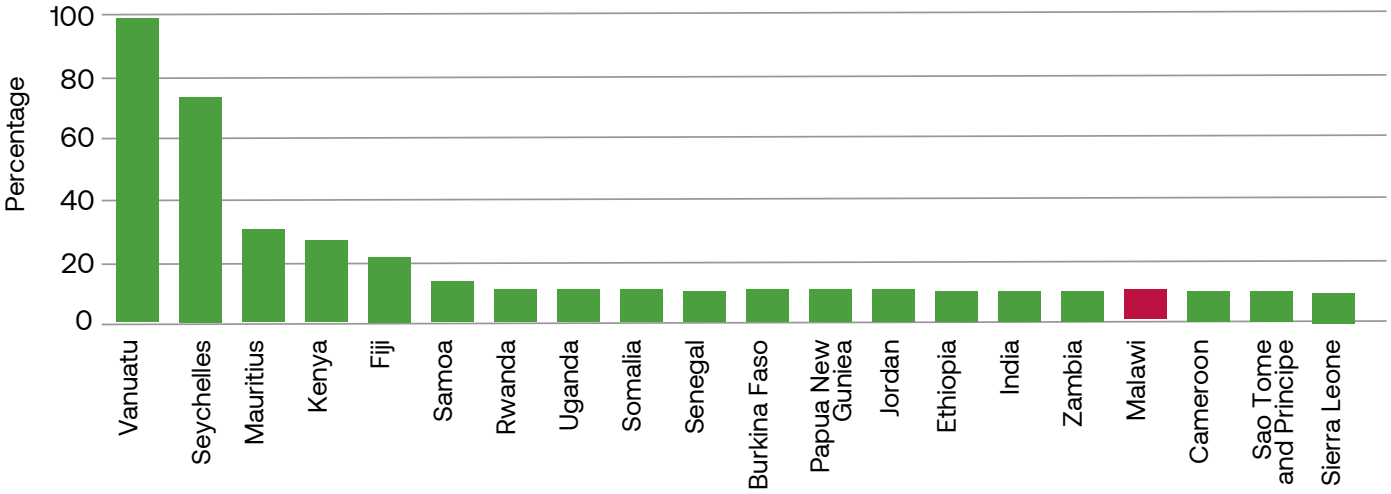


Figure 1: Share of population using solar lights
Source: IRENA 2021.

- Existence of carbon emission reduction (CER) funding for promoting PURE technologies; There is existence of carbon emission reduction (CER) funding as one opportunity for PURE technologies even though there will be need for aggregation of projects in order to obtain enough carbon credits to be able to use as financing.
- PURE technology project implementers have been able to access additional funding to promote PURE technologies. For example, ECOGEN, the supplier of biogas plants has experienced an increase in the sales of biogas plants with the coming in of the carbon credit program. From 2021 to 2023, the company managed to sell 110 systems but with the coming of the carbon program from October 2023 to date, 550 biogas plants have been sold. The additional funding through the carbon finance reduced the price of the biogas plant from K1,200,000.00 to K250,000.00.

5. Development partners are providing both technical and financial support towards implementation of PURE technologies: Development partners have implemented various PURE projects through implementing agencies across the country. These development partners include GIZ, UNDP, World Bank, USAID, Scottish government and EU. GIZ is implementing various PURE projects with private companies, social enterprises and NGOs through results -based financing covering irrigation, schools, health centers and retail shops. GIZ is also implementing capacity building initiatives where private companies, social enterprises and NGOs are trained on various issues pertaining to the promotion of PURE technologies. UNDP has implemented mini-grid projects through Community Energy Malawi at Sitolo in Mchinji, Mulanje Energy Generation Agency at Bondo in Mulanje and recently through Ministry of Energy at Chulu in Zomba. EU implemented solar energy kiosks and solar irrigation schemes through CARD and HIVOS in Chikwawa and Nsanje Districts. USAID provided financial assistance through Power Africa to private companies for the promotion of PURE technologies. The World Bank is funding the Ngwee Ngwee Ngwee Project where 200,000 houses will be connected to off-grid electrification. Five companies namely Green Impact technologies, Zuwa Energy, Yellow Africa, Vitalite and Start Times have been contracted by Ministry of Energy to supply rural houses with off-grid options under this Project.

6. The higher education institutions have training modules covering PURE technologies which the youth can access: There are formal and short courses being offered by universities and technical colleges which include PURE technologies to be accessed by the youth who have not been absorbed by public and private universities. There are also readily available institutions, organizations and development partners which are able to support the promotion of PURE technologies through the development of human capital.

7. Existence of suppliers supporting value chains for poultry such as incubation, brooding, lighting, biosecurity and cooling for milk bulking groups: There are suppliers of PURE technologies that support value chains for poultry covering incubation, brooding, lighting, heating and biosecurity. Suppliers of solar PV systems supporting cooling of milk for milk bulking groups are there.

8. arious sources of finance for generic loans for PURE technologies: There are various sources of finance being provided by commercial banks and microfinance institutions towards the promotion of PURE technologies. Such institutions include Standard Bank, NBS bank, NEEF Fund for small scale irrigation and FINCOOP and these opportunities are targeting both importers as well as end users.

9. Subsidized sources of finance from development partners: Development partners such as GIZ, USAID, World Bank and EU are providing subsidized sources of finance towards the promotion of PURE technologies in the country. GIZ is implementing the ENDEV DSS, the World Bank is supporting the Ngwee Ngwee Fund, GIZ EnDeV, USAID

through Power Africa and EU is supporting the PEACE project amongst others. Some PURE technology suppliers have accessed finance opportunities from development partners to increase their business portfolio through results-based finance mechanisms.

10. Existence of suppliers supporting solar powered irrigation systems: There are various companies across the country which are doing businesses covering PURE activities supporting solar powered irrigation systems. Such suppliers include SOLAIR, BLUE ZONE, WALA Ltd, SONLITE, ZASOLAR and BNG among others.

Figure 2: Blue zone (Solar water pumps supplier)

Demand Side Analysis

11. Increased agricultural productivity and hectarage from solar powered irrigation: According to the Irrigation department report: the country has the total Area under Solar-powered irrigation of 5,059.2 Ha. Total number of smallholder farmers is 27,708 (Male 14,139, Female 13,569). These have increased productivity and Hectarage due to increased frequency of planting and mixed cropping e.g. maize and horticultural crops. For example, Tiyanjane scheme in Nsanje District implemented by CARD, has 130 farmers (82 women and 48 men) on 10 hectares under irrigation having an average of 0.1 hectares per person. This has led to increased household food security and income diversification which has led to the farmers buying assets, livestock, building houses with iron sheets and solar home systems.
12. Improved access to modern, affordable and sustainable energy at household level for

Figure 3: Vendors ordering onions from Tiyanjane Solar Powered Irrigation scheme in Nsanje

productive use-Households are increasingly investing in biogas plants, which not only enhance access to clean and efficient cooking energy but also produce liquid manure that supports crop production. Additionally, many community members are adopting solar home systems, which provide reliable lighting, enable refrigeration, phone charging, access to information, and entertainment significantly improving daily life in both rural and peri-urban areas.

Furthermore, the fast-growing sales of SHS has driven the increase in electricity access between 2020 and 2023 with on-grid connections remaining stagnant at around 12 percent There is a significant backlog of households waiting for grid connections. It is also important to continue supporting the growth of off-grid solutions such as SHS, which can help to bridge the gap until grid connections can be made. Overall, while progress has been made, a lot more needs to be done to accelerate electrification, especially for grid connections. (World Bank 2022). The increase in uptake of SHS access at household level increases the economic opportunities of the population of the country . The success in the SHS sub-sector has established off-grid market structures from which the PURE sector has benefited.

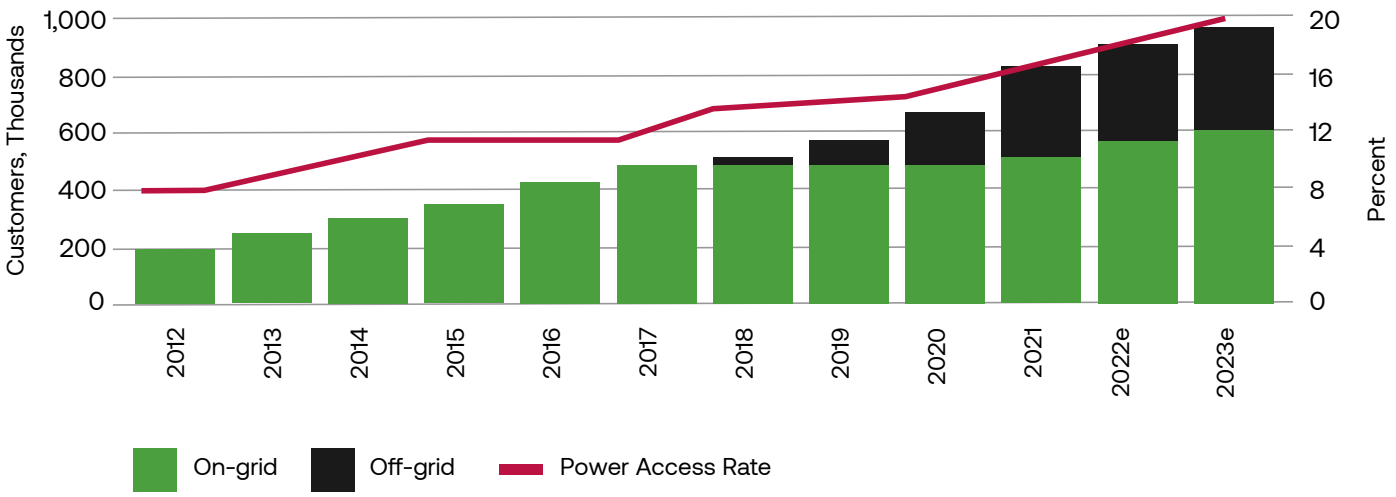


Figure 4: Off-grid solar is driving the electricity access rate increase while on-grid connections stalled

13. Increased businesses through PURE technologies: The provision of PURE technologies in communities have resulted into an increase in businesses using PURE technologies. The businesses include saloons, welding shops, retail shops, bars, TV shows, maize mills, bakeries and tailoring shops as shown in Appendix 14. The businesses have also increased their sales due to increase in the number of operating hours through the provision of lighting at night. For example, at Nyamvuwu and Mthembanji Minigrids, there are solar energy kiosks that employ more than five workers and agents within the community.

[1] GOGLA-Handbook for Governments and Development Partners

Figure 5: Hair Salon Lady with customer at Sitolo Solar powered Mini-grid

14. Improved health service delivery; PURE access improves health services at rural health centers. For example, at Bondo Health Centre in Mulanje, the health Centre is able to keep vaccines. Patients can be treated at night. Mothers can deliver at night unlike in the past when there were using candles. In addition, the systems in health worker's homes have motivated them to remain at Bondo health facility.

15. Improved education service delivery; The utilization of PURE in schools improves the performance of students and reduces the operation cost of the school. This is illustrated by the case study at Kabichi Primary School in Mulanje which utilizes PURE from Mulanje Energy Generation Company.

Figure 6: Kabichi Primary School powered by Bondo hydro mini-grid

16. Establishment of PURE mini-grids in rural areas; PURE mini-grids have been developed across the country. There are two PURE mini-grids in the North, three PURE mini-grids in the Centre and four PURE mini-grids in the South. These mini-grids are supporting PURE activities in their communities. The mini-grids have been developed with support from both GoM and development partners.

Figure 7: Sales specialist at Bondo mini hydro power plant

17. Some PURE technology suppliers have been trained in business skills with funding from GIZ. The training covered preparation of strategic plans, finance manuals, human resource manuals, organograms, marketing strategies, investment preparedness, investment pitch and financial management.

18. PURE technicians trained; There are technicians who have been trained and are being trained in PURE technologies supply and installation. These technicians are trained through short courses and formal courses. Short courses are conducted by MZUNI, NCIC and technical colleges. Formal courses are conducted by technical colleges such as Mzuzu Technical College, Miracle Technical College and Lilongwe Technical college. Short courses are either funded by development partners such as UNDP and British Council or company funded or individually funded.

19. Developed standards on PURE technologies; There are standards which have been developed by MBS for PURE technologies. Some of the standards include MS696:2004-Battery based photovoltaic solar home systems covering specifications, MS696:2004-Battery based photovoltaic solar home systems covering code of practice and MS 780:2007-Solar photovoltaic water pumping system covering specification. Players in the industry are required to abide by the developed standards. The standards are a prerequisite for high quality PURE technologies. This ensures that end users have access to high quality PURE technologies.

Case Study #1: Successful case study for the north is Mantchewe Mini-grid, a hydropower system providing electricity to around 200 houses, businesses and social sectors, for the following reasons

1) It is self-sustaining and quality services are provided. Except for major repairs, when external help is needed. The system has some sustainable aspect.
2) The system is able to power maize mill thereby reducing drudgery of women who were traveling long distances and uphill to have their maize ground into flour at Livingstonia. Women and girl empowerment and reduction of drudgery is key here.
3) The system is able to connect businesses such as Mushroom camp, which is mostly patronized by international tourists. This is contributing to the generation of foreign exchange, job creation and supporting local businesses.
4) Women at Mtende group are involved in productive use of electricity through juice making using a blender and baking of scones and bread through a micro cooker. Tailoring with use of electricity is also done at the Centre. Some form of women empowerment.
5) Community members were actively involved in the construction works, navigating several challenges including logistics, hence the power of local community in solving own problems.
6) The founder, John Sailence, had been supported with a gift of a maize mill which he runs as a business, as a token of appreciation for initiating the project. This shows some level appreciation of the people for a job well done.

Figure 8: Juice made, electric sewing machine and Mini-cooker for baking scones and bread

Digital Access and Innovation

Current Situation in Malawi

Most PURE technologies (solar irrigation pumps, solar freezers, e-mobility solutions) are not digitally enabled. Aavailable data shows that Malawi's low digital adoption affects the integration of digital features in PURE technologies. According to Datareportal (2025), only about 3.95 million Malawians (19% of the population) use the internet. The Malawi Digital Economy Strategy (2021–2026) notes that device ownership remains low at around 51%, with affordability and high taxes as major barriers. The GSMA Mobile Economy Report (2022) highlights Malawi's persistent mobile internet usage gap, meaning coverage exists but adoption remains limited. Although the World Bank Digital Foundations Project (2019–2025) has expanded high-speed connectivity, most rural areas where PURE projects are concentrated still face weak access and digital literacy challenges. Importantly, there is no Malawi-specific data on the digital enablement of PURE or IoT-linked technologies, with available evidence largely drawn from regional or project-level studies such as the EnDev PURE Study (2022). Additionally, less than 5% of rural households have access to electricity, a critical barrier to both charging devices and powering digitally enabled productive systems (Malawi Energy Access Survey, 2024).

Renewable energy systems require precise monitoring of load, capacity, and performance, which is challenging without digital tools. Lack of digital integration reduces efficiency, preventive maintenance, and scalability. As such, it is essential to digitally adapt PURE technologies to allow real-time monitoring, data collection, and performance management.

Approaches to Digital Integration for PURE

Internet of Things (IoT) Integration: The integration of IoT technology into PUE devices presents a significant opportunity to enhance monitoring, maintenance, and performance optimisation. Equipment such as solar-powered irrigation pumps, refrigeration units, or Agro-processing machines can be fitted with sensors that collect real-time data on variables such as energy consumption, water flow, temperature, and system faults. These devices should be connected to cloud-based platforms to allow for centralized, remote monitoring. For example, a digitally enabled solar irrigation pump can automatically transmit daily data on the volume of water pumped, energy used, and any operational faults, enabling service providers and users to make timely decisions and reduce downtime.

Mobile Platforms: Given Malawi's growing mobile phone penetration developing mobile apps can offer a practical interface for farmers, service providers, and technicians to monitor

device performance, receive alerts for maintenance of the technologies and to track energy consumption and productivity gains. These platforms could also serve channels for providing customer support and training materials to the end-users.

Data Analytics: Through digitalising PURE systems, large volumes of operational data from IoT devices and mobile applications will be generated. This data could be aggregated to analyse patterns of energy use which can inform the optimal sizing and placement of renewable systems in different agricultural zones. Data could also be used to forecast performance issues of the technologies or recommend seasonal adjustments of the equipment bases on climatic and crop cycles to end-user like small-holder farmers.

Capacity Building: It is crucial to accompany digital integration efforts with deliberate capacity building initiatives. Technicians employed to develop the renewable energy systems and end-users require practical training in the installation, use and maintenance of digital monitoring technologies and local innovation for custom IoT solutions suited to Malawi's context. Capacity building can also be channelled through promoting local innovation through universities, technical colleges and entrepreneurship hubs.

CHAPTER 3

Barriers and Challenges

The market assessment identified some peculiar challenges and gaps in the current PURE landscape; the following were highlighted:

3.1. Policy and regulatory framework

- **Inadequate policy coherence on PURE;** Despite the existence of the National Energy Policy PURE products and services remain underexplored and not integrated by many key stakeholders. To address this issue there is need for policy coherence and programmatic alignment to create efficiencies and efforts to scale PURE and boost their impact, and also Creating a multi-sectoral task force or working group under the Ministry of Energy to harmonize policies, strategies, and programs relating to PURE (agriculture, trade, ICT, water, health, etc.)

- **Lack of PURE dissemination to rural areas;** Although the National Energy Policy exists, it has limited reach in rural areas, where PURE (Productive Use of Renewable Energy) technologies are most needed. Most rural communities are unaware of the policy provisions, opportunities, or support mechanisms related to PURE. This gap arises because: The policy lacks a dedicated dissemination and communication strategy targeting rural communities. This can be addressed through developing and implementing a PURE dissemination and awareness strategy tailored for rural areas. which can include: Translation and simplification of policy content into local languages and easy-to-understand formats (leaflets, radio spots, posters, infographics) and also use of community platforms such as traditional leaders, extension workers, cooperatives, schools, and local associations to spread PURE information.

- **High cost and lead time of obtaining permits for PURE mini-grids;** The cost for obtaining a PURE mini-grid is high in Malawi. This is shown by the comparison on the number of days before a developer secures permits, total cost for obtaining permit and days before securing generation license in selected countries including Malawi the figures below.

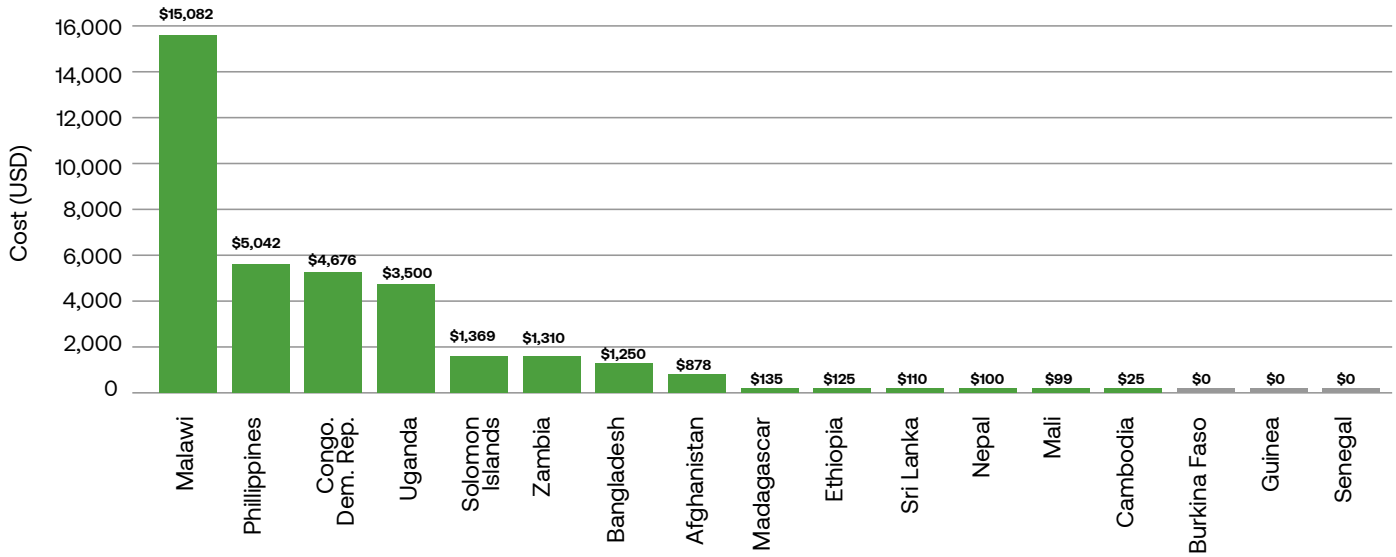


Figure 9: Total cost of obtaining permits to set up a mini-grid facility in the 17 surveyed countries. Source: RISE database, World Bank as cited by Banerjee, Moreno, Sinton, Primiani, et al., 2017; 179)

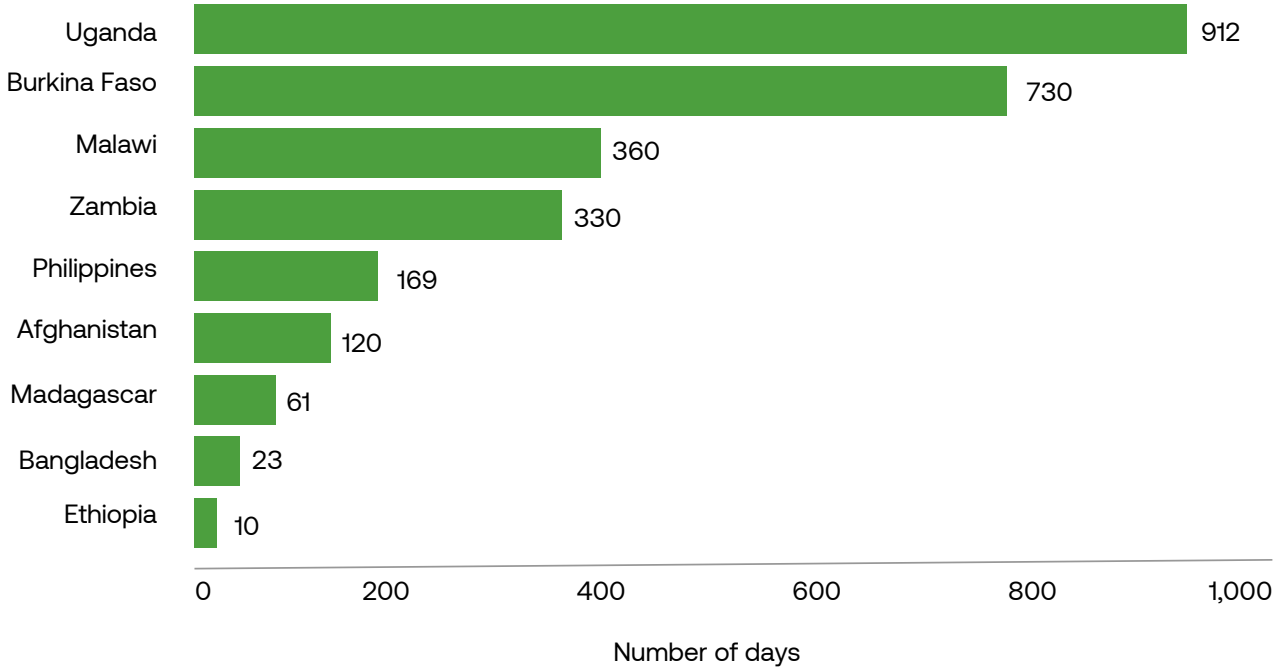


Figure 10:. Comparison of days before securing a generation license in selected countries.
Source: RISE database, World Bank as cited by Banerjee et al., (2017;177)

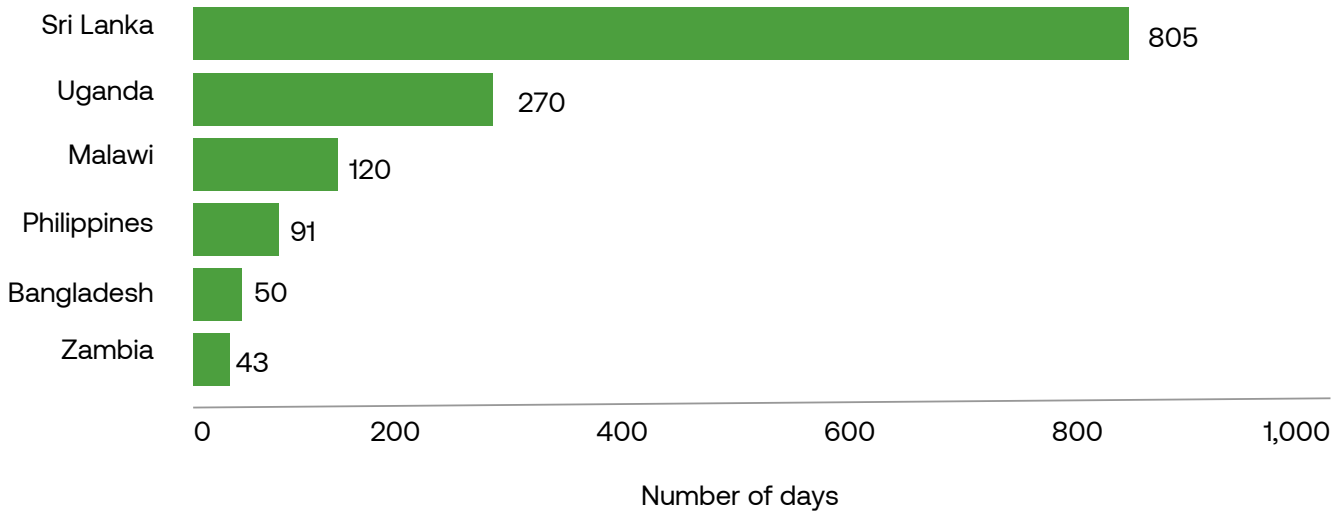


Figure 11: Comparison of days before securing environmental clearance in selected countries.
Source: RISE database, World Bank as cited by Banerjee et al., (2017;177)

3.2. Lack of enforcement of regulations and standards on PURE technologies

- Existing legal and regulatory frameworks should be effectively implemented and enforced. The PURE technology suppliers cited lack of enforcement of standards as a critical challenge. The suppliers indicated that MERA, MBS and MRA are not vigilant and cooperative to curb poor standards of the equipment that enters the country. MERA is not inspecting all installations being done in the country. MERA is not following up on the installers. MBS is not conducting surveillance inspections of the products in the shops. A potential solution is to identify key stakeholders to assist in enforcing regulations e.g. Department of Irrigation, Department of Water and Sanitation, etc.

- Proliferation of substandard PURE products on the market; The consequence of inadequate enforcement and inspection has led to the proliferation of counterfeit products on the market. Currently there is inadequate capacity by MBS, MERA and MRA to enforce the quality standards of PURE technologies entering the country. This can be addressed by involving MERA to supply a list of verified suppliers and have an agreement for the supplier to provide training to local technicians as one of their verification requirements

3.3. Limited and erratic access to financing for PURE

- Lack of dedicated funding for PURE technologies; even in the private financial sector there are no financial institutions that are offering tailormade financial products to support PURE technologies, the private companies should lobby support of PURE technologies that can grow the economy of the country. Under the current budget scenario, the national budget allocations to Goal 7 as a proportion of the national budget has been averaging around 2% from 2019 and further reduced to 1.1% in the year 2022/2023 national budget. The analysis further shows that the average allocation to the energy sector over the 4 years is still under 1% of GDP. In per capita terms, Government financing to SDG 7 was estimated at (US$ 3) which is inadequate to make any meaningful impact on achieving the 2030 targets. This low level of financing towards sustainable energy largely explains its implications on the stagnating percentage of population with access to electricity estimated at 11.3 % for a long period (NSO 2020).

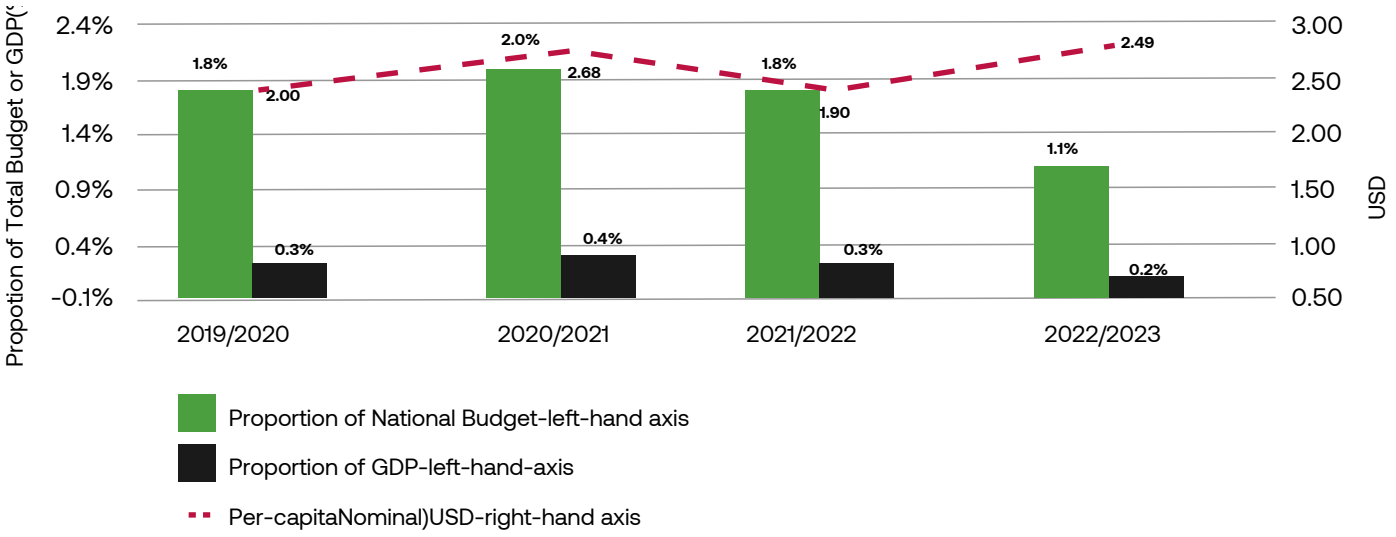


Figure 12: SDG Goal 7 Budget as share of National Budget (%)
Source: UNDP Malawi SDG Budget Analysis 2022/2023

The major sources of development funds for this goal were loans 99% in 2019, 87% in 2020. Over the years Part II of development financing to the energy sector was averaging 10%, with grants Part I development financing averaging over 90% of the capital financing of the goal. Finance of the goal, this complements Target 7.a (Enhance international cooperation to facilitate access to clean energy research and technology, including PURE, energy efficiency) that received the highest funding averaging over two thirds and 83% in the 2022/2023 total goal budget.

High upfront costs of the equipment; The landed cost of the equipment is high despite removal of custom duty and VAT on some of the PURE technologies. This is so because Malawi does not manufacture many of the PURE technologies. The majority of the population in the country live below the poverty line therefore they cannot afford the PURE technologies. To address this, there's a need to promote affordability and financing mechanisms that lower entry barriers for rural households and enterprises. By Introducing innovative financing models such as pay-as-you-go (PAYG), micro-leasing, and rent-to-own schemes that spread costs over time and match rural income cycles and also encouraging bulk procurement and cooperative ownership models, enabling communities or groups to pool resources and access equipment at lower unit costs.

Lack of financial solutions for small holder farmers who have no collateral; The small holder farmers who need solar irrigation pumps cannot purchase them due to low output of their fields due to climate change and high inputs costs. The farmers would like to get loans to purchase the solar irrigation pumps but do not have the required collateral to guarantee the loans despite that the solar irrigation pumps themselves can be used as collateral. The recommended approach can be Promoting group/cooperative lending schemes that allow farmers to access loans collectively, share risk, and use pooled guarantees and also encourage partnerships between MFIs, SACCOs, and technology providers to roll out pay-as-you-go (PAYG), rent-to-own, or micro-leasing models suited to smallholder income flows.

Lack of forex to access PURE technologies; Technology suppliers have lamented on the shortage of forex to import the technologies. Suppliers wait for a long time before forex could be allocated to them for the purchase of PURE technologies. This affects the cash flow of the businesses. To address the forex shortages that hinder technology suppliers from importing PURE equipment, Malawi can adopt a multi-pronged strategy by establishing a dedicated forex allocation window (through the Reserve Bank of Malawi) for strategic imports such as renewable energy and PURE technologies and Support bulk procurement mechanisms coordinated by government or industry associations to optimize forex use and lower transaction costs

Lack of markets for the produce by small holder farmers; The small holder farmers produce crops for sale using PURE technologies. It so happens that the crops do not fetch breakeven prices on the market and the farmers make losses. The farmers lack markets that can support their farming businesses which use PURE technologies. To address this Malawi needs to strengthen market access and value chain development through Market linkages and aggregation centres that establish farmer cooperatives and aggregation hubs that connect smallholder farmers to large buyers (processors, supermarkets, exporters) and Promotion of contract farming and off-taker agreements Secure guaranteed markets and stable prices for farmers through formalized agreements with Agro-processors and buyers. Therefore, Farmers have guaranteed markets and stable prices, reducing the risk of losses due to price fluctuations or unsold crops.

Lack of sustainability of grant funded projects providing PURE; The grant funded projects require sustainability measures to ensure that the projects benefit the communities for their lifetime. However, most of the PURE grant funded projects have failed to generate enough funds for their sustainability. The projects often collapse due to lack of exit strategies, weak cost-recovery models, or poor community ownership structures. Based on the roadmap and its activities, the table below outlines sustainability measures to ensure continuity beyond donor funding.

Priority	Key Activities	Timeline	Lead Institutions	Exit Strategy Approach
1. Build Local Technical & Institutional Capacity	Develop lectures and showcase PURE technologies to University Students	6months to 1 year	• Private Energy	• Sign MoUs between universities and private companies to continue providing guest lectures, technology demos, and internships. • Establish PURE clubs or innovation hubs where students can interact with companies, test prototypes, or run small projects. • Encourage alumni who are in the energy sector to return as mentors and guest speakers.
1. Increase Access and Uptake of PURE Technologies	- Run social media campaigns and disseminate IEC materials (e.g., flyers) REIAMA will be posting its members technologies on its socials are, LinkedIn, Twitter, Facebook	quarterly	• TWG • REIAMA • Private Sector Players	• Collaborate with media houses, influencers, and development partners who may share or amplify REIAMA's content at no cost. • Each REIAMA member company contributes content regularly (photos, videos, case studies) as part of their marketing. • This reduces cost and keeps platforms active since companies benefit from visibility.
	- Host PURE-focused session at National Energy Conference	Annually	• TWG • MoE, • REIAMA, • MRA, Tax Incentive Task Force	• Secure agreement with the Ministry of Energy and conference organizers to make PURE a standing agenda item every year, regardless of funding source. • Encourage private sector players (solar companies, banks, telecoms) to sponsor the PURE session in exchange for branding, exhibition space, and visibility.
3. Policy and Regulatory Support	- Advocate for VAT and duty exemption on PURE technologies that were left in the first place	Annually	• TWG • MoE, • REIAMA, • MRA, Tax Incentive Task Force	• Establish a permanent Energy Tax and Incentives Task Force within REIAMA or the TWG to continuously lobby government and track policy gaps. • This ensures advocacy doesn't stop when donor funding ends.
4. Promote Awareness and End-User Empowerment	- Produce and publish PURE promotional videos a company will be shooting videos for REIAMA to post and advertise their Products	quarterly	TWG, REIAMA	• Collaborate with media houses, influencers, and development partners who may share or amplify REIAMA's content at no cost.

3.4. Low technical capacity and skills

Inappropriate design, supply and installation of systems; The primary cause of failure in most Solar Powered Irrigation Systems is the use of poor-quality equipment, often from unreliable brands. This highlights the need for stricter enforcement of regulations to ensure only durable solar equipment enters the country. Much as the Ministry of Agriculture and the Department of Irrigation reports of 139 solar- powered irrigation schemes, many of these systems are failing immediately after handovers. Systems do not meet the requirements of end users, mostly due to poor design that means installations should be undertaken by verified contractors with proven expertise. For example, solar water pumping systems fail to pump the daily water requirement for irrigation or handed over without working, resulting into challenges as shown in figure 13. To support this, a Technical Solar Powered Irrigation Systems Guide should be developed, outlining minimum specifications such as pump duty calculations, storage sizing, wiring and earthing requirements, spare parts provision, commissioning test logs, and final designs verified by certified engineers

Figure 13: Abandoned water pump, removed solar panels and deformed water tanks and dried canal

Lack of backup service by PURE technology providers; The end users cited lack of backup service by most of service providers. Some technologies were not working due to lack of backup service. This was evidenced in the sampled study locations. This can be addressed by building local technical capacity by training local technicians and youth entrepreneurs in rural areas to provide repair and maintenance services closer to end-users.

Theft and vandalism of PURE technologies in rural areas: Theft and vandalism of PURE technologies is a big challenge in some communities. Communities pay security fees to guard against theft and vandalism. This challenge can be addressed through targeted capacity building, ensuring that users are equipped with the knowledge and resources to properly safeguard solar equipment. Also, System designs should also incorporate resilience measures such as elevated panels, robust and anchored mounting structures, perimeter fencing, and alarm systems. And also, insurance options for Solar Powered Irrigation Systems to mitigate risks of theft, vandalism, and natural hazards should be considered.

Failure to build resilience and destruction of PURE technologies by floods in flood prone areas; In some communities, PURE technologies were destroyed by floods due to designs that did not account for the likelihood or severity of flooding. To protect these investments in flood-prone areas, Malawi should adopt climate-resilient planning and design measures. This includes careful site selection and risk mapping to prioritize installations in low-risk areas using hydrological and climate data, as well as climate-resilient infrastructure design, such as elevating systems on raised platforms or using flood-proof foundations to prevent water damage.

Seasonal and erratic energy output from mini-grids; PURE technologies are affected by change in seasons. Some mini-grids powered by hydro experience blackouts during dry season due to low water flows while others powered by solar experience black outs during rainy and cold seasons.

Low maintenance of generation facilities of mini-grids; PURE technologies are affected by lack of corrective maintenance of generation facilities powered by hydro power. This affects the availability of power for consumers. This can be addressed by training local technicians and operators in maintenance, troubleshooting, and system monitoring to reduce downtime.

Technological challenges for purchase of units in mini-grids; Purchase of units by users sometimes takes time due to challenges in the technology. Other systems have resorted to charging flat rate per month due to lack of or failure to purchase a vending system. This affects business activities of the communities. Service institutions such as schools and health centers are also affected. Household energy driven activities are affected. This can be addressed by upgrading or standardizing vending/payment systems to ensure smooth, user-friendly operation for all consumers and providing technical support and training to local operators and community members on using and troubleshooting vending systems.

3.5. Organizational Capacity Challenges

Failure or delays to institutionalise the Rural Electrification Agency (REA) as a semi-autonomous legal entity to manage the Rural Electrification Fund and Rural Electrification activities in both grid extension and off-grid options. The National Energy Policy is very explicit on the urgency to have the REA institutionalized by 2018/19 as part of restructuring of Rural Electrification Program and PURE management governance. Accountability on the utilization of rural electrification funds which in turn would bring donor confidence thereby attracting donor funding into the MAREP program. All our neighboring countries and beyond have REA in place. For example, Zambia

had its Rural Electrification Authority instituted in 2003 (Rural Electrification Authority (REA), 2003), Tanzania had its REA operationalized in 2007 (Rural Electricification Agency, 2007), while Zimbabwe had its Rural Electrification Fund (similar to REA) in 2002 while Senegal had it in 1998.

Lack of research in PURE technologies and business Models and sharing of PURE knowledge in universities; Universities are carrying out limited research on PURE technologies including business scenarios supporting PURE technologies. There is lack of knowledge on the performance of PURE technologies in terms of technical and financial viability. This can be supported by Promoting applied research in universities, integrate PURE into curricula, and establish platforms to share technical and business knowledge for informed decision-making.

Lack of practical training at universities and colleges; There is shortage of practical training at universities and colleges. This is caused by lack of adequate tools, materials and equipment. There are no simulation laboratories at the universities and colleges. This can be addressed by developing partnerships with industry and technology providers to facilitate internships, field visits, and on-site training for students,

Providing training-of-trainers programs to equip lecturers and instructors with skills to deliver hands-on sessions effectively and leveraging donor and private sector support to fund equipment, tools, and practical learning initiatives.

Lack of District Energy Officers to promote PURE technologies in the country; Technology suppliers are calling for the employment of District Energy Officers so that they act as links for the support of PURE projects. The suppliers indicated that there are a lot of poorly installed public PURE systems due to lack of District Energy Officers who could have checked the authenticity of the suppliers and installers of the systems. This can be addressed by Recruiting and deploying District Energy Officers (DEOs) across all districts to serve as technical focal points for PURE technologies and all related Energy issues.

Limited promotion of cooperative formation in rural areas".; The presence of cooperatives in rural areas can significantly increase the utilization of PURE technologies. However, their prevalence is currently low due to limited sensitization and training. This can be addressed by conducting awareness campaigns on the benefits of forming cooperatives for collective access to PURE technologies, and by documenting and sharing successful cooperative models to encourage replication across rural communities.

Lack of end user training; The end users indicated that training was not offered after the systems were installed. This was pointed out by end users whose systems failed. This can be addressed by Providing hands-on training after installation on operation, routine maintenance, and troubleshooting of PURE systems, developing user manuals and simple guides in local languages to support day-to-day system management and establishing follow-up support mechanisms through suppliers, District Energy Officers, or community technicians.

Failure of the mini-grid sector to grow as planned; The mini-grid sector is still at nascent stage even though the government through the Malawi Renewable Energy Strategy 2017-2022 planned to construct 50 mini-grids by 2025. The failure is attributed to lack of financing and failure to decentralise so as to be able to attract private financing. This can be addressed by Promoting capacity building for local developers to design, operate, and maintain mini-grids sustainably.

Lack of integration of PURE into demand forecasting and site prioritisation into national and off grid electrification planning process; This gap results in limited visibility of PURE technologies in energy planning frameworks. Site selection for off-grid projects often overlooks areas with high productive use potential, leading to underutilization of energy infrastructure. This can be addressed by Incorporating PURE demand forecasting into national energy planning models to reflect productive use potential alongside household and commercial demand.

3.6. Public awareness and information challenges

Lack of Information for finance opportunities in rural areas; Rural areas do not have access to information on financial instruments towards the purchase of PURE technologies. There are no deliberate efforts by the government, CSOs, NGOs, and financial institutions to alert the rural areas on the availability of financial instruments for the purchase of PURE technologies. More than ninety percent of the respondents were not aware of any financial instruments towards purchase of PURE technologies. This issue can be supported by Conducting targeted awareness campaigns in rural communities on available loans, grants, and financing schemes for PURE technologies and collaborating with financial institutions, NGOs, and CSOs to reach remote areas through local networks, community meetings, and radio programs.

Failure to involve community participation during project implementation; The participation by the community in a project funded by a donor is critical. Some projects do not involve the community during implementation and the success of the project is greatly affected. This is so because the project lacks ownership. Therefore, it is necessary to actively engage communities throughout the project lifecycle.

CHAPTER 4

Market Opportunities

There are various opportunities on which the promotion of PURE technologies can thrive on in Malawi and these include:

4.1. Policy opportunities

GoM is supportive towards promotion of PURE technologies by enactment of Mini-Grid and IPP frameworks, setting up of regulatory bodies and setting up of projects technical advisory committees. GoM through the Ministry of Energy is currently reviewing the National Energy Policy, 2018 and this is an opportunity to cover PURE technologies. The policy should be able to highlight PURE technologies promotion. The promotion of PURE technologies makes investment in energy access infrastructure financially viable. Malawi 2063 of

The Malawi 2063 Pillars on agricultural productivity and Commercialization, Industrialization and Urbanization aim at transforming the country into a more industrialized and prosperous nation. As such, investment in energy access is a top priority to advance the country's economic development and wealth creation. Globally, the SDG Agenda 2030 Goal 7 aims to achieve affordable and clean energy. In particular Target 7.a aims to enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy and energy efficiency among others.

4.2. Financial opportunities

There are finance opportunities to be accessed by individual entrepreneurs and cooperatives if they are investment ready. Individual entrepreneurs and cooperatives need to be trained on investment readiness if they are to access the finance opportunities. Generally, a lot of Financial Institutions have demonstrated an increased interest in the energy sector, especially with PURE being cross-cutting between energy and agriculture. Similarly, development partners have also developed demand side subsidies (DSS) through result-based financing mechanisms. These are helping to address the affordability gap of PURE appliances and products and encourage PURE companies to expand towards hard-to-reach communities.

4.3. Market opportunities

The demand for PURE technologies is increasing in the country. This is witnessed by the large number of players in the PURE sector and the high demand for forex for importation of PURE products. The access to electricity is currently at 23% with national grid at 12% and off-grid at 11% . The Malawi Population Census of 2018 indicated that access to electricity was 18% with national grid at 11.4 and off-grid at 6.6%. This indicates that off-grid through renewable energy has greatly increased the access to electricity in the country which will in turn increase the utilization of PURE technologies. Table 1 presents the Maturity model of PURE technologies in Malawi.

4.4. Business Case – Malawi

According to the Productive Use of Energy Standard Business Case Analysis Study conducted by REIAMA the following opportunities on PURE were identified.

4.4.1. Solar Freezer

Solar freezers are appliances that use photovoltaic technology as a power supply to generate cooling and freezing capabilities. These units can be used to keep perishable goods like vegetables or fruits at a chilled temperature ensuring food preservation.

The study found out that amongst others, in the case where the SMEs or if fishermen decide to purchase a solar freezer, their yearly net profit increases to MK 161,020,000.00 which is approximately 2 times more than operating their business with the cooler box. This is through the assumption that after purchasing the cooler box, they invested in the solar freezer, meaning they can store more fish.

Alternative Financing Options include

- Microfinance: Small business owners, such as fish sellers and dairy farmers, can take small loans to acquire solar-powered freezers, ensuring cash flow sustainability.
- Leasing: Cold chain service providers can offer a pay-as-you-use model, where users rent freezers for a fixed period instead of owning them.
- Subsidies: NGOs and government programs might provide subsidies, especially in off-grid areas, to support food security and reduce post-harvest losses.

4.4.2. Solar Irrigation Water Pumps

Solar water pumps are type of pump that pump water from various sources (e.g. Rivers, wells, ponds) for agricultural irrigation, and is powered by electricity produced from solar panels. They are a climate-friendly and cost-efficient way to pump water to areas where there is limited or no access to the power grid.

Types of water pumps

Submersible: This type of pump must be fully submerged into a water source that is not easily accessible. The ideal water source for the submersible pump are boreholes or deep wells.
Surface: This type of pump is placed on the ground near the water source. They are used to pump water from shallow wells, lakes and rivers.

AC pumps: Electric motor in this pump needs an inverter to transform the DC voltages produced by the solar panels into AC voltages to operate the pump.
DC pumps: This pump has an electric motor that uses DC power. However, the power produced is highly dependent on the intensity of the sunlight.

The study found out that amongst others, despite higher Capex, Solar Irrigation Water Pumps are the most cost-effective and sustainable option for long-term agricultural productivity, since they also have low OPEX. Farmers can double their profits and maximize crops with solar irrigation technology. (REIAMA 2025)

Alternative Financing Options

- Microfinance: Smallholder farmers can access loans through microfinance institutions (MFIs) to purchase solar pumps, allowing them to pay in instalments rather than upfront.
- Leasing: Farmers can lease pumps from service providers, paying a periodic fee instead of purchasing outright, making it cost-effective for seasonal use.
- Subsidies: Government or donor programs may provide partial subsidies to reduce the initial investment cost, especially for low-income farmers.

4.4.3. E-mobility Motor Bikes

E-mobility motorbikes, also known as electric motorbikes or e-motorcycles, are two-wheeled vehicles powered by electricity rather than internal combustion engines. They are part of the broader category of electric vehicles (EVs) designed to provide sustainable and eco-friendly alternatives to traditional petrol or diesel-powered vehicles.

Based on the models results between Electric motorbike and fuel-based motorbikes, despite that Electric motorbikes require a significantly higher initial investment, they offer lower operational costs (due to zero fuel expenses and reduced maintenance). (REIAMA 2025)

Alternative financing Options

- Microfinance: Entrepreneurs and delivery businesses can access loans to purchase e-bikes, making them affordable for low-income earners.
- Leasing: Fleet operators or ride-hailing services can provide leasing options, allowing riders to use bikes to generate income without high upfront costs.
- Subsidies: Green energy initiatives and carbon credit programs may offer subsidies to promote clean mobility and reduce emissions.

Table1 below presents the snapshot of how PURE technologies are emerging across sectors in Malawi using maturity model. The findings of the market assessment presented in the table shows three stages of maturity.

High-Maturity Opportunities (Commercial stage): These applications are already market-ready and may benefit from scaling, financing, or streamlining supply chains: These include;

- **Agriculture:** Solar water pumps, maize/rice mills, oil pressers
- **MSMEs:** Hairdressing equipment, cooling appliances, popcorn/chapati machines
- **Public Services:** Cold chain freezers for health; lighting for education
- **Household tech:** TVs, solar home systems

Emerging & Near-Market Innovations: These technologies are gaining traction and may need pilot programs, policy support, or targeted subsidies: These include;

- **Agri-cooling:** Walk-in cold rooms, milk chillers, freezers
- **Cooking solutions:** Biogas cookers, near-to-market electric cookers
- **Transport:** Electric motorcycles and vehicles
- **Food Processing:** Baking ovens, honey filtering and Juice makers
- **Clothing care:** Flat irons using DC/inverter

Horizon Technologies (Early-stage potential): These are still in development or early adoption phases; ideal for innovation hubs or grant-based programs: These include;

- Ice makers, egg incubators, solar dryers
- De-huskers and fishing lamp technologies

Table 1: List of PURE Technologies in Malawi

Sector	Application	Technology	Use DC/ Inverter	Maturity stage
AGRICULTURE	Irrigation	Solar water pumps	DC and inverter	Commercial
	Cooling	Walk-in cold rooms	Inverters	Emerging
		Refrigerators	DC and inverter	Near to market
		Freezers	DC and inverter	Near to market
		Milk chillers	Inverter	Emerging
		Ice makers	Inverter	Horizon
		Freezer maker	DC and inverter	Emerging
		Ice blocks maker	DC and inverter	Emerging
	Agro-processing	Maize mills	Inverter	Commercial
		Rice mills	Inverter	Commercial
		De-huskers	Inverter	Horizon
		Oil pressers	Inverter	Commercial
		Dryers (Solar-powered)	DC and inverter	Horizon
		Honey filters/bottling	DC and inverter	Near to market
	Poultry	Egg incubators	Inverter	Horizon
	Fishing	Fishing lamps	DC	Commercial
MSMEs	Hairdressing	Shavers	DC and inverter	Commercial
		Hair dryer	DC and inverter	Commercial
		Hair clipper	DC and inverter	Commercial
		Hair blowers	DC and inverter	Commercial
	Cooking	Electric cookers	DC and inverter	Emerging
		Biogas cooker		Emerging
		Electric cooker	DC and inverter	Near to Market
		Water heaters	DC and inverter	Commercial
	Cooling	Refrigerators	DC and inverter	Commercial
		Freezers	DC and inverter	Commercial
	Food and Beverages	Baking ovens	DC and inverter	Near to Market
		Popcorn machines	DC and inverter	Commercial
		Chapati maker	DC and inverter	Commercial
		Juice makers	DC and inverter	Emerging
	Lights and Appliances	Solar home systems	DC and inverter	Commercial
	Entertainment	TVs and audio systems	DC and inverter	Commercial
	Clothing	Flat irons	DC and inverter	Near to market
Transport	Electric vehicles	Motor bikes (Kabaza)	DC and inverter	Near to market
		Vehicles	DC and inverter	Near to market
Health	Cold Chain	Freezers	DC and inverter	Commercial
Education	Lights and Appliances	Lighting and Power	DC and inverter	Commercial
Tourism	Heating	Electric cookers	DC and inverter	Near to market

4.4.4. Capacity opportunities

The higher education institutions have modules covering PURE technologies which the youth can access. There are readily available institutions, organizations and development partners which are able to support the promotion of PURE technologies through the development of human capital. There are a lot of youth who are attaining Malawi School Certificate of Education but are not being absorbed by public and private universities. These youths are ready to be trained in PURE technologies. There is need to open up opportunities for them to access knowledge of PURE technologies.

CHAPTER 5

Stakeholder Analysis

Table 2: List of RE Stakeholders in Malawi

Name of Stakeholder	Key Roles and Focus Areas	Power and Influence
Ministry of Energy, Ministry of Agriculture, Finance, Trade and Industry	The government should Incorporate PURE technologies in the policy interventions; • Incentivize PURE investments through taxes reduction, grants, Carbon credits, tax breaks and creation of green bonds; • Facilitate quicker projects approvals and implementation; • Improve national grid infrastructure to allow more IPPs participation in the generation mix; • Provide funding to universities and colleges for research and development in PURE technologies; • Facilitate linkage of farmers to markets; • Provide extension services to farmers involved in irrigation; • Promote success stories of PURE technologies utilization; and • Conduct public awareness campaigns on PURE technologies.	Influencer
MERA, MBS, NCIC	The regulators should carry out the following: • Review standards and regulations to be in line with industry trends; • Strengthen and Enforce standards and regulations; and • Conduct public awareness campaigns on standards and regulations.	Influencer
Development Partners	The development partners should be involved in the following: • Provide financial and technical support for the promotion of PURE technologies; • Conduct training workshops on PURE technologies supply and installations; • Facilitate successful utilization of PURE technologies; • Promote use of consultants in delivery of PURE technologies at community level to avoid poor design, supply and installation of systems; • Engage MERA and MBS before systems are handed over to beneficiaries; and • Provide financial support to CSOs for policy advocacy and implementation monitoring.	Enabler

Table 2: List of RE Stakeholders in Malawi

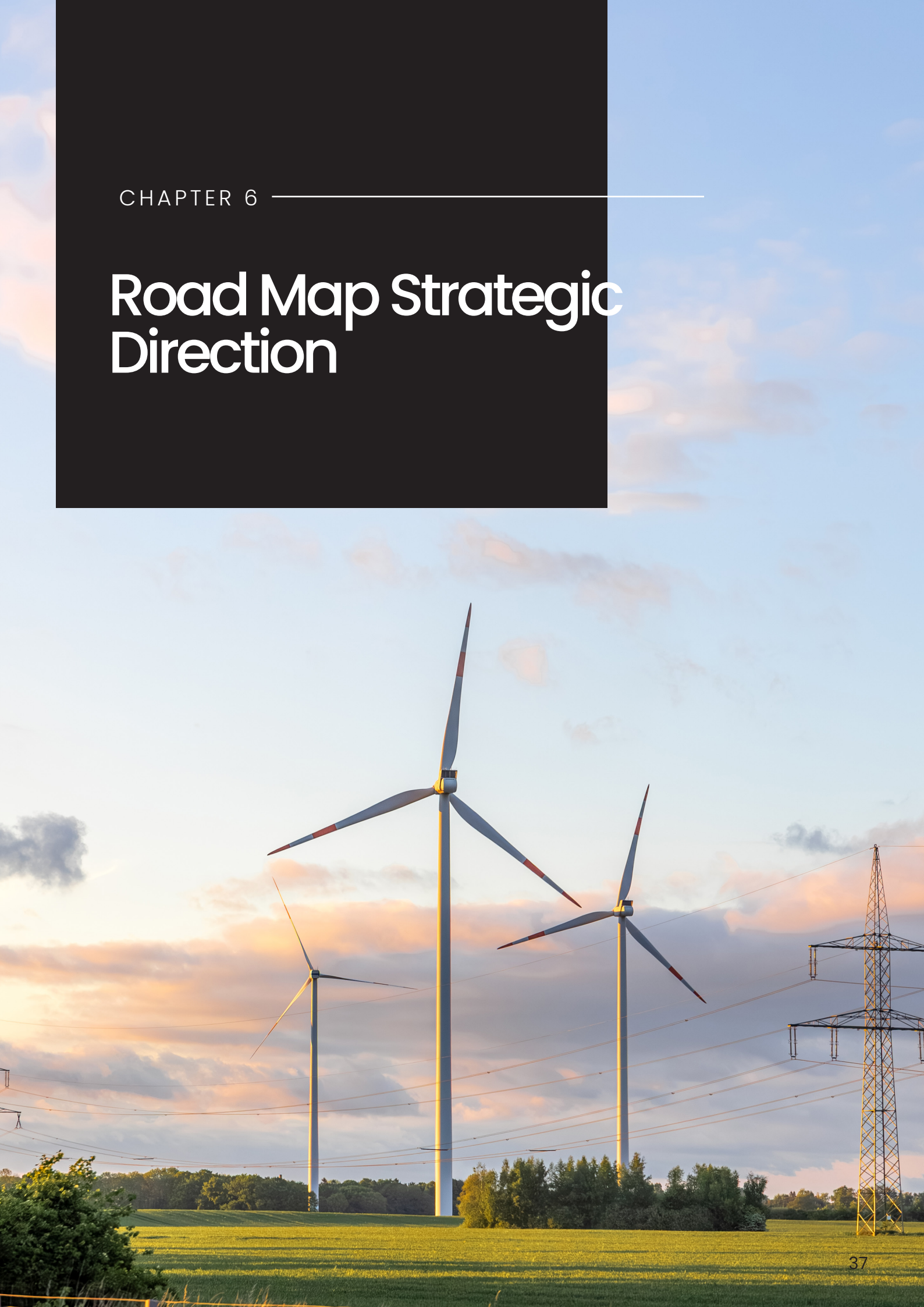
Name of Stakeholder	Key Roles and Focus Areas	Power and Influence
Financial Institutions	The financial institutions should carry out the following: • Provide tailored financial products for PURE technologies that can be accessed by low-income earners such as low interest loans and grants; • Develop innovative risk mitigation measures to address perceived risks associated with PURE technologies. Such measures could be insurance products or guarantees; and • Create and promote green bonds and other financial instruments that support environmentally friendly projects.	Enabler
TEVET and Higher Education Institutions	The academic institutions should address the following: • Review curriculums periodically to meet changes in the industry; • Establish partnerships with industry leaders to ensure that research and training align with current market trends and technological advancements; • Request research topics from industry players and other stakeholders; • Develop innovative strategies for research funding; • Carry out research and development on PURE technologies; • Share research outputs with industry and other stakeholders; and • Undertake CPD programmes for industry players.	Enabler

Table 2: List of RE Stakeholders in Malawi

Name of Stakeholder	Key Roles and Focus Areas	Power and Influence
REIAMA and Industry Players	REIAMA should promote PURE technologies by addressing the following: • Share knowledge and best practices within the industry to promote efficiency and effectiveness in PURE projects; • Coordinate with GoM and other stakeholders on public awareness on the benefits of PURE technologies; • Conduct dialogue with MERA, MBS and NCIC to develop and implement standards and regulations that facilitate the growth of PURE technologies; • Promote networking among industry players; • Facilitate training opportunities and works for industry players; • Facilitate internships and job openings for PURE graduates; • Facilitate innovation amongst the youth; and • Promote CPD among industry players.	Influencer
End users/Beneficiaries	The end users should take the following roles: • Actively seek and utilize PURE technologies; • Support and advocate for policies that promote PURE technologies at national and local levels; • Share positive experiences and knowledge about PURE technologies; • Follow appropriate guidelines and instructions when using PURE technologies; • Seek guidance from GoM, REIAMA and regulators.	Beneficiary

CHAPTER 6

Road Map Strategic Direction



Coupled with the above situational analysis that brings out bottlenecks and leveraging on existing threats and opportunities, the road map for prioritized Issues for strengthening PURE uptake emerged. The roadmap has come up with the following Strategic Objectives and priority areas for future programming:

Objective 1: Review and fully implement the National Energy Policy and regulatory frameworks

i). Review and update the National Energy Policy and PURE Strategy to include proper guidance on PURE and the inclusion of PURE technologies in the successor energy policy. The need for alignment of policy documents for different MDAs on the implementation of PURE.

ii). Speed up the devolution of the energy sector as highlighted in both the decentralisation policy and the energy policy to ensure PURE technologies are at service delivery points in the districts. In addition, the Ministry of Energy together with Ministry of Local Government, Unity and Culture should speed up recruitment and deployment of district energy officers.

iii). Eliminate some policy mismatches in line with the development Agenda. For example, the Cooperative Registration Procedures, need to be devolved for ease of access, in the current set many farmer groups in rural areas are demotivated with the process of registering a cooperative. MoJCA and MoTI need to consider to review the Cooperatives Registration Act to make it accessible.

iv). Implementation of additional list on removal of duty and VAT for PURE technologies such as EVs

Examples of Best RE Policy Practices in the Region

Case Study 1. Rwanda RE Policy

The Rwanda RE Strategy has the following strengths:

- The government of Rwanda has a renewable energy fund specifically targeting off grids (Pico and mini-grids). The fund is also structured in a way that a household can access financing. SACCO's and microfinance agencies get funding through a window in the Development Bank of Rwanda for easy access by low-income households. As a country, households are categorized according to their financial status and benefit according to their category. The subsidy also extends to clean cooking initiatives to reduce carbon emission.

Financing:

- Rwanda Development Bank (BRD) has a Renewable Energy Fund called 'Cana Uhendukiwe'. This fund provides concessional lines of credit to SACCO's, banks and microfinance institutions, mini-grid developers and off-grid solar companies who lend to the final beneficiary households and micro-enterprises for off-grid connections. The fund has two components; Line of credit, direct financing and subsidy for off-grid electrification that provides 30 million USD line credit facilities and 15 million UDS RBF subsidy through five windows and technical assistance, capacity building and project implementation support on a need basis to BRD and participating entities. The following are the five windows of investment used:

- Banks are provided with Wholesale line of credit through on-lending to eligible commercial banks and microfinance banks, which extend sub-loans to eligible final beneficiaries
- Mini-grid- direct financing to eligible mini-grid developers to finance up to 70% of the construction of renewable energy-based mini-grid systems. BRD also provides bridging loans until grant funding from available Results Based Financing programs becomes available as well as long-term financing beyond commissioning.
- SACCO's- Obtain wholesale line of credit through on-lending to Sacco's complying with established eligibility criteria. They then on-lend the funds to final beneficiaries e.g. households, off-grid solar companies, enterprises
- Off-grid solar companies- provides direct financing to qualifying locally registered off-grid solar companies supporting high quality solar home systems. Renewable Energy Companies provide loans for PURE technologies to end users and the end users pay for the PURE technologies through tariffs payments.
- Subsidy window- RBF subsidy window is designed to address affordability issue of solar home systems faced by households in the off-grid area. This is done through the reduction of prices for the systems at varying amounts allocated to social economic categories called 'ubudehe' 1,2,3 categories with the aim of reaching lowest income population. For category 1 which is the lowest class gets 90% subsidy of the system cost while category 2 and 3 get 70% and 45% respectively. These subsidies are channeled through eligible off-grid solar companies

Case Study #2: Tanzania RE Policy

Tanzania is regarded highly on provision of enabling environment for mini-grids; hence, offering many lessons. Tanzanian's regulation specifies that energy projects generating less than 100kW required no tariff approval from the regulator. There are shared costs of feasibility studies, environmental impact assessment between developers and Rural Electrification Agency. Tanzania had 209 mini-grids and total installed capacity of 158 MW in 2019.

Mini-grids of Tanzania

- Simplified regulation made the country make positive strides in the sector. For example, small scale power producers with capacity of 1 MW are reportedly not require to apply for licenses from the regulator in the country (Contejean & Verin, 2017 & Energy Environment Partnership, 2018).

Financing

- Developers are encouraged to collaborate with community or customers over how much should be charged as tariffs. Energy developers with installed capacity of less than 100 kW of electricity are again allowed to sell electricity to the utility in Tanzania. Developers were allowed to sell electricity to the utility in US$ to avoid loss of value with the local currency. It was by law that a utility must pay out the mini-grid operators the capital cost minus subsidy

upon arrival of main grid. In addition, a mini-grid can also opt for conversion to Small Power Producers (SPP) or Small Power Distributors (SPD). The issues of dedicated funding towards mini-grid establishments and the sharing of cost for preparatory work of mini-grids are some of the incentives that were there to attract developers for the sector in the country.

- It is by law that a utility must pay out mini-grid operator the capital minus subsidy upon the arrival of main grid in the perimeter of the mini-grid. Owing to these encouraging environments, Tanzania received a US$ 23 million World Bank credit line for developers of mini-grids to be able to access up to 85 percent of total investment of mini-grid projects of 10 MW or less from 2010. The country was able to get a lion's share of around 40 percent as donor support from the Energy and Environment Partnership, which had coverage of Tanzania, Kenya, Uganda and Malawi among others.

Objective 2: Strengthen and Institutionalise RE Regulatory frameworks

i). Institutionalise and strengthen, quality assurance teams (MERA)enforcement of standards and regulations in a coordinated approach; MERA should institutionalise the inspectorate unit and decentralise its function.

ii). MBS should strive to institutionalise the RE standards, disseminate and strengthen their enforcement.

iii). To improve public awareness and adherence and compliance by suppliers, MBS should improve on collecting RE samples for testing and regular reporting of compliance to the public. In the current set up sharing of reports from MBS is limited. This leads to the public being unable to detect counterfeit products on the market.

Objective 3: Strengthening multisectoral coordination and collaboration among stakeholders involved in PURE technologies at national and sectoral level,

i). The Ministry of Energy should step up developing a framework and MOUs for spearheading Coordination, this will ensure strengthened coordination and collaboration mechanisms structures are established between the Ministry of Energy and other MDAs and other stakeholders to mainstream PURE.

ii). Establish Joint country programs, across sectoral strategic need, joint monitoring, reporting and accountability systems for scaling up Productive Energy Use by Development Partners and the aim will be for stakeholders to gain a clear understanding of how the Government, Development Partners and the private sector (REIAMA) collaborate within a country to maximize resources, streamline operations, and amplify their collective impact. Energy is cross cutting, while energy policy generation belongs to Ministry of Energy, its usage and scaling up leis with other MDAs such as Ministry of Agriculture, Trade, Transport, Education, Health, Trade etc., hence the need for multisectoral collaboration and reporting.

iii). Map partners by geographical location and priority areas of intervention to avoid leaving some sections of the population behind during scale up.

Objective 4: Enhance the local capacity and technical skills and in PURE

i). Build Capacity and support local suppliers in RE, the market is currently dominated by foreign companies

ii). Strengthen industrial and academic partnerships and increase practical training at higher education institutions through tailored made training courses
iii). Develop strategic collaboration on internship programs with RE apprentices, in the current set up the industrial attachment's programmes are not structured. There are a lot of unemployed youths in Malawi that renders the job market opportunity.
iv). Conduct Research and Development in PURE technologies by higher education institutions in addition to research capacity programmes at MZUNI

Objective 5: Ensure sustainable RE financing models

i). Establish a basket/dedicated financing fund for PURE technologies.;
ii). Build political support and develop an outreach plan for finance opportunities for PURE technologies;
iii). Given the shortage of forex, there is need to recognize PURE sector priority area to access forex;
iv). Establish clear guidelines for accessing operational and capital investment subsidy under Rural Electrification Fund whether through MAREP or institutionalised REA
v). Develop robust business models for operators of PURE mini-grids and speed up concession agreements for PURE mini-grids
vi). Negotiate with financial institutions and microfinance institutions to set up a loan portfolio for PURE technologies.
vii). Strengthen the promotion of cooperatives formation in rural areas to access group financing such as Green Finance, NEEF Fund.

Objective 6: Develop a PURE Information, Education and Communication strategy

i). Sensitize the suppliers, public, clearing agents and consumers on the existing tax incentives on PURE technologies.
ii). Conduct and Public Awareness and involve communities in the projects implementation to ensure sustainability of projects;

Objective 7: Build and strengthen the capacity of REIAMA to enhance its footprint, improve its branding and marketing.

The REIAMA Secretariat should consider the following:

i). Lobby financial assistance from donors and well-wishers for broadening and strengthening REIAMA operations and infrastructure.
ii). Strengthen REIAMA human resource capacity by amongst others bringing back the original ED position as was at inception
iii). Strengthen collaboration with key stakeholders like NCIC, MERA, MBS, MOE ETC
iv). Establish substantive secretariat operations to all districts through district representatives or support non-established posts for District PURE focal points.
v). Establish RETs chapters for Solar, biogas, wind, suppliers, researchers, etc.
vi). Establish dedicated Media function within REIAMA structures to champion RE awareness and advocacy activities.

Table 3: Roadmap Results framework

Strategic Objective	Outcome	Activities/ Outputs	Responsible Institution
1: Review and fully implement the National Energy Policy and regulatory frameworks	Strengthened Policy and enabling Environment for PURE	a) Set up of Rural Energy Agency; b) Inclusion of PURE technologies in the reviewed energy policy; c) Speed up devolution of the energy sector as highlighted in both the decentralisation policy and the energy policy to ensure PURE technologies are at service delivery points in the districts. Recruit and deploy district energy officers. d) Develop MOUs for coordination and collaboration between the Ministry of Energy and other MDAs and other stakeholders to mainstream PURE. e) Implementation of additional list on Removal of duty and VAT for PURE Technologies such as EV, by GESI Integration highlight how tax exemptions benefit women-led businesses and low-income groups and Include gender considerations in policy briefs and lobbying materials.	Ministry of Energy, MRA, MDAs

Table 3: Roadmap Results framework

Strategic Objective	Outcome	Activities/ Outputs	Responsible Institution
3: Strengthen multisectoral coordination and collaboration among stakeholders involved in PURE technologies at national and sectoral level,	Increased cooperation and collaboration among stakeholders involved in PURE technologies;	a) Develop a framework and MOUs for spearheading Coordination, this will ensure strengthened coordination and collaboration mechanisms structures are established between the Ministry of Energy and other MDAs and other stakeholders to mainstream PURE. b) Establish Joint country programs, across sectoral strategic need, joint monitoring, reporting and accountability systems for scaling up Productive Energy Use by Development Partners and the aim will be for stakeholders to gain a clear understanding of how the Government, Development Partners and the private sector (REIAMA) collaborate within a country to maximize resources, streamline operations, and amplify their collective impact. Energy is cross cutting, while energy policy generation belongs to Ministry of Energy, its usage and scaling up leis with other MDAs such as Ministry of Agriculture, Trade, Transport, Education, Health, Trade etc., hence the need for multisectoral collaboration and reporting. c) Partnership development workshops, organizing national energy conference, formalization of working with strategic stakeholders e.g. banks centralized information sharing platforms e.g. websites, REIAMA paid-up WhatsApp groups and facilitating educational/learning visits (local and international) d) Expedite formation of cooperatives in rural areas by decentralizing the process at district level.	Ministry of Energy, MERA, MBS, MDAs, REIAMA, TEVETA Authority and TEVETA Colleges

Table 3: Roadmap Results framework

Strategic Objective	Outcome	Activities/ Outputs	Responsible Institution
4: Build the local institutional capacity and technical skills and in PURE	Enhanced local institutional capacity and technical skills and in PURE	a) Renew existing TVET courses on RE and develop specialised short courses on specific PURE technologies offered, incorporating GESI integration and involving the private sector. Encourage and track female student enrolment in training courses, incorporate gender-sensitive case studies in lectures and training, and partner with women-led innovation hubs or student groups. b) Operating a PURE Business, increase awareness amongst suppliers on available products /innovations and support on running on PURE business by identifying customers, marketing and stocking etc. c) Increase practical training at higher education institutions; d) Strengthen industrial and academic partnerships e) Improve back up services and end user training by PURE technology providers; f) Improve operation and maintenance procedures for mini-grid systems; g) Improve management of catchment areas for hydro mini-grid systems; h) Conduct research in PURE technologies at higher education institutions; i) Improve administration of products warranty. j) Increase capacity on remote monitoring of PURE Systems such as Minigrids	TEVETA, NCIC, HEIs Development Partners

Table 3: Roadmap Results framework

Strategic Objective	Outcome	Activities/ Outputs	Responsible Institution
5.Promote sustainable PURE financing models	Sustainable PURE financing	a) Negotiate with Financial Institutions and Microfinance Institutions to set up a loan portfolio for PURE technologies, ensuring GESI inclusion, build political support, and develop an outreach plan for finance opportunities for PURE technologies and financing products that target youth and women entrepreneurs. b) Given the shortage of forex, there is need to recognize PURE technologies as priority goods to access forex; c) Speed up concession agreements for green mini-grids d) Establish clear guidelines for accessing operational and capital investment subsidy under Rural Electrification Fund. e) Develop robust business models for operators of green mini-grids f) Establish a dedicated financing fund for PURE technologies; g) Improve payment systems for purchase of end user tokens for mini-grid systems; h) Develop an out-reach plan for finance opportunities for green technologies; i) Mandate commercial banks and microfinance institutions to set up a loan portfolio for PURE technologies j) Integrate PURE in Agricultural and food security support programmes such as FISP, NEEF and AGCOM projects to include solar powered irrigation during winter cropping and value addition	Ministry of Finance, RBM, Financial Institutions

Table 3: Roadmap Results framework

Strategic Objective	Outcome	Activities/ Outputs	Responsible Institution
6. Increase access and uptake of PURE technologies	Increased public awareness and knowledge of PURE by the general public	a) Conduct awareness events like energy week and upscale to rural areas and other sectors b) Promote awareness and end-user empowerment through customer education. c) Organise national PURE exhibitions i.e. the energy week, recognizing credible sector actors through awards, community sensitization campaign and end-user trainings e.g. digital awareness ~creating videos and physical demonstrations on PURE, Ensure GESI inclusion by creating an end-user complaint hotline and promoting user-friendly technologies. Highlight success stories of women and vulnerable groups who are using PURE technologies to showcase inclusive benefits, and track participation using gender-sensitive indicators such as the number of women and vulnerable groups trained, reached, or benefiting from the technologies. d) Involve communities in the projects implementation to ensure sustainability of projects; e) Host PURE-focused session at National Energy Conference and to ensure GESI Inclusion, include panels or speakers who are women entrepreneurs, community leaders, or representatives of vulnerable groups. Ensure session discussions examine gendered impacts of PURE technologies across sectors (agriculture, health, mobility etc.). Advocate for policies that address barriers to women's participation in energy access and productive use. f) Increase promotion of cooperatives formation in rural areas; g) Sensitize the suppliers, public, clearing agents and consumers on the existing tax incentives on PURE technologies	All MDAs, REIAMA, Suppliers

ANNEXES:

Annex 1: List of Stakeholders consulted during the study

Name	Designation	Institution	Location	Email and Contact number
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Andrew Sonkhani	Maize mill owner	COMMUNITY ENERGY MALAWI	Mchinji	
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Ben Friday	Facility In charge	MEGA	Mulanje	996795601
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Mackson Kathumba	Field Officer	SELF HELP AFRICA	Dedza	
Ben Friday	Facility In charge	MEGA	Mulanje	
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Fishani Kamutoni	Member	MATCHEWE HYDRO MINI GRID	Rumphi	889873936
John Sailesi	Founder &Manager	MATCHEWE HYDRO MINI GRID	Rumphi	882730754
Duncan	Member	MATCHEWE HYDRO MINI GRID	Rumphi	882576480
Lesia Nyirenda	Member	MATCHEWE HYDRO MINI GRID	Rumphi	888583323
Rachel Mhango	Member	MATCHEWE HYDRO MINI GRID	Rumphi	885624267
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Watson Nyirenda	Member	MSONGOLE IRRIGATION SCHEME	Rumphi	
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Elias Nyasulu	Treasurer	LWEYA WATER USERS	Nkhatabay	
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Annex 2: List of companies trained under GIZ Programme

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DAWN ENERGY		
IMAJINET		

Annex 3: List of PURE technologies under custom duty and VAT exemption

Product	Custom Duty	Excise Tax	Value Added
Biogas Industrial	Free	Free	Exempt
Wind turbines	Free	Free	Exempt
Solar pumps	Free	Free	Exempt
Inverters	Free	Free	Zero
Solar battery chargers	Free	Free	Zero
Solar lighting kits	Free	Free	Zero
Energy saver bulbs	Free	Free	Zero
Solar panels	Free	Free	Zero
Solar batteries	Free	Free	Zero
Electric vehicles	Free	Free	Exempt

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